OPENING SESSION

Room A1 07:15 – 8:25 *Chairs:* David G. Norris, ISMRM President & Isabel Berry, M.D., Ph.D., ESMRMB President

07:15 Welcome and Awards Presentations

2010 LAUTERBUR LECTURE

Room A1 08:25 – 9:05 *Chair:* David G. Norris, ISMRM President

08:25 **Lauterbur Lecture: MRI Over the Next Decade: Quo Vadis?**
William G. Bradley, M.D., Ph.D.
University of California, San Diego, CA, USA

Clinical Needs & Technological Solutions: Alzheimer's & Dementia

A1 09:05-10:15 *Organizers & Moderators:* Stefan Sunaert and Mark A. van Buchem

09:05 ***1*. Clinical Needs for Dementia and AD: Revising the Criteria**
Bruno Dubois[1]
[1]Hôpital La Salpêtrière, Paris, France

New diagnostic criteria for Alzheimer disease have been recently proposed that are centered around a clinical core of early and significant episodic memory impairment. They stipulate that in addition there must also be at least one or more abnormal biomarkers amongst structural neuroimaging with MRI, molecular neuroimaging with PET and CSF analysis of amyloid β/tau proteins. The timeliness of these criteria is underscored by the myriad of drugs currently under development that are directed at altering the disease pathogenesis, particularly at the production and clearance of amyloid β as well as at the hyperphosphorylation state of tau.

09:25 ***2*. Imaging Solutions I: Structural and Functional Imaging**
Wiesje M. van der Flier[1]
[1]Lieden University, Leiden, Netherlands

MRI has an increasingly large role in the clinical work-up of dementia. In the new research criteria, atrophy of the medial temporal lobe is mentioned as one of the diagnostic criteria for AD, but norm values are still awaited. Mixed disease (i.e. combination with vascular disease) remains a challenge, as there are no diagnostic guidelines available. MRI measures hold promise as markers of disease progression and can potentially be used as outcome measures in trials. The heterogeneity of AD is increasingly acknowledged. MRI may prove valuable to describe endophenotypes of AD, both in terms of structural and functional brain changes

09:50 ***3*. Imaging Solutions II: Molecular Imaging**
Louise van der Weerd[1]
[1]Leiden University Medical Centre, Leiden, Netherlands

The development of molecular imaging techniques for in vivo assessment of beta-amyloid accumulation in the ageing brain is an important and active area of research in AD. Numerous ligands have been developed with affinity for beta-amyloid, based on beta-amyloid peptide, monoclonal antibody fragments, or small peptides, which were functionalized with iron oxide particles or gadolium chelates. Alternatively, amyloid plaques have been labeled with small molecules containing a 19F atom and visualized using 19F MRI. Up to now, the only compounds that are in use for clinical imaging are nuclear medicine–based amyloid labeling tracers.

CLINICAL INTENSIVE COURSE
(Admission limited to Clinical Intensive Course registrants only)
Shoulder & Elbow Imaging: Case-Based Teaching

K1 08:15-10:15 *Organizer & Moderator*: Juerg Hodler

08:15 **Elbow: Case-based**
Russell C. Fritz, M.D.

09:15 **Shoulder: Case-based**
Lynne S. Steinbach, M.D.

10:15 Adjournment

CLINICAL INTENSIVE COURSE
Women's Imaging: Case-Based Teaching

K1 11:00 -13:00 *Moderators*: Talissa Altes, Elmar Max Merkle, and Bachir Taouli

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the impact of functional MR methods in body imaging;
- Apply new body MR techniques in their practice;
- Use multiparametric MRI for improved diagnosis of abdominal diseases; and
- Design new female pelvic and prostate MR protocols tailored to new therapeutic methods, introduce these methods and compare them to more conventional approaches.

11:00 **Benign Breast Lesions**
Elizabeth A. Morris, M.D.

11:30 **Breast MRI: Easy and Difficult Cases**
Bonnie N. Joe, M.D., Ph.D.

12:00 **Benign Diseases of the Uterus**
Andrea G. Rockall, M.R.C.P., F.R.C.R.

12:30 **Ovarian Masses**
Evis Sala, M.D., Ph.D., F.R.C.R.

13:00 Adjournment

CLINICAL INTENSIVE COURSE
SWI Metalheads: Imaging Brain Iron

K2 11:00 -13:00 *Organizers & Moderators*: Stefan Sunaert and Mark A. Van Buchem

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe methods and underlying principles for obtaining and analyzing susceptibility weighted images;
- Explain current thinking regarding iron metabolism and deposition within the brain; and
- Describe several diseases of iron deposition within the brain and the application of susceptibility weighted imaging to diagnosis and study of these processes.

11:00 **SWI Basics, Applications and Pitfalls**
Jürgen R. Reichenbach, Ph.D.

11:40 **Pathophysiology of Brain Iron**
John F. Schenck, M.D., Ph.D.

12:20 **Diseases of Iron Deposition**
Mark A. Van Buchem, M.D., Ph.D.

13:00 Adjournment

MRI of Neural Plasticity

Room A1 11:00-13:00 *Moderators:* Jeffrey Joseph Neil and John G. Sled

11:00 **Introduction**
Jeffrey Joseph Neil

11:12 ***4.*** **Training Induced Volume Changes Seen by Structural MRI Correlate with Neuronal Process Remodelling**

Jason Philip Lerch[1], Adelaide P. Yiu[2], Alonso Martinez-Cabal[2], Tanyar Pekar[2], Veronique D. Bohbot[3], Paul Frankland[2], R Mark Henkelman[1], Sheena A. Josselyn[2], John G. Sled[1]
[1]Mouse Imaging Centre, Hospital for Sick Children, Toronto, Ontario, Canada; [2]Program in Neuroscience and Mental Health, Hospital for Sick Children, Toronto, Ontario, Canada; [3]Douglas, Department of Psychiatry, McGill University, Montreal, Quebec, Canada

We correlated training induced volume changes seen by high-resolution mouse MRI with four cellular markers to test whether (1) alterations in neuron numbers/sizes; (2) alterations in astrocyte numbers/sizes; (3) increased neurogenesis/survival of new neurons; or (4) remodelling of neuronal processes best explain the MRI results. We detected a significant positive correlation between GAP-43 and structure volume, but found no correlation between MR volume and any other cellular measure. We can thus conclude that, among the hypotheses tested, the largest explanatory factor for learning induced MRI detectable volume changes is the remodelling of neuronal processes.

11:24 ***5.*** **Do Congenitally Blind People Have a Stria of Gennari? First *in Vivo* Insights on a Subcortical Level**

Robert Trampel[1], Derek Veit Ott[1], Robert Turner[1]
[1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

The primary visual cortex V1 is characterized by an easily identifiable anatomical landmark: the heavily myelinated stria of Gennari. Using T_1, T_2, T_2^* or phase contrast, high resolution MRI studies can routinely identify the stria of Gennari *in vivo*. However, the development and function of the Gennari stripe is unclear. MRI at 7 Tesla with isotropic 0.5 mm voxels was used to scan the occipital brain of sighted and congenitally blind subjects. The stria of Gennari was reliably detected in both sighted and blind subjects, showing that this anatomical feature is not a developmental result of visual input, and it does not degenerate in the absence of visual input.

11:36 ***6.*** **Cerebral Myelin Content Correlation with Mathematical Abilities in Young Children**

Richard Davis Holmes[1], Silvia Mazabel[2], Burkhard Maedler[3], Christian Denk, Linda Siegel[4], Christian Beaulieu[5], Alex MacKay[6]
[1]UBC MRI Research Centre, University of British Columbia, Vancouver, British Columbia, Canada; [2]Department of Educational and Counselling Psychology, and Special Education, University of British Columbia; [3]Philips Medical Systems; [4]Department of Educational and Counselling Psychology and Special Education, University of British Columbia; [5]Department of Biomedical Engineering, University of Alberta; [6]Department of Physics and Astronomy, University of British Columbia

Structural imaging applied to children with wide ranging mathematical abilities has the potential to elucidate the question of what neural circuits underly computation based tasks. The present investigation analyzed the myelin water fraction images of 20 children in a standard space to deduce correlations between myelin content and math abilities. Subjects wrote a calculation-based test and an applied problem-based test. The results implicated occipital/parietal white matter, the right anterior limb of the internal capsule and the left external capsule with positive correlations of 0.61,0.65 and 0.60, respectively.

11:48 ***7.*** **Structural Brain Plasticity Visualized with Diffusion MRI Following a Learning and Memory Task**

Tamar Blumenfeld-Katzir[1], Ofer Pasternak[2], Yaniv Assaf[1]
[1]Neurobiology Department, Tel-Aviv University, Tel-Aviv, Israel; [2]Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States

We utilized DTI to follow up on micro-structural changes that occur following a spatial memory task. We scanned rats before and after water maze task and compared their MRI scans using voxel-based statistics. Significant changes in the various DTI parameters were found in a multitude of brain regions including the limbic system and white matter systems. The changes in the DTI indices were found to correlate with immuno-reactivity staining of myelin, synapses and astrocytes. Using these observations, we conclude that DTI can be used as an in-vivo probe of structural plasticity both in gray matter and white matter.

12:00 ***8.*** **Hard-Wired or Soft-Wired ? Evidence for the Structural Plasticity of White Matter Networks Following Anterior Temporal Lobectomy**

Mahinda Yogarajah[1], Niels Focke[2], Silvia Bonelli[1], Pam Thompson[1], Christian Vollmar[1], Andrew McEvoy[3], Mark Symms[1], Matthias Koepp[1], John Duncan[1]
[1]MRI Unit, National Society for Epilepsy, Chalfont St Peter, Bucks, United Kingdom; [2]University of Goettingen, Germany; [3]University College London Hospital, United Kingdom

Epilepsy is the most chronic, common neurological condition. Many patients with temporal lobe epilepsy undergo anterior temporal lobe resection, but up to 40% of patients are at risk of language decline after surgery. We carried out a longitudinal study using diffusion tensor imaging to assess the structural reorganisation of white matter after surgery. In patients undergoing surgery in the language dominant hemisphere, there is an increase in FA in white matter connecting fronto-temporal regions. The location of these increases and their correlation with language function suggest they may represent the structural plasticity of language networks after surgery.

12:12 ***9***. **Diffusion MRI of Short-Term Spatial Memory Related Brain Plasticity**

Ido Tavor[1], Yaniv Sagi[1], Shir Hofstetter[1], Efrat Sasson[1], Yaniv Assaf[1]
[1]Neurobiology, Tel Aviv university, Tel Aviv, Israel

Neuroimaging studies of brain plasticity reveal long-term learning related structural changes in several brain regions. Animal studies revealed that short term micro-structural changes can be observed with diffusion MRI. Here, we study the diffusion MRI changes in a short term spatial memory task in humans. Subjects underwent two MRI scans separated by two hours of a learning session. We found that DTI parameters had changed in several brain regions, including the hippocampus, entorhinal cortex, amygdala and insula. The main result of this work is that DTI can follow on learning-induced micro-structural tissue changes, already 2 hours following the training episode.

12:24 ***10***. **A Demonstration of Neural Plasticity in Resting Brain Network**

Kuang-Chi Tung[1], Jinsoo Uh[1], Hanzhang Lu[1]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States

We hypothesized that an important feature of the evoked activity, the plasticity of the neural response, may also be present in the resting condition and may provide critical information for understanding the nature and significance of the resting state brain activity. Using motor cortex as a model, we demonstrated for the first time that the resting brain activity can be altered after repetitive stimulation of the associated brain networks. This method may provide a new approach to study brain plasticity in humans and may find applications in studies of aging and neurodegenerative diseases.

12:36 ***11***. **Unilateral Infraorbital Denervation Leads to Plasticity in the Rat Whisker Barrel Cortex.**

Xin Yu[1], Stephen J. Dodd[1], Seungsoo Chung[1], John Isaac[1], Judith R. Walters[1], Alan P. Koretsky[1]
[1]NINDS, NIH, Bethesda, MD, United States

Interhemispheric plasticity may play a critical role during functional restoration following central/peripheral nervous system injuries in humans. Previously, the interhemispheric plasticity in the rat somatosensory cortex (S1) following forepaw unilateral denervation has been studied in order to develop rodent models of plasticity detected in humans by fMRI. Here, the effects of unilateral infraorbital denervation (IO) to rat whisker responses were studied. Large ipsilateral fMRI activation was detected after IO. In addition, BOLD signals in the contralateral barrel cortex were significantly increased. This indicates that the unilateral IO caused plasticity of the whisker-barrel cortex ascending pathways and increased interhemispheric interactions.

12:48 ***12***. **fcMRI Plasticity Following Rat Median Nerve Injury and Repair at 9.4T**

Rupeng Li[1], Patrick Hettinger[2], Younghoon Cho[1], Christopher P. Pawela[1], Maida Parkins[2], Seth Jones[2], Ji-Geng Yan[2], Andrzej Jesmanowicz[1], Anthony Hudetz[3], Hani Matloub[2], James Hyde[1]
[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States; [2]Plastic Surgery, Medical College of Wisconsin, Milwaukee, WI, United States; [3]Anesthesiology, Medical College of Wisconsin, Milwaukee, WI, United States

Plasicity happening to the resting state connectivity map following rat peripheral nerve injury and repair was shown using 9.4T. Unique patterns of plasticity could help monitoring the neuro-network function when functional test in not available.

Advanced Neuro Imaging of Dementing Diseases

Victoria Hall 11:00-13:00 *Moderators:* Mark A. van Buchem and Wolfgang Weber-Fahr

11:00 ***13***. **The Role of Iron in T_2* Contrast and Transverse Relaxation of Beta-Amyloid Plaques in Alzheimer's Disease**

Mark David Meadowcroft[1,2], James R. Connor[3], Qing X. Yang[1,3]
[1]Radiology - Center for NMR Research, Pennsylvania State University - College of Medicine, Hershey, PA, United States; [2]Neural and Behavioral Sciences, Pennsylvania State University - College of Medicine, Hershey, PA, United States; [3]Neurosurgery, Pennsylvania State University - College of Medicine, Hershey, PA, United States

Conventional belief is that iron associated with beta-amyloid (Aβ) plaques is the underlying mechanism for plaque contrast in transverse imaging. Through detailed histological MR examination in comparison to traditional histology methods utilizing iron chelation of plaques, this body of work has determined that there is a dual relaxation associated with human (Aβ) plaques. Removal of iron from human (Aβ) plaques still results in plaque MR imaging and relaxation. The data indicate that iron content alone is not responsible for the hypo-intensities seen on the MR images and that there is a synergy between iron and plaque morphology on transverse relaxation.

11:12 ***14***. **Optimization of Susceptibility Weighted Imaging at 7T for Improved Detection of Alzheimer's Amyloid Plaques Associated with Iron in Human Postmortem Brain**

Yulin Ge[1], Tang Lin[1], Daniel K. Sodickson[1], Edward Lin[1], Jing Yang[1], E Mark Haacke[2], Mony de Leon[1], Robert I. Grossman[1], Thomas Wisniewski[1]
[1]New York University School of Medicine, New York City, NY, United States; [2]Wayne State University, Detroit, MI

Due to markedly enhanced susceptibility contrast and signal-to-noise ratio at ultra-high-field MR, it is possible to detect amyloid plaques associated with iron deposition using susceptibility weighted imaging in patients with AD.

11:24 ***15***. **Quantitative Cerebral Blood Flow Changes in Huntington's Disease Measured Using Pulsed Arterial Spin Labeling**

J. Jean Chen[1], David H. Salat[1], H. Diana Rosas,[12]
[1]A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA, United States; [2]Department of Neurology, Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States

Huntington's disease (HD) has been associated with wide-spread cortical and subcortical grey matter atrophy, in which the role of cerebral blood flow (CBF) abnormalities is potentially significant. However, low spatial resolution erodes the ability of conventional techniques to reveal spatially-specific CBF

changes. In this work, we present, for the first time, HD-related quantitative CBF changes measured using pulsed arterial-spin labelling (PASL). Regressing out the effect of cortical thinning, our results still show significant underlying CBF reduction across the cortex. CBF also decreased in the striatum and hippocampus. CBF reduction patterns were found to be partially independent of structural atrophy.

11:36 ***16***. **Dynamic Changes in Brain Metabolites and Tissue Water Diffusion Following Oral Amino Acid Challenge in Cirrhotics with Hepatic Encephalopathy**

Fiona Smith[1], Hanan Mardini, Christopher Record, Andrew M. Blamire[1]
[1]Newcastle MR Centre & Institute of Cellular Medicine, Newcastle University, Newcastle upon Tyne, United Kingdom

Liver cirrhosis kills more than 750,000 people worldwide each year. Almost 30% of patients with cirrhosis experience hepatic encephalopathy (HE), a neuropsychiatric complication potentially linked to formation of cerebral edema driven by elevated blood ammonia. We used DTI and proton MRS to monitor edema and metabolite changes during induced hyperammonaemia by amino acid challenge in HE patients. Elevated blood ammonia was accompanied by increased ADC and decreased myo-Inositol. Absolute increase in blood ammonia significantly correlated with ADC and inversely correlated with myo-Inositol in the individual patients strongly supporting ammonia driven brain edema as a neurochemical mechanism for HE in cirrhosis.

11:48 ***17***. **Joint Contribution of Structural and Perfusion MR Images for the Classification of Alzheimer's Disease**

Duygu Tosun[1], Pouria Mojabi[1], Mike W. Weiner[1], Norbert Schuff[1]
[1]Center for Imaging Neurodegenerative Diseases, San Francisco, CA, United States

To determine the joint contribution of structural and arterial spin labeling MR imaging for the classification of Alzheimer's disease (AD), we analyzed the cortical thickness and cerebral blood flow (CBF) measures jointly in a cross-sectional study of 24 AD and 38 healthy elderly controls using an integrated multimodality MRI processing framework and a cortical surface-based analysis approach. From the joint analysis, we infer that cortical atrophy dominates prediction of AD while CBF adds no significant value. One interpretation of the results is that CBF is diminished proportionately to brain tissue loss and therefore provides no additional information to structural alterations.

12:00 ***18***. **Neuroprotective Mechanism of Minocycline in an Accelerated Macaque Model of NeuroAIDS**

Eva-Maria Ratai[1,2], Chan-Gyu Joo[1,2], Jeffrey Bombardier[1], Robert Fell[1], Julian He[1,2], Reza Hakimelahi[1,2], Tricia Burdo[3], Jennifer Campbell[3], Patrick Autissier[3], Lakshmanan Annamalai[4], Eliezer Masliah[5], Susan Westmoreland, [2,4], Kenneth Williams[3], Ramon Gilberto Gonzalez[1,2]
[1]Department of Radiology, A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States; [2]Harvard Medical School, Boston, MA, United States; [3]Biology Department, Boston College, Boston, MA, United States; [4]Division of Comparative Pathology, New England Primate Research Center, Southborough, MA, United States; [5]Department of Neurosciences, University of California at San Diego, La Jolla, CA, United States

HIV-associated neurocognitive disorders continue to be a significant problem. Using the accelerated macaque model of neuroAIDS in combination with in vivo MR spectroscopy minocycline was found to be neuroprotective and able to reverse increased high energy metabolism, most likely localized to glia. Evaluating our observations, clues into the mechanisms underlying neuroprotection included reduction of microglial activation, reductions of CSF and plasma viral loads during treatment, and a reduction in a subset of circulating monocytes considered to be responsible for viral infection of the CNS by cell trafficking mechanisms.

12:12 ***19***. **The Role of the Uncinate Fasciculus in the Development of Dementia: A DTI-Tractography Study**

Laura Serra[1], Mara Cercignani[1], Roberta Perri[2], Barbara Spanò[1], Lucia Fadda[2,3], Camillo Marra[4], Franco Giubilei[5], Carlo Caltagirone[2,6], Marco Bozzali[1]
[1]Neuroimaging laboratory, Fondazione IRCCS Santa Lucia, Roma, Italy; [2]Department of Clinical and Behavioural Neurology, Fondazione IRCCS Santa Lucia, Roma, Italy; [3]Department of Neuroscience, , University of Rome 'Tor Vergata', Rome, Italy; [4]Institute of Neurology, Università Cattolica, Roma, Italy; [5]Department of Neurology, II Faculty of Medicine University of Rome, 'Sapienza', Rome, Italy; [6]Department of Neuroscience, University of Rome 'Tor Vergata', Rome, Italy

The uncinate fasciculus (UF) connects temporal and frontal regions, traditionally implicated by pathological damage in dementia. We aimed at assessing, using DTI and tractography, the role of UF damage in the progression from mild cognitive impairment (MCI) to Alzheimer's disease (AD), and whether its involvement could distinguish between patients with AD and patients with dementia with Lewy Bodies (DLB). Fractional anisotropy was significantly reduced only in the UF of demented patients as compared to both, HS and a-MCI patients. This suggests that UF involvement is relevant for the development dementia, but it does not distinguish between AD and DLB.

12:24 ***20***. **Cerebral Microbleeds Are Predictive of Mortality in the Elderly**

Irmhild Schneider[1], Stella Trompet[1], Anton J.M. de Craen[1], Adriaan C.G.M. van Es[1], Mark A. van Buchem[1], Jeroen van der Grond[1]
[1]Leiden University Medical Center, Leiden, Netherlands

Cerebral microbleeds are commonly found in patients with ischemic stroke, intracerebral hemorrhage (ICH) and Alzheimer disease. In this study we investigated the prognostic value of microbleeds in terms of all-cause mortality and cardiovascular mortality in a population suffering from vascular disease or at high risk for developing this condition. We found that the presence of two or more microbleeds implicates an increased risk of overall death. Furthermore, only "non-CAA" type microbleeds were associated with increased risk of cardiovascular death. Therefore, CAA type small vessel disease cannot be considered as risk factor for (cardiovascular) mortality.

12:36 ***21***. **Tract Atrophy in Alzheimer'S Disease Measured Using Probabilistic Tractography**

Hojjatollah Azadbakht[1,2], Hamied A. Haroon[1,2], David M. Morris[1,2], Karl V. Embleton, [2,3], Stephen F. Carter[4], Brandon Whitcher[5], Julie Snowden[6], Geoff J.M. Parker, [27]
[1]Imaging Science and Biomedical Engineering, , School of Cancer and Imaging Sciences,, University of Manchester, Manchester, United Kingdom; [2]The University of Manchester Biomedical Imaging Institute, University of Manchester, Manchester, United Kingdom; [3]School of Psychological Science, University of Manchester, Manchester, United Kingdom; [4]Wolfson Molecular Imaging Centre, University of Manchester, Manchester, United Kingdom; [5]Clinical Imaging Centre, GlaxoSmithKline, London, United

Kingdom; [6]Greater Manchester Neuroscience Centre, Salford Royal Foundation Trust, Salford, United Kingdom; [7]Imaging Science and Biomedical Engineering, School of Cancer and Imaging Sciences,, University of Manchester, Manchester, United Kingdom

The quantitative characterisation of atrophy can provide useful biomarkers for assessing the evolution of neurological conditions such as Alzheimer's disease (AD). It is likely that atrophy caused by such conditions also affects white matter (WM) tracts via degenerative processes. If specific tract systems are more prone t¬¬o atrophy than others, then tractography-guided atrophy measurements may be more sensitive than less targeted methods which focus on global gray and/or white matter. In this work we apply a novel method for quantifying the width of WM tracts to look for evidence of tract atrophy in mild cognitive impairment (MCI) and AD subjects.

12:48 ***22***. **Increases in CBF by Donepezil Treatment Enhance Cingulate Functional Network Activity in Mild Alzheimer's Disease**

Wenjun Li[1], Chunming Xie[1,2], Jennifer Jones[3], Malgorzata Franczak[3], Piero Antuono[3], Shi-jiang Li[1]
[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States; [2]Neurology, Southeast University, Nanjing, Jiansu, China,; [3]Neurology, Medical College of Wisconsin, Milwaukee, WI, United States

Cholinergic inhibitor (AriceptÂ®) has been shown to improve cognitive function in adults with Alzheimer's disease (AD). Also, it has an effect on improving the cerebral blood flow (CBF) perfusion detected by PET technology. Previously we have found increased CBF in cingulate and posterior cingulated regions using a Pseudo-Continuous Arterial Spin Labeling (pCASL) MR technique. It is hypothesized that the increase in CBF after treatment could alter functional connectivity in related neural networks. The aim of the current study is to determine the changes in the functional connectivity in networks with significantly increased CBF after the drug treatment.

Strategies of Localization & Imaging Methodology

Room A4 11:00-13:00 *Moderators:* Anke Henning and M. Albert Thomas

11:00 ***23***. **Focused RF in High Field 1H-MRSI: Outer Volume Suppression by Local Excitation**

Vincent O. Boer[1], Ingmar J. Voogt[1], Hugo Kroeze[1,2], Bart Leo van de Bank[1], A H. Westra[2], Peter R. Luijten[1], Dennis W.J. Klomp[1]
[1]Radiology, UMC Utrecht, Utrecht, Netherlands; [2]MTKF, UMC Utrecht, Utrecht, Netherlands

An alternative to SAR demanding outer volume suppression is proposed for 7T MRSI. Low power suppression is achieved by using focused RF to locally saturate subcutaneous signals by using an RF headband; a close fitting, small element, eight-channel transmit receive array. Two sets of RF shims are defined to drive the RF headband; a 'ring' mode for outer volume suppression close to the elements and a quadrature mode for water suppression and excitation of the brain. High spatial resolution MRSI is shown within a short scan time.

11:12 ***24***. **Motion Artifact Reduction Using Bipolar Diffusion Gradients in Diffusion-Weighted Echo-Planar Spectroscopic Imaging**

Yoshitaka Bito[1], Koji Hirata[1], Toshihiko Ebisu[2], Yuko Kawai[3], Yosuke Otake[1], Satoshi Hirata[1], Toru Shirai[1], Yoshihisa Soutome[1], Hisaaki Ochi[1], Masahiro Umeda[3], Toshihiro Higuchi[4], Chuzo Tanaka[4]
[1]Central Research Laboratory, Hitachi, Ltd., Kokubunji-shi, Tokyo, Japan; [2]Neurosurgery, Nantan General Hospital, Nantan-shi, Kyoto, Japan; [3]Medical Informatics, Meiji University of Integrative Medicine, Nantan-shi, Kyoto, Japan; [4]Neurosurgery, Meiji University of Integrative Medicine, Nantan-shi, Kyoto, Japan

Diffusion-weighted echo-planar spectroscopic imaging (DW-EPSI), using bipolar diffusion gradients, has been developed to reduce motion artifacts. Signal loss in signal accumulation, which is detrimental in diffusion-weighted spectroscopic measurements, is estimated by numerical analysis using bipolar diffusion gradients. Reduction of motion artifacts is demonstrated by applying DW-EPSI, using bipolar diffusion gradients, to a phantom and a rat brain in vivo. The results suggest that the effectiveness and limitations of this technique in reduction of motion artifacts and numerical analysis is helpful in investigating errors due to motion.

11:24 ***25***. **Spatial Localization Accomplished by Sensitivity Heterogeneity**

Li An[1], Steven Warach[1], Jun Shen[2]
[1]National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD, United States; [2]National Institute of Mental Health, National Institutes of Health, Bethesda, MD, United States

This work demonstrates a new method that allows multi-compartmental spatial localization based on the heterogeneity of sensitivity profiles of phased array receiver coils. This method offers an alternative to SENSE-CSI for performing spectroscopy using phased array coils. It allows the user to manually prescribe compartments following natural anatomical or physiological boundaries to reduce partial volume artifacts associated with conventional CSI and SENSE-CSI. In vivo application using PRESS and an eight-element phased array head coil demonstrates that this method can extract spectra from stroke tissue and normal tissue in 4 seconds.

11:36 ***26***. **Selective Homonuclear Polarization Transfer at 7T: Single Shot Detection for GABA in Human Brain**

Jullie W. Pan[1], Nikolai Avdievich[1], Hoby P. Hetherington[1]
[1]Yale University School of Medicine, New Haven, CT, United States

Given its important role as the major inhibitory neurotransmitter, GABA is a well known target for detection in human brain. However, because of its overlap with many other resonances, editing is required for its unambiguous detection. We describe implementation of selective homonuclear polarization transfer to detect the C4 3.0ppm GABA in a single shot in human brain. This is based on a broad T1 based inversion pre-sequence suppression with a J-refocused acquisition. As implemented in human brain, we demonstrate the performance of this approach at 7T in spectroscopic imaging format with 1.44cc resolution.

11:48 ***27***. **Fast 3D Proton Spectroscopic Imaging of the Human Brain at 3 Tesla by Combining Spectroscopic Missing Pulse SSFP and Echo Planar Spectroscopic Imaging**

Wolfgang Dreher[1], Peter Erhard[1], Dieter Leibfritz[1]
[1]Dept. Chemistry, University of Bremen, Bremen, Germany

One of the limitations of the fast spectroscopic imaging sequence "spectroscopic missing pulse SSFP" are the rather long minimum total measurement time for 3D measurements with large matrix size. This drawback is eliminated by acquiring the echo-like signal under a symmetrically oscillating read gradient in slice direction. The sequence was implemented on a 3 Tesla head scanner and applied to healthy volunteers. Within 4:19 minutes only, a 3D measurement of the brain was performed with 32x32x16 matrix size and 0.33 ml nominal voxel size using weighted k-space averaging with a maximum of four accumulations in the k-space center.

12:00 ***28***. **Spectrally Selective Phosphocreatine Imaging on a 9.4T Whole-Body Scanner Using a Spatial-Spectral RF Pulse**

Yi Sui[1,2], Haoyang Xing[2], Theodore Claiborne[2], Keith R. Thulborn,[2,3], Xiaohong Joe Zhou,[2,4]
[1]Department of Bioengineering, University of Illinois at Chicago, Chicago, IL, United States; [2]Center for Magnetic Resonance Research, University of Illinois Medical Center, Chicago, IL, United States; [3]Department of Radiology, University of Illinois Medical Center, Chicago, IL, United States; [4]Departments of Radiology, Neurosurgery and Bioengineering, University of Illinois Medical Center, Chicago, IL, United States

In this study, we report a spatial-spectral (SPSP) pulse that is tailored for selectively exciting the phosphocreatine (PCr) resonance at 9.4T while suppressing all other major phosphorus metabolites including inorganic phosphate and adenosine triphosphates. Using this pulse in conjunction with a RARE sequence, we have obtained PCr images from phantoms (50 mM) and the lower extremity of human volunteers in 10 minutes on a 9.4T whole-body scanner. With an in-plane spatial resolution of 7.5mm x 7.5mm, the PCr images show anatomic details with an adequate signal to noise ratio (SNR=14).

12:12 ***29***. **1H MR Spectroscopy of the Human Prostate Using an Adiabatic Sequence with a SAR Optimized Endorectal RF Coil**

Catalina Arteaga[1], Uulke A. van der Heide[1], Marco van Vulpen[1], Peter R. Luijten[2], Dennis W.J. Klomp[2]
[1]Radiotherapy, UMC Utrecht, Utrecht, Netherlands; [2]Radiology, UMC Utrecht, Utrecht, Netherlands

Prostate 1H MRSI at 7T with fully adiabatic sequences like full-LASER allows polyamine detection. In addition, choline and creatine levels can also be depicted in prostate cancer patients even with hormone therapy. We showed that fully adiabatic sequences can overcome the B1 inhomogeneities compared to semi-adiabatic sequences.

12:24 ***30***. **High Resolution GABA Mapping in Vivo Using a Slice Selective MEGA-MRSI Sequence at 3 Tesla**

He Zhu[1,2], Ronald Ouwerkerk[1,3], Richard A.E. Edden[1,2], Peter B. Barker[1,2]
[1]Russell H Morgan Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States; [2]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States; [3]The National Institute of Diabetes and Digestive and Kidney Diseases, NIH, Bethesda, MD, United States

A spin echo based MEGA-MRSI sequence was developed to acquire MEGA-edited spectra of γ-aminobutyric acid (GABA) in an entire slice with excellent sensitivity. Co-editing of lipid and NAA signals was greatly suppressed by a dualband pre-saturation sequence and integrated outer volume suppression (OVS) pulses. Experiments in normal volunteers were performed at 3 Tesla using a 32-channel head coil. High signal-to-noise ratio spectra and metabolic images of GABA (and glutamate) were acquired from 4.5 cm3 voxels in a scan time of 17 minutes.

12:36 ***31***. **Qualitative Detection of Ceramide and Other Metabolites in Brain Tumor by Localized Correlated Spectroscopy**

Rajakumar Nagarajan[1], Whitney B. Pope[1], Noriko Salamon[1], Linda M. Liau[2], Timothy Cloughesy[3], M Albert Thomas[1]
[1]Radiological Sciences, University of California Los Angeles, Los Angeles, CA, United States; [2]Neurosurgery, University of California Los Angeles; [3]Neurooncology, University of California Los Angeles

Magnetic resonance spectroscopy (MRS) provides metabolic information about brain tumors complementary to what can be obtained from anatomic images. In contrast to other metabolism-based imaging techniques, MRS yields multiparametric data, does not require ionizing radiation, and can be performed in conjunction with magnetic resonance imaging studies. Magnetic resonance spectral patterns have been shown to be distinct for different tumor types and grades. Two-dimensional (2D) localized correlated spectroscopy (L-COSY) in patients with high and low grade gliomas provides better dispersion of several metabolites such as N-acetylaspartate (NAA), creatine (Cr) choline (Cho), ceramide (Cer), phosphoethanolamine (PE), glutamine/glutamate (Glx), lactate (Lac), myo-inositol (mI), taurine (Tau), etc. which has been a major difficulty in 1D MRS.

12:48 ***32***. **Increased Signal-To-Noise in High Field Localized Spectroscopy of the Temporal Lobe Using New Deformable High-Dielectric Materials**

Andrew Webb[1], Hermien Kan[1], Maarten Versluis[1], Nadine Smith[1]
[1]Radiology, Leiden University Medical Center, Leiden, Netherlands

The intrinsic B1 non-uniformities from standard volume resonators at high field are particularly problematic for localized spectroscopy of areas such as the temporal lobe, where low signal-to-noise results from a reduced B1 field. Using a recently developed high dielectric constant material placed around the head, increases in signal-to-noise of ~ 200% can be achieved in such problem areas without reducing the sensitivity in other areas of the brain.

MR Sensors & Reporters

Room A5 11:00-13:00 *Moderators:* Eric T. Ahrens and Assaf Gilad

11:00 ***33***. **Enzymatic Triggered Release of Imaging Probe from Paramagnetic Liposomes**

Sara Figueiredo[1], Enzo Terreno[2], Joao Nuno Moreira[3], Carlos F.G.C. Geraldes[1], Silvio Aime[2]
[1]Dep. of Biochemistry and Technology and Center for Neurosciences and Cell Biology, University of Coimbra, Coimbra, Portugal; [2]Department of Chemistry and Molecular Imaging Center, University of Torino, Torino, Italy; [3]Lab. of Pharmaceutical Technology and Center for Neurosciences and Cell Biology, University of Coimbra, Coimbra, Portugal

The design of imaging probes reporting about a given enzymatic activity is an important task in Molecular Imaging investigations.
The aim of this work was to prepare paramagnetic liposomes encapsulating the clinically approved Gd-HPDO3A complex and able to release the imaging probe in the presence of a specific enzyme upregulated in a given disease.
To do this, an amphiphilic lipopeptide acting as substrate for MMP (Matrix Metallo Proteinases) was prepared and incorporated in liposomes.
It has been reporetd that in the presence of MMP like collagenase, the liposomes release its content, thus determining the detection of a T1 contrast enhancement.

11:12 ***34***. **A Novel Dual MRI-PARACEST/Fluorescent Probe for the Detection of Cathepsin-D Activity in Alzheimer's Disease**

Robert Ta[1,2], Alex Li[1], Mojmir Suchy, [1,3], Robert Hudson[3], Stephen Pasternak[4,5], Robert Bartha[1,2]
[1]Imaging Research Group, Robarts Research Institute, London, Ontario, Canada; [2]Medical Biophysics, University of Western Ontario, London, Ontario, Canada; [3]Chemistry, University of Western Ontario, London, Ontario, Canada; [4]Molecular Brain Research Group, Robarts Research Institute, London, Ontario, Canada; [5]Clinical Neurological Sciences, University of Western Ontario, London, Ontario, Canada

A novel dual magnetic resonance/fluorescent probe has been designed for molecular targeting of Cathepsin D in Alzheimer's disease. The MRI contrast of this probe has been detected using the on-resonance paramagnetic agent chemical exchange effect (OPARACHEE) method. Greater than a 1% OPARACHEE contrast was observed in 1.5 mM Tm^{3+}-DOTA-Glycine in a 5% BSA phantom. The dual probe demonstrated uptake into neuronal cells by confocal microscopy and had no toxic effects on these cells at the concentrations tested.

11:24 ***35***. **Self-Degrading, MRI-Detectable Hydrogels with Picomolar Target Sensitivity**

Jason Colomb[1], Katherine Louie[1], Stephen P. Massia[1], Kevin M. Bennett[1]
[1]School of Biological and Health Systems Engineering , Arizona State University, Tempe, AZ, United States

Nanostructured hydrogels have been developed as synthetic tissues, tissue scaffolds for cell and drug delivery, and as guides for tissue regeneration. A fundamental problem with hydrogels is that implanted gel structure is difficult to monitor noninvasively. Here we demonstrate that the aggregation of cationic magnetic nanoparticles, attached to specific macromolecules in biological and synthetic hydrogels, can be controlled to detect changes in gel macromolecular structure with MRI. Sensitivity of the gels to target molecules is finely controlled using an embedded zymogen cascade amplifier and we show that these gels self-degrade when they come into contact with pM concentrations of enterokinase.

11:36 ***36***. **Direct Detection of Cytosine Deaminase Enzymatic Activity Using CEST MRI**

Guanshu Liu[1,2], Segun M. Bernard[2,3], Terence Tse[2], Piotr Walczak[2,3], Michael T. McMahon[1,2], Jeff W.M. Bulte[2,3], Peter C.M. van Zijl[1,2], Assaf A. Gilad[2,3]
[1]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States; [2]Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States; [3]Institute for Cell Engineering, Johns Hopkins University School of Medicine, Baltimore, MD, United States

A new MRI method for assessing cytosine deaminase (CD) enzymatic activity was developed. This method allows the direct detection and quantification of CD by observing the changes in Chemical Exchange Saturation Transfer (CEST) signal when the substrates cytosine and 5-Fluorocytosine (5-FC) are converted to products uracil and 5-Fluorouracil (5-FU) by CD respectively. In addition, this method is capable of continuously monitoring the CD activity using the natural compounds in the cytosine/uracil system. Possible applications for this method include monitoring of in vivo CD activity and CD gene therapy for cancer.

11:48 ***37***. **A Novel Class of S-Gal™ Analogs as ^{1}H MRI *LacZ* Gene Reporter Molecules**

Praveen Kumar Gulaka[1], Vikram D. Kodibagkar[1,2], Jian-Xin Yu[2], Ralph P. Mason, [12]
[1]Biomedical Engineering, UT Arlington and UT Southwestern Medical Center at Dallas, Dallas, Tx, United States; [2]Radiology, UT Southwestern Medical Center at Dallas, Dallas, Tx, United States

Extensive implementation of gene therapy as a therapeutic strategy for cancers has been hampered by difficulties in quantitatively assessing the success of gene transfection and longevity of gene expression. Therefore development of non-invasive reporter techniques based on appropriate molecules and imaging modalities may help to assay gene expression. We have evaluated a range of S-Gal™ analogs as novel 1H MR lacZ gene-reporter molecules in vitro and have identified C3-GD as an optimal agent for in vivo studies.

12:00 ***38***. **Multispectral MRI Contrast Through Cylindrical Nanoshell Agents**

Gary Zabow[1,2], Stephen Dodd[1], John Moreland[2], Alan Koretsky[1]
[1]NINDS, NIH, Bethesda, MD, United States; [2]NIST, Boulder, CO, United States

Thanks to the processing control afforded by top-down microfabrication techniques, geometrically tailored magnetic microparticles have recently been shown able to produce tunable, multispectral MRI contrast. Here we demonstrate a new form of such agent based on new cylindrical nanoshell structure designs. These hollow magnetic cylinders can produce large NMR frequency shifts through the control of the cylinder materials, aspect ratios and wall

thicknesses. Apart from yielding distinct frequency shifted NMR peaks, it is also shown that these cylindrical nanoshell structures exhibit good mechanical robustness and automatically self-align (as is required) to the applied MRI B_0 field.

12:12 ***39***. **Eu^{3+}-Based PARACEST Agents with Intermediate Water Exchange Rates Also Act as T_2 Exchange (T_{2exch}) Contrast Agents**

Todd C. Soesbe[1], Federico A. Rojas-Quijano[1], Matthew E. Merritt[1], A. Dean Sherry[1,2]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Department of Chemistry, The University of Texas at Dallas, Dallas, TX, United States

In our initial in vivo murine studies of CEST agents, we observed a significant loss of MR signal in certain tissue types, most notably the kidneys (intravenous injection) and human cancer cell xenografts (intratumoral injection). This loss in signal was present even when the CEST saturation pulse was omitted from the imaging sequence, and appeared to be caused by a local decrease in T_2 due to the presence of the CEST agent. We hypothesized that the proton exchange that enables the CEST effect can also cause a decrease in T_2 for compounds with intermediate proton exchange rates.

12:24 ***40***. **MR Contrast from Ascorbic Acid (Vitamin C) in Phantoms and in Vivo**

Christopher D. Lascola[1], Talaignair Venkatraman[1], Bjorn Engstrom[1], Haichen Wang[1]
[1]Department of Radiology and Brain Imaging and Analysis Center, Duke University Medical Center, Durham, NC, United States

: L-ascorbic acid (vitamin C) is the most abundant intracellular antioxidant and an essential co-factor. Intracellular levels of ascorbic acid (AA) are remarkably high, where concentrations may exceed 10-30 mM. In this study, we show that AA in solution produces significant changes in T2 and T2* relaxivity at physiologically relevant concentrations. These results raise two important possibilities: first, that endogenous AA may be an important contributor to native T2 and T2* contrast in CNS and other tissues; and second, that both oxidized and reduced forms of ascorbic acid may have utility as novel MR contrast probes.

12:36 ***41***. **Hyperpolarized 89Y Complexes as PH Sensitive NMR Probes**

Ashish Kumar Jindal[1], Matthew E. Merritt[1], Eul Hyun Suh[1], Craig R. Malloy[1,2], Alan Dean Sherry[1,3], Zoltan Kovacs[1]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Veterans Affairs, North Texas Health Care System, Dallas, TX, United States; [3]Department of Chemistry, University of Texas at Dallas, Richardson, TX, United States

Hyperpolarization followed by fast dissolution provides tremendous gains in SNR in both NMR and MRI experiments, but a primary bottleneck in its application is the T_1 decay of the magnetization in the liquid state. Due to its long T_1, hyperpolarized ^{89}Y makes an excellent candidate as an *in vivo* imaging agent. Here we report the chemical shift dependence upon pH for two hyperpolarized ^{89}Y complexes and clearly demonstrate how such complexes can be used as sensitive spectroscopy/imaging probes to measure pH.

12:48 ***42***. **Remote MRI Sensing of PH and Cell Viability Using Immunoprotective Microcapsules Crosslinked with Polycationic DIACEST Peptides**

Dian Respati Arifin[1,2], Kannie W.Y. Chan[1,2], Guanshu Liu[1,3], Amanda Cardona[1], Muksit Jamil[1], Jeff W.M. Bulte[1,2], Michael T. McMahon[1,3]
[1]Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Cell Imaging Section, Institute for Cell Engineering, Johns Hopkins University School of Medicine, Baltimore, MD, United States; [3]F.M. Kirby Center for Functional Brain Imaging, Kennedy Krieger Institute, Johns Hopkins University School of Medicine, Baltimore, MD, United States

Cell transplantation is a potential treatment for various diseases such as type I diabetes, liver failure and cardiovascular disorders. Encapsulation of cells inside semi-permeable microcapsules offers immunoprotection for the cells and recipient. We have developed new biodegradable microcapsules using polycationic peptides from our library of CEST agents that are detectable by MRI. These DIACEST capsules are pH-responsive and can be used to monitor biological events, which are accompanied by pH changes. Human pancreatic cells encapsulated inside these microcapsules were alive and functional for at least 27 days *in vitro*. We also demonstrate that these microcapsules can detect cell apoptosis *in vitro*.

Transmit Technology

Room A6 11:00-13:00 *Moderators:* Kenneth M. Bradshaw and Tamer Ibrahim

11:00 ***43***. **1.5T On-Coil Current-Mode Class-D (CMCD) Amplifier with Amplitude Modulation Feedback and Voltage-Mode Class-D (VMCD) Preamplifier**

Natalia Gudino[1], Matthew J. Riffe[1], Lisa Bauer[2], Jeremiah A. Heilman[3], Mark A. Griswold[4]
[1]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States; [2]Physics Department, Case Western Reserve University, Cleveland, OH, United States; [3]3Quality Electrodynamics, Mayfield Village, OH, United States; [4]Radiology Department, Case Western Reserve University, Cleveland, OH, United States

We present a Current-Mode Class-D (CMCD) Feedback amplifier with class-D preamplification that avoids the characteristic DC losses of linear preamplification. We demonstrated a good wave profile of the AM feedback system that modulates the RF pulse and preliminary images that prove successful operation of the system in the scanner.

11:12 ***44***. **RF Sensor Considerations for Input Predistortion Correction of Transmit Arrays**

Pascal Stang[1], Marta Zanchi[1], William Grissom[1], Adam Kerr[1], John Pauly[1], Greig Scott[1]
[1]Electrical Engineering, Stanford University, Stanford, CA, United States

Transmit arrays promise accelerated excitation, B1 shimming, and the potential for SAR and RF safety management. Yet good results demand high-fidelity RF playback in a challenging multi-channel environment. Parallel transmit RF systems must overcome a host of issues including mutual coupling, loading variations, RF amplifier non-linearity, ill-defined impedances, and memory effects. We have proposed Vector Iterative Predistortion and Cartesian

Feedback as input predistortion methods to address PTx challenges. We now present our on-coil and in-line RF feedback sensors critical to these technologies, and discuss their relative capabilities in the context of PTx array control.

11:24 ***45***. **Efficient EPI Friendly 3x3 Array with Receive-Only Array Insert**

Tamer S. Ibrahim[1], Tiejun Zhao[2], Fernando E. Boada[3]
[1]Departments of Bioengineering and Radiology, University of Pittsburgh, Pittsburgh, PA, United States; [2]Siemens Medical Solutions; [3]Department of Radiology, University of Pittsburgh

In this work, we will examine the efficiency of Tic Tac Toe RF array designs including the original 2x2 and new 3x3 versions and extend their usefulness to become more application friendly. This will be achieved by yielding optimal SNR (through a combination with a separate 7-channel receive-only array) and by designing echo-planar imaging (EPI) compatible prototypes. The results show excellent improvement in eddy current reduction and SNR enhancement with a receive-only array insert.

11:36 ***46***. **Constellation Coil**

Yudong Zhu[1], Ryan Brown[1], Cem Deniz[1], Leeor Alon[1], Kellyanne Mcgorty[1], Daniel Sodickson[1]
[1]New York University School of Medicine, New York, United States

An RF coil plays a central role in the induction of a B1 field for creating an excitation profile, and meanwhile, a concomitant E field that causes undesirable RF loss and SAR. A coil structure that supports flexible current distribution control is essential for management of both the excitation profile and RF power, and is hence a key factor in parallel Tx performances. We developed a "constellation coil" which prioritizes field optimization-based Tx/Rx improvement with a continuum structure, and accommodates scalability supporting highly parallel Tx/Rx. Preliminary 7T MRI results obtained with prototype parallel Tx and Rx constellation coils are presented.

11:48 ***47***. **Reduce Power Deposition Using Microstrip Array with Tilted Elements at 7T**

Yong Pang[1], Bing Wu[2], Xiaoliang Zhang[2,3]
[1]Radiology and Biomedical imaging, University of California San Francisco, San Francisco, CA , United States; [2]Radiology and Biomedical imaging, University of California San Francisco, San Francisco, CA, United States; [3]UCSF/UC Berkeley Joint Graduate Group in Bioengineering, San Francisco & Berkeley, CA, United States

Power deposition increases with the static magnetic field strength. In this work, a microstrip array with tilted elements is built and the electric field E and magnetic field B1+ are simulated using FDTD method. Their ratio E/B is used to predict the power deposition for two type of different arrays: microstrip array with regular elements and tilted elements. Results show that using the tilted array, coil efficiency and decoupling between elements can be increased. The reduction in E/B ratio indicates possible reduction in power deposition.

12:00 ***48***. **High-Field Imaging at Low SAR: Tx/Rx Prostate Coil Array Using Radiative Elements for Efficient Antenna-Patient Power Transfer**

Alexander Raaijmakers[1], Ozlem Ipek[1], Dennis Klomp[1], Hugo Kroeze[1], Bart van de Bank[1], Vincent Boer[1], Paul Harvey[2], Cecilia Possanzini[2], Jan Lagendijk[1], Nico van den Berg[1]
[1]Radiotherapy, UMC Utrecht, Utrecht, Netherlands; [2]Philips Healthcare, Best, Netherlands

Abdominal imaging at 7 T is challenging due to reduced RF penetration at 298 MHz. Conventional high-field surface coil arrays with stripline elements deposit high SAR levels and suffer from inhomogeneous B1-field distribution. We present results of a prototype coil array consisting of so-called radiative antennas. These elements emit power to the region of interest more efficiently. Simulations and volunteer measurements show reduced SAR levels and increased image homogeneity.

12:12 ***49***. **RF Coil Designs for 7T Cardiac Imaging**

John Thomas Vaughan[1], Carl j. Snyder[1], Lance Delabarre[1], Jinfeng Tian[1], Can Akgun[1], Gregor Adriany[1], John Strupp[1], Peter Andersen[1], Eddie Auerbach[1], Pierre-Francois Van de Moortele[1], Kamil Ugurbil[1]
[1]University of Minnesota-Center for Magnetic Resonance Research, Minneapolis, MN, United States

Our objective was to investigate three RF coil approaches to human cardiac imaging at 7T. The first approach used a 16-channel, whole body coil together with 16 channel local receivers. The second approach used a 16-channel transceiver array. And the third approach made use of a close fitting torso coil with local 16 channel receivers. The three approaches were evaluated by image and efficiency data, as well as practical constraints such as lead placement, receiver coil accommodation, and human comfort. All three coils were used successfully, and found to offer options and respective trade-offs for successful cardiac imaging at 7T.

12:24 ***50***. **16-Channel Tx/Rx Body Coil for RF Shimming with Selected Cp Modes at 7T**

Stephan Orzada[1,2], Stefan Maderwald[1,2], Oliver Kraff[1,2], Irina Brote[1,2], Mark E. Ladd[1,2], Klaus Solbach[3], Pedram Yazdanbakhsh[3], Achim Bahr[4], Hans-Peter Fautz[5], Andreas K. Bitz[1,2]
[1]Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, NRW, Germany; [2]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, NRW, Germany; [3]High Frequency Engineering, University Duisburg-Essen, Duisburg, NRW, Germany; [4]IMST GmbH, Kamp-Lintfort, Germany; [5]Siemens Healthcare Sector, Erlangen, Germany

To increase the capability of a 7 Tesla 8-channel RF shimming system, a 16-channel Tx/Rx body coil was built to be used with a 16-channel Butler matrix for mode compression and an 8-channel variable power combiner. The array has a large field of view and shows good homogeneity in gradient echo images. RF shimming with mode compression and variable power combining was successfully performed in human volunteers.

12:36 ***51***. **Optimizing 7T Spine Array Design Through Offsetting of Transmit and Receive Elements and Quadrature Excitation**

Qi Duan[1], Daniel K. Sodickson[1], Riccardo Lattanzi[1], Bei Zhang[1], Graham C. Wiggins[1]
[1]Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, NY, United States

This abstract presents a novel 7T spine array design for optimizing SNR at the regions of interest. This design takes into account opportunities for quadrature excitation and the twisting of B1+ and B1- fields to optimize SNR within the ROIs. The design parameters were quantitatively optimized via full wave simulation. The benefits of the proposed design were validated via actual MR scan with higher SNR within ROI, more efficient excitation, and less peak local heating than alternative designs. This design can be easily extended for larger longitudinal coverage, providing a more efficient excitation and MR images without obvious signal nulls.

12:48 ***52***. **On the Reduction of the Transmit B1 Non-Uniformity and SAR Using a Single-Element Rotating RF Coil**

Feng Liu[1], Ewald Weber[1], Adnan Trakic[1], Hua Wang[1], Stuart Crozier[1]
[1]The School of Information Technology and Electrical Engineering, The University of Queensland, Brisbane, St.Lucia, Queensland, Australia

In this work, we presented a complete technological solution for tailoring uniform RF fields and minimizing tissue heating for high field MRI. The success of the new B1 shimming technique is largely facilitated by a mechanically rotating RF coil (RRFC) configuration. The proposed method is explained with a biologically loaded, one-element rotating coil operating at 400 MHz. The coil is modelled using the method of moment (MoM) and tissue-equivalent sphere phantom is loaded and modelled using the Green's function method. A sensitivity matrix is constructed based on the pre-characterized B1 and electric field profiles of a large number of angular positions around the imaged phantom, an optimization procedure is then employed for the determination of optimal driving configuration by solving the ill-posed linear system equation. Test simulations show that, compared with conventional bird-cage mode driving scheme, the proposed excitation scheme is capable of significant improvement of the B1 -field homogeneity and reduction of the local and global SAR values. This primary study indicates that the proposed RF excitation technology can effectively perform field-tailoring and might hold the potential of solving the high frequency RF problem.

Image Analysis Applications

Room A7 11:00-13:00 *Moderators:* Claudia Lenz and Simon K. Warfield

11:00 ***53***. **Automatic Computational Method for the Measurement of Neuronal Cell Loss in Transgenic Mouse Model of AD**

George Iordanescu[1,2], Palamadai Venkatasubramanian[1,2], Alice Wyrwicz[1,3]
[1]Center for Basic MR Research, Northshore University HealthSystem, Evanston, IL, United States; [2]Pritzker School of Medicine, University of Chicago, Chicago, IL, United States; [3]Biomedical Engineering, Northwestern University, Evanston, IL, United States

Loss of neurons and synapses is a key features that characterize Alzheimer's disease (AD). A novel semi-automatic segmentation method is used to quantify the neuronal loss in the pyramidal cell layer in hippocampal CA1 subfield (PLCA1) in a very rapid progression AD model. The proposed method uses unsupervised support vector machines. The resulting distance to the classification hyperplane combines all classification features and measures the neuronal cell loss as indicated by the MR contrast. The distribution of the neuronal cell loss within the PLCA1 may be a useful tool to understand the mechanism of cell loss in AD.

11:12 ***54***. **Analysis of MRI Data Monitoring the Treatment of Polycystic Kidney Disease in a Preclinical Mouse Model**

Stathis Hadjidemetriou[1], Wilfried Reichardt[1], Juergen Hennig[1], Martin Buechert[2], Dominik von Elverfeldt[1]
[1]Department of Diagnostic Radiology, University Hospital Freiburg, Freiburg, Germany; [2]MRDAC, Freiburg, Germany

Autosomal dominant polycystic kidney disease (ADPKD) is characterized by the growth of kidney cysts and the eventual kidney failure in humans. A treatment for ADPKD is not yet available. Treatment development involves preclinical studies with a mouse ADPKD model. Such mice have been monitored longitudinally with high field animal MRI. In this work the mouse kidneys are segmented with an unsupervised, reliable, and reproducible method. A region of interest is identified and analyzed for its statistics and for kidney geometry. This information is incorporated into the graph cuts algorithm that delineates the kidneys. Extensive validation is presented.

11:24 ***55***. **Effects of Smoking on Mouse Adipose Tissue Volumes Measured by IDEAL at 11.7T**

David Johnson[1], Jiarui Lian[1], Mohamed El-Mahdy[1], Jay L. Zweier[1]
[1]Heart and Lung Research Institute, Ohio State University, Columbus, OH, United States

An imaging technique was developed to produce uniform, robust fat-water separation in mice at 11.7T using Iterative Decomposition of water and fat with Echo Asymmetry and Least-squares estimation method (IDEAL). Cigarette smoking (CS) C57BL/6 mice had less body weight and subcutaneous adipose tissue volumes as compared to controls. The volumes of muscle and other non-adipose tissues were not different between CS and control mice, supporting the hypothesis of a selective reduction in fat storage due to smoking.

11:36 ***56*. T2* Evaluation of Iron Overload at 3T and Comparison with 1.5 T**

Daniele De Marchi[1], Antonella Meloni[1], Alessia Pepe[1], Vincenzo Positano[1], Luca Menichetti[1], Petra Keilberg[1], Chiara Ardenghi[1], Federico Vivarini[1], Saveria Campisi[2], Massimo Lombardi[1]
[1]MRI Lab, "G. Monasterio Foundation" and Institute of Clinical Physiology, CNR, Pisa, Italy; [2]A.O. Umberto I, Siracusa, Italy

The relationship between T2* values at 3T and 1.5T over the range of clinical interest of tissue iron concentrations was evaluated by GRE multiecho sequences on a dedicated phantom and on thalassemia patients. A strongly significant linear relationship between T2* values at 1.5T and at 3T was found for both liver and phantoms data. The slope was about 0.6, with a negligible intercept. The distribution of T2* values in heart did not allow to establish the relationship between T2* values at 1.5T and at 3T in heart.

11:48 ***57*. Accuracy of Wholebody Fat Quantification with MRI: A Comparison to Air-Displacement Plethysmography**

Florian Klausmann[1], Ute Ludwig[1], Matthias Honal[1], Daniel König[2], Peter Deibert[2], Sandra Huff[1]
[1]Department of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany; [2]Department for Rehabilitation, Prevention and Sports Medicine, University Hospital Freiburg, Freiburg, Germany

Besides the total amount of adipose tissue, its distribution has recently been recognized as an important factor in the pathogenesis of metabolic diseases like diabetes mellitus. MRI is capable for space-resolved imaging of fat distributions in the human body. In this study, we present a fully automatic algorithm for fat quantification in MRI two-point Dixon data which considers partial volume effects of fat voxels, compensates B1-inhomogeneities in the MR images and separates subcutaneous and inner fat in the abdomen. MR quantification results were compared to air-displacement plethysmography measurements, which served as the standard of reference.

12:00 ***58*. Fat Quantitation Using Chemical Shift Imaging and 1H-MRS in Vitro Phantom Model**

Shenghong Ju[1], Xingui Peng[1], Fang Fang[1], Gaojun Teng[1]
[1]Radiology, Zhongda Hospital, Southeast University, Nanjing, Jiangsu, China

Present study aims to evaluate the accuracy of CSI and MRS in fat quantification and composition by using phantom model at high field 7.0 Tesla MR.The ability for quantitative fat measurement is verified in phantoms. They are promising for further application in vivo quantitation of fat composition.

12:12 ***59*. An Integrated Approach for Perfusion Lesion Segmentation Using MR Perfusion for Acute Ischemic Stroke**

Dattesh D. Shanbhag[1], Rakesh Mullick[1], Sumit K. Nath[1], Catherine Oppenheim[2], Marie Luby[3], Katherine D. Ku[3], Lawrence L. Latour[3], Steven Warach[3], - NINDS Natural History of Stroke Investigators[3]
[1]Imaging Technologies, GE Global Research, Bangalore, Karnataka, India; [2]Department of Neuroradiology, Université Paris-Descartes, Paris, France; [3]NINDS, NIH, Bethesda, MD, United States

In this work, we demonstrate a fully automated, fast and robust analysis pipeline for segmenting the perfusion lesion on different PWI maps (MTT, Tmax, TTP) and mismatch in acute ischemic stroke setting. The automatically segmented perfusion lesion and mismatch volume showed a strong correlation of 0.9 and 0.88 respectively, when compared to manually segmented PWI lesion on MTT maps. Variability for perfusion lesion volume estimates were lower compared to manual inter-rater variability, but was higher for mismatch estimates. Overall, Tmax PWI lesion had a lower volume compared to MTT PWI lesion.

12:24 ***60*. Quantitative Imaging of Cortical Abnormalities in Extratemporal Epilepsy**

Heath Richard Pardoe[1], Graeme D. Jackson[1,2]
[1]Brain Research Institute, Florey Neuroscience Institutes, Melbourne, Victoria, Australia; [2]Department of Medicine, University of Melbourne, Melbourne, Victoria, Australia

In this study software-based analysis of structural MRI was used to map the thickness of the cortex in extratemporal epilepsy subjects with radiologically observable lesions. The technique was used to identify cortical abnormalities in the epilepsy patients. Non-rigid registration of the patient group and an age-matched group of controls to a custom template allowed voxel-wise comparison of the cortical thickness in each epilepsy subject with the control group using a standard score. Thresholds for the objective identification of cortical abnormalities were empirically determined by investigating the relationship between standard score and number of voxels exterior to manually delineated lesions.

12:36 ***61*. 3D Visualization and Quantification of Subdural Electrode Shift Due to Craniotomy Opening**

Peter Sherman LaViolette[1], Alastair Hoyt[2], Scott D. Rand[3], Kathleen M. Schmainda[1], Wade M. Mueller[2]
[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States; [2]Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States; [3]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States

Epileptic patients with medically intractable seizure disorders are subject to implantation of subdural electrodes for the purpose of seizure localization. It is assumed that these electrodes remain stationary during the reopening of the craniotomy defect at the time of resective surgery. This study shows that brain compression changes and general grid shift both occur and move electrodes in non-trivial amounts. This study builds a case for adoption of electrode/brain model reliance for electrode position determination instead of traditional visual assessment at the reopening of the craniotomy.

12:48 ***62*. Localization of Subdural Electrodes on MRI Cortical Surface Images for Evaluation of Epilepsy Patients**

Boklye Kim[1], Jack Parent[1], Oren Sagher[1], Karen Kluin[1], Charles R. Meyer[1]
[1]University of MIchigan, Ann Arbor, MI, United States

Presurgical evaluation of surgical treatment of epilepsy patients often requires implantation of subdural grid electrodes on the cortex. The exact locations of implanted electrodes are essential to evaluate cortical lesions related to seizure onsets and delineate eloquent brain areas. The process requires registration via multi-modality image warping and correction of post-craniotomy brain deformation. The loss of CSF fluid the presence of epidural or subdural

hematoma from open craniotomy cause brain shifts. This work presents an mapping of electrodes from post-implant CT data to pre- or post surgery MRI by intermodality image warping to determine accurate positions involved in electrocortical stimulation.

Flow Quantification & Vessel Function

Room A8 11:00-13:00 *Moderators:* Tino H.G. Ebbers and Thoralf Niendorf

11:00 ***63***. **Coregistration of Wall Shear Stress and Plaque Distribution Within the Thoracic Aorta of Acute Stroke Patients**

Michael Markl[1], Stephanie Brendecke[2], Jan Simon[1], Alex Frydrychowicz[3], Andreas Harloff[2]
[1]Diagnostic Radiology, Medical Physics, University Hospital, Freiburg, Germany; [2]Neurology, University Hospital, Freiburg, Germany; [3]Radiology, University of Wisconsin, Madison, United States

Flow-sensitive 4D-MRI (3D morphology and 3-directional blood flow) and segmental wall shear stress analysis were employed in 94 patients with aortic atherosclerosis. A one-to-one comparison of wall parameter distribution with plaque location was performed in a large number of complex aortic plaques. Critical wall parameters such as low wall shear stress and high oscillatory shear index were concentrated at the inner curvature of the aorta and near the outlet of the supra-aortic arteries. For most complex plaques a consistent location of critical wall parameters in wall segments adjacent to the atheroma suggested a close correlation of hemodynamics and advanced atherosclerosis.

11:12 ***64***. **Analysis of Right Atrial and Ventricular Flow Patterns with Whole Heart 4D Flow MRI – Comparison of Tetralogy of Fallot with Normal Volunteers**

Christopher J. François[1], Shardha Srinivasan[2], Benjamin R. Landgraf[1], Alex Frydrychowicz[1], Scott B. Reeder[1,3], Mark L. Schiebler[1], Oliver Wieben[1,3]
[1]Radiology, University of Wisconsin, Madison, WI, United States; [2]Pediatrics, University of Wisconsin, Madison, WI, United States; [3]Medical Physics, University of Wisconsin, Madison, WI, United States

An appropriate understanding of cardiac function requires analysis of flow patterns through the heart. This is particularly true in congenital heart disease prior to and following repair, where reconstruction of a normally functioning heart would be desirable. This work describes the analysis of flow patterns in the right heart in normal volunteers and patients with Tetralogy of Fallot using whole heart 4D flow MRI.

11:24 ***65***. **Simultaneous Quantification of Blood Velocity and Oxygenation in Femoral Artery and Vein in Response to Cuff-Induced Ischemia**

Michael C. Langham[1], Jeremy Magland[1], Felix W. Wehrli[1]
[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States

Quantifying reactive hyperemia in the lower extremities is a common approach for assessing vascular dysfunction associated with peripheral arterial disease (PAD). Often assessment is limited to measuring a single physiologic parameter such as velocity, flow-mediated dilatation and blood oxygenation. As a first step toward the development of an integrated MRI examination of PAD we have combined velocity quantification technique with a field mapping pulse sequence allowing simultaneous time-course mapping of blood velocity and oxygenation in femoral artery and vein during cuff-induced hyperemia. The results of blood velocity and oxygenation quantification agree with those found in the literature.

11:36 ***66***. **5-Point, Ultra-Short TE, 3D Radial Phase Contrast: Improved Characterization of Complex and Turbulent Flow**

Kevin M . Johnson[1]
[1]Medical Physics, University of Wisconsin - Madison, Madison, WI, United States

The accuracy of PC MR is deteriorated by flow features common to pathology such as acceleration, unstable flow, and turbulence. Recently, ultra short TE 2D radial sequences have been shown to provide more reliable through plane flow measurements than standard PC. Meanwhile, investigators have utilized conventional 3D PC sequences for the measurement of turbulence kinetic energy using signal losses. In this work, we investigate a synergistic combination of ultra-short TE 3D radial trajectories and a 5-point velocity encoding scheme for improvements in both the velocity measurement accuracy and estimation of intra-voxel standard deviations utilized for turbulence mapping

11:48 ***67***. **Hadamard-Transform K-T PCA for Cine 3D Velocity Vector Field Mapping of Carotid Flow**

Verena Knobloch[1], Daniel Giese[1], Peter Boesiger[1], Sebastian Kozerke[1]
[1]Institute for Biomedical Engineering, Swiss Federal Insitute of Technology and University Zurich, Zurich, Switzerland

It has been shown recently that k-t PCA permits high acceleration without compromising the accuracy of single directional flow quantification. In this work 3D velocity fields are measured in a phantom and an in-vivo case and reconstructed with different acceleration factors. Pathline tracking is possible up to an acceleration factor of 10.

12:00 ***68***. **Metric Optimized Gating for Fetal Cardiac MR Imaging**

Michael Shelton Jansz[1,2], Mike Seed[3], Joshua F. van Amerom[1,2], Shi Joon Yoo[3,4], Christopher K. Macgowan[1,2]
[1]Medical Biophysics, University of Toronto and Hospital for Sick Children, Toronto, Ontario, Canada; [2]Medical Imaging, University of Toronto and Hospital for Sick Children, Toronto, Ontario, Canada; [3]Pediatric Cardiology, University of Toronto and Hospital for Sick Children, Toronto, Ontario, Canada; [4]Dignostic Imaging, University of Toronto and Hospital for Sick Children, Toronto, Ontario, Canada

Phase-contrast MRI of pulsatile flow typically requires cardiac gating; however, a gating signal is not necessarily available *in utero* for fetal cardiac imaging. We propose a new technique for reconstructing ungated data where the gating is determined retrospectively by optimizing an image metric. Simulations and *in vivo* data are presented to demonstrate the feasibility of this technique.

12:12 ***69***. **Objective Characterization of Disease Severity by Determination of Blood Flow Reserve Capacity of the Popliteal Artery in Intermittent Claudication**

Bastiaan Versluis[1], Marjolein HG Dremmen[1], Patty J. Nelemans[2], Joachim E. Wildberger[1], Tim Leiner[1], Walter H. Backes[1]
[1]Radiology, Maastricht Universitary Medical Centre, Maastricht, Netherlands; [2]Epidemiology, Maastricht Universitary Medical Centre, Maastricht, Netherlands

Objective characterization of peripheral arterial disease (PAD) severity remains difficult purely on the basis of morphological assessement. We describe a method to determine rest flow and blood flow reserve capacity (BFRC) of the popliteal artery, using serial velocity encoded 2D MR cine PCA flow measurements. Using this method, we found a strong reduction in rest flow, maximum flow and BFRC in 10 patients with intermittent claudication compared to 10 healthy subjects. This method can potentially be used to supplement MR angiography to objectively characterize PAD disease severity and to monitor therapy efficacy in intermittent claudication.

12:24 ***70***. **Analysis of Complex Flow Patterns with Acceleration-Encoded MRI**

Felix Staehle[1], Simon Bauer[1], Bernd André Jung[1], Jürgen Hennig[1], Michael Markl[1]
[1]Department of Diagnostic Radiology, University Hospital Freiburg, Freiburg, Germany

The phase contrast principle (PC) can be employed to measure flow acceleration by using acceleration sensitive encoding gradients. The aim of this study was to evaluate a newly developed gradient optimized acceleration-sensitive PC-MRI technique with full three-directional acceleration encoding of aortic blood flow. Results were compared to standard velocity encoded phase contrast MRI. In addition, the value of acceleration induced intravoxel dephasing as a new image contrast providing information about complex and vortical flow was investigated.

12:36 ***71***. **Novel Hybrid Real-Time Phase-Contrast Sequence**

Jennifer Anne Steeden[1,2], David Atkinson[1], Andrew M. Taylor[2], Vivek Muthurangu[2]
[1]Medical Physics, University College London, Gower Street, London, United Kingdom; [2]Centre for Cardiovascular MR, UCL Institute of Child Health, 30 Guilford Street, London, United Kingdom

Real-time phase contrast (PC) imaging has a low temporal resolution because interleaved flow-encoded and compensated readouts must be acquired. We have developed a hybrid real-time PC sequence that acquires real-time flow-encoded and flow-compensated readouts in alternating blocks. The encoded data is subsequently matched to the compensated data, allowing the temporal resolution to be effectively doubled. This technique was demonstrated in 10 volunteers to adequately match the flow-compensated data to the flow-encoded data. It was also shown to accurately measure stroke volumes, with a good correlation against a reference gated sequence and an in-house real-time interleaved flow sequence.

12:48 ***72***. **Analysis and Correction of Background Velocity Offsets in Cine Phase-Contrast Imaging Using Magnetic Field Monitoring**

Daniel Giese[1,2], Maximilian Haeberlin[1], Christoph Barmet[1], Tobias Schaeffter[2], Klaas Paul Pruessmann[1], Sebastian Kozerke[1,2]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland; [2]Division of Imaging Sciences, King's College London, London, United Kingdom

The sensitivity of phase contrast MRI to magnetic field gradient imperfections has long been recognized and a number of image-based approaches exist to partially correct for background velocity offsets. Image-based velocity offset correction assumes a sufficient number of static image pixels and often only phase offsets with 0th and 1st order in space can be accounted for. In this work, a 16-channel magnetic field camera is employed to analyze and correct background velocity offsets in cine phase-contrast velocity imaging. It is demonstrated that phase offsets exhibit primarily constant and linear terms in space but do considerably vary in magnitude over time in triggered cine sequences necessitating heart-phase dependent correction.

SSFP & Non-Cartesian

Room A9 11:00-13:00 *Moderators:* Jin Hyung Lee and Krishna S. Nayak

11:00 ***73***. **An Analytical Description of Balanced SSFP with Finite RF Excitation**

Oliver Bieri[1]
[1]University of Basel Hospital, Basel, Switzerland

Conceptually, the only flaw in the common SSFP signal theory is the assumption of quasi-instantaneous radio-frequency (RF) pulses. An exact analytical solution for finite RF balanced SSFP will be derived and it will be shown that finite RF effects can be quite significant even for moderate RF pulse durations. Thus care should be taken when interpreting SSFP signal based on the common Freeman-Hill formulae since only recently it was realized that besides finite RF pulses also magnetization transfer effects may induce a significant modulation in the steady state amplitude.

11:12 ***74***. **Simple Cross-Solution for Banding Artifact Removal in BSSFP Imaging**

Qing-San Xiang[1,2], Michael N. Hoff[2]
[1]Radiology, University of British Columbia, Vancouver, BC, Canada; [2]Physics & Astronomy, University of British Columbia, Vancouver, BC, Canada

Balanced SSFP imaging (or TrueFISP, FIESTA) has broad clinical applications for its high time efficiency and desirable contrast. Unfortunately, banding artifacts are often seen in bSSFP images as signal modulation due to B0 inhomogeneity. To reduce banding, phase-cycled bSSFP acquisitions have been used with various reconstruction algorithms, such as Maximum Intensity Projection (MIP), Sum of Squares (SOS), Nonlinear Averaging (NLA), and Complex Sum (CS). However, none of these techniques remove banding completely. In this work, a novel elliptical signal model and a simple analytical "Cross-Solution (XS)" are presented. The latter is able to remove banding artifacts completely.

11:24 ***75***. **Spectral Profile Design for Multiple Repetition Time Balanced SSFP**

R. Reeve Ingle[1], Tolga Çukur[1], Dwight G. Nishimura[1]
[1]Electrical Engineering, Stanford University, Stanford, CA, United States

A method for optimizing the spectral profile of a given multiple repetition time balanced SSFP (multi-TR bSSFP) sequence is proposed and analyzed via Bloch simulation and phantom imaging. In this method, a linear model of transverse magnetization versus flip angle is constructed by perturbing pairs of flip angles and simulating the resulting change in transverse magnetization. Least-squares analysis is used to compute flip angles that minimize the squared error between the linear model and a desired magnetization profile. The method is demonstrated on a reference multi-TR bSSFP sequence, resulting in a 6 dB improvement in the passband-to-stopband ratio.

11:36 ***76***. **Extended Chimera SSFP**

Oliver Bieri[1], Klaus Scheffler[1]
[1]Radiological Physics, University of Basel Hospital, Basel, Switzerland

Only recently, a new type of steady-state free precession (SSFP) sequence was introduced, termed chimera SSFP. The chimera sequence consists of two alternating SSFP kernels: odd TR-intervals feature a balanced SSFP (bSSFP) type of protocol, whereas even TR-intervals undergo gradient dephasing (non-balanced SSFP) and hence the name. In contrast to the recently proposed sequence, the non-balanced SSFP kernel is played out with minimal TR $\rightarrow$ 0 and the constraint of identical flip angles for both kernels is discarded. Frequency response profile modifications achievable with the extended chimera sequence are discussed.

11:48 ***77***. **Suppression of Banding and Transient Signal Oscillations in Balanced SSFP Using a Spoiled RF Pre-Phasing Approach**

Jon Fredrik Nielsen[1], Daehyun Yoon[2], Douglas C. Noll[1]
[1]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States; [2]Electrical Engineering and Computer Sciences, University of Michigan, Ann Arbor, MI, United States

Balanced steady state free precession (bSSFP) offers high SNR efficiency and unique contrast mechanisms, but is prone to banding artifacts and transient signal oscillations. We present an RF "pre-phasing" approach for suppression of banding and transient oscillations in bSSFP.

12:00 ***78***. **Dual-Projection Cardiac and Respiratory Self-Navigated Cine Imaging Using SSFP**

Liheng Guo[1], Elliot R. McVeigh[1], Robert J. Lederman[2], J Andrew Derbyshire[2], Daniel A. Herzka[1]
[1]Biomedical Engineering, Johns Hopkins University, Baltimore, MD, United States; [2]Translational Medicine Branch, National Heart, Lung, and Blood Institute, National Institute of Health, Bethesda, MD, United States

A dual-projection self-navigated SSFP sequence is implemented to acquire navigation projections at two alternating angles during all TRs; it offers projections of high spatiotemporal resolution at two different orientations, thus providing a platform for 2D motion tracking and robust self-navigation, which can replace the standard ECG gating and patient breath hold. Preliminary post-processing of the projection data has shown that cardiac and respiratory motions can be automatically extracted and separated, and that free-breathing cardiac cine images can be automatically reconstructed to comparable quality as standard breath-hold images.

12:12 ***79***. **Optimized 3D Single Shot Trajectories by Radial Arrangement of Individual Petals (RIP)**

Benjamin Zahneisen[1], Thimo Grotz[1], Kuan J. Lee[1], Marco Reisert[1], Juergen Hennig[1]
[1]University Hospital Freiburg, Freiburg, Germany

With the use of multiple localized, small receive coil arrays, single shot whole brain coverage becomes feasible for fMRI applications using undersampled reconstruction. Using a 3D-rosette trajectory and iterative, regularized reconstruction a 64^3 volume can be acquired in 23ms with acceptable PSF-broadening. However, the analytical rosette offers only limited degrees of freedom for optimization. In this work we present an optimized 3D single-shot trajectory based on a radial arrangement of individual petals (RIP-trajectory). Compared to the "conventional" rosette trajectory it has a narrower PSF, no visible sidelobes and is faster (19.3ms) and therefore less sensitive to field inhomogeneities.

12:24 ***80***. **Image Domain Propeller FSE (IProp-FSE)**

Stefan Skare[1,2], Samantha Holdsworth[1], Roland Bammer[1]
[1]Radiology, Stanford University, Stanford, CA, United States; [2]Clinical Neuroscience, Karolinska Institute, Stockholm, Sweden

In PROPELLER imaging, multiple blades are acquired in k-space and rotated around the center to cover all of k-space. This has proven useful to mitigate motion artifacts in Cartesian FSE. In this work, a new pulse sequence called Image domain Propeller FSE (iProp-FSE) is proposed as an alternative for T2-w imaging, having propeller blades in the image domain instead of k-space. Similar to PROPELLER, motion correction can be performed between the blades. Moreover, the averaging effect of all blades in the center of the image FOV increases the SNR locally, which is especially useful for multi-channel head coils.

12:36 ***81***. **Steer-PROP: A GRASE-PROPELLER Sequence with Inter-Echo Steering Gradient Pulses**

Girish Srinivasan[1,2], Novena Rangwala[1,2], Xiaohong Joe Zhou[1,3]
[1]Center for Magnetic Resonance Research, University of Illinois Medical Center, Chicago, IL, United States; [2]Department of Bioengineering, University of Illinois at Chicago, Chicago, IL, United States; [3]Departments of Radiology, Neurosurgery and Bioengineering, University of Illinois Medical Center, Chicago, IL, United States

PROPELLER imaging has increasingly been used in motion-sensitive applications such as long anatomic scans and diffusion imaging. EPI-PROPELLER provides short scan times but is susceptible to off-resonance artifacts, producing distorted images. FSE-based PROPELLER, on the other hand, offers excellent immunity against off-resonance artifacts at the expense of acquisition efficiency. We propose a new PROPELLER sequence - Steer-PROP - which mediates the problems in EPI- and FSE-PROPELLER. This sequence has reduced the scan time by at least 3 times as compared to FSE-PROPELLER and avoided the off-resonance artifacts in EPI sequences. Steer-PROP also provides a natural mechanism to effectively address a long-standing phase correction problem.

12:48 ***82***. **Image Reconstruction from Radially Acquired Data Using Multipolar Encoding Fields**

Gerrit Schultz[1], Hans Weber[1], Daniel Gallichan[1], Jürgen Hennig[1], Maxim Zaitsev[1]
[1]Diagnostic Radiology - Medical Physics, University Hospital Freiburg, Freiburg, BW, Germany

In this contribution a radial imaging technique is presented in the context of nonlinear and non-bijective encoding fields. Efficient image reconstruction methods are described and analyzed. For multipolar encoding fields, the reconstruction can be performed in a particularly simple and useful way: The inverse Radon Transform to polar coordinates leads to undistorted images represented in polar coordinates. In the angular direction pixels are aliased equidistantly. Therefore a standard Cartesian SENSE algorithm is applicable for the unfolding process. The developed reconstruction method is applied to simulated as well as measured data to demonstrate each reconstruction step separately.

GOLD CORPORATE MEMBER LUNCHTIME SYMPOSIUM

GE Healthcare

Victoria Hall 13:00 - 14:00

CLINICAL INTENSIVE COURSE
Hip & Pelvis Imaging : Case-Based Teaching

Room K1 14:00-16:00 *Organizer & Moderator*: Christine Chung

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the MR appearance of the most common abnormalities of the hip joint and its surroundings;
- Describe the differential diagnosis of such abnormalities; and
- Identify four hip abnormalities which radiologists should not miss.

14:00 **Pubalgia**
Adam C. Zoga, M.D.

14:40 **Femoroacetabular Impingement**
Suzanne E. Anderson-Sembach, M.D., Ph.D.

15:20 **Soft Tissue Injury**
Christine Chung, M.D.

16:00 Adjournment

CLINICAL INTENSIVE COURSE
Advances in Spine Imaging

Room K2 14:00-16:00 *Organizers*: Walter Kucharczyk and Pia C. Maly Sundgren

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Implement new sequences and select coils that might be appropriate to imaging less cooperative or unstable patients;
- Describe the potential for use of high-field MRI of the spine;
- Describe situations when DWI/DTI might be useful to obtain information about a spine lesion; and
- Explain different vascular malformations and how to image them with MRI.

Moderators: **Claude Henri Manelfe, M.D. and Majda Thurnher, M.D.**

14:00 **The Role of New Sequences and Coils in Imaging Less Cooperative or Instable Patients**
Danielle Balériaux, M.D.

14:25 **Spine Imaging at High Field**
John R. Hesselink, M.D.

14:50 **Is There a Role for DWI/DTI in Spine Imaging**
Majda M. Thurnher, M.D.

15:15 **MRI of Vascular Malformations of the Spine**
Stephanie Condette-Auliac, M.D.

Young Investigators Awards

Room A1 14:00-16:00 *Moderators:* Richard L. Ehman and Michael Garwood

14:00 ***83***. **Validation of Functional Diffusion Maps (FDMs) as a Biomarker for Human Glioma Cellularity**
Benjamin M. Ellingson[1,2], Mark G. Malkin[2,3], Scott D. Rand[1,2], Jennifer M. Connelly[2,3], Carolyn Quincey[3], Pete S. LaViolette[2,4], Devyani P. Bedakar[1,2], Kathleen M. Schmainda[1,2]
[1]Dept. of Radiology, Medical College of Wisconsin, Milwaukee, WI, United States; [2]Translational Brain Tumor Program, Medical College of Wisconsin, Milwaukee, WI, United States; [3]Dept. of Neurology and Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States; [4]Dept. of Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States

The purpose of the current study was to comprehensively validate the assumptions made in human functional diffusion map (fDM) analyses and provide a biological and clinical basis for thresholds used in fDM tissue classification.

14:20 ***84***. **Detecting Blood Oxygen Level Dependent (BOLD) Contrast in the Breast**
Rebecca Rakow-Penner[1], Bruce Daniel[1], Gary Glover[1]
[1]Department of Radiology, Stanford University School of Medicine, Stanford, CA, United States

Detecting and understanding breast tissue oxygenation may help characterize tumors, predict susceptibility to treatment, and monitor chemotherapeutic response. We have developed a robust methodology for detecting BOLD contrast in the breast and have tested this technique on healthy volunteers and patients. We found that BOLD signal positively correlates to a carbogen stimulus in healthy glandular tissue. In a small patient pilot study, we found that BOLD signal negatively correlates to a carbogen stimulus in breast cancer.

14:40 ***85***. **Quantitative 4D Transcatheter Intraarterial Perfusion MRI for Monitoring Chemoembolization of Hepatocellular Carcinoma**
Dingxin Wang[1], Brian Jin[2], Robert Lewandowski[2], Robert Ryu[2], Kent Sato[2], Mary Mulcahy[3,4], Laura Kulik[5], Frank Miller[2], Riad Salem[2,3], Debiao Li[1], Reed Omary[1,4], Andrew Larson[1,4]
[1]Departments of Radiology and Biomedical Engineering, Northwestern University, Chicago, IL, United States; [2]Department of Radiology, Northwestern University, Chicago, IL, United States; [3]Department of Medicine, Northwestern University, Chicago, IL, United States; [4]Robert H. Lurie Comprehensive Cancer Center, Northwestern University, Chicago, IL, United States; [5]Department of Hepatology, Northwestern University, Chicago, IL, United States

Quantitative 4D TRIP-MRI can be performed successfully in a combined x-ray DSA-MRI unit to monitor intra-procedural reductions in liver tumor perfusion during TACE procedures in patients with HCC.

15:00 ***86***. **Three Dimensional Rapid Diffusion Tensor Microimaging for Anatomical Characterization and Gene Expression Mapping in the Mouse Brain**
Manisha Aggarwal[1], Susumu Mori[1], Tomomi Shimogori[2], Seth Blackshaw[3], Jiangyang Zhang[1]
[1]Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]RIKEN Brain Science Institute, Saitama, Japan; [3]The Solomon H. Snyder Department of Neuroscience, Johns Hopkins University School of Medicine, Baltimore, MD, United States

Diffusion tensor imaging (DTI) can reveal superior contrasts than relaxation-based MRI in premyelinated developing mouse brains. Current challenges for the application of DTI to mouse brain imaging at microscopic levels include the limitation on the achievable spatial resolution. In this study, high resolution rapid DT-microimaging of the embryonic and adult mouse brains (up to 50-60 μm) based on a 3D diffusion-weighted gradient and spin echo (DW-GRASE) scheme with twin-navigator echo phase correction is presented. We also demonstrate successful 3D mappings of gene expression data from in situ hybridization to high resolution DTI images in the early embryonic mouse brain.

15:20 ***87***. **B_1 Mapping by Bloch-Siegert Shift**
Laura Sacolick[1], Florian Wiesinger[1], W. Thomas Dixon[2], Ileana Hancu[2], Mika W. Vogel[1]
[1]GE Global Research, Garching b. Munchen, Germany; [2]GE Global Research, Niskayuna, NY, United States

Here we present a novel method for B1+ field mapping based on the Bloch-Siegert shift. The Bloch-Siegert shift refers to the effect where the resonance frequency of a nucleus shifts when an off-resonance RF field is applied. This shift is proportional to the square root of the RF field magnitude B12. An off-resonance RF pulse is added to an imaging sequence following spin excitation. This pulse induces a B1 dependent phase in the acquired image. A B1 map is calculated from the square of the phase difference between two images, with the RF pulse applied at two frequencies symmetrically around the water resonance. In-vivo Bloch-Siegert B1+ maps with 25.6 seconds/ 128x128 slice were found to be quantitatively comparable to 13 minute conventional double-angle maps. The method can be integrated into a wide variety of fast imaging sequences, and is compatible with EPI, alternative readout trajectories, receive array acceleration, etc. Insensitivity to B0, chemical shift, TR, T1, and magnetization transfer is shown as well.

15:40 ***88***. **Improved Arterial Spin Labeling After Myocardial Infarction in Mice Using Respiratory and Cardiac Gated Look-Locker Imaging with Fuzzy C-Means Clustering for T1 Estimation**

Moriel H. Vandsburger[1], Robert L. Janiczek[1], Yaqin Xu[1], Brent A. French[1], Craig H. Meyer[1], Christopher M. Kramer[1], Frederick H. Epstein[1]
[1]University of Virginia, Charlottesville, VA, United States

Arterial spin labeling is used to quantify myocardial perfusion in mice, but not after myocardial infarction (MI). We developed a cardio-respiratory triggered ASL method which incorporates a fuzzy C-means clustering algorithm during image reconstruction in order to reduce respiratory motion artifact and improve perfusion quantification after MI. Using this technique, we measured myocardial perfusion in distinct reperfused infarct and remote zones of myocardium during the time course of infarct healing in mice. Our data indicate that while perfusion in remote zone myocardium is unchanged, infarct zone perfusion drops significantly 1 day post-MI and recovers by 28 days post-MI.

Abdominal Diffusion & Whole Body Diffusion

Room A5 14:00-16:00 *Moderators:* Dow-Mu Koh and Thomas C. Kwee

14:00 ***89***. **Whole-Body Magnetic Resonance Imaging, Including Diffusion-Weighted Imaging, for Diagnosing Bone Marrow Involvement in Malignant Lymphoma**

Thomas Kwee[1], Rob Fijnheer[2], Inge Ludwig[3], Henriëtte Quarles van Ufford[1], Cuno Uiterwaal[4], Marc Bierings[5], Taro Takahara[1], Rutger-Jan Nievelstein[1]
[1]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands; [2]Department of Hematology, Meander Medical Center, Amersfoort, Netherlands; [3]Department of Hematology, University Medical Center Utrecht, Utrecht, Netherlands; [4]Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, Utrecht, Netherlands; [5]Department of Pediatric Hematology, University Medical Center Utrecht, Utrecht, Netherlands

This study aimed to determine the value of whole-body MRI, including diffusion-weighted imaging (DWI), for diagnosing bone marrow involvement in malignant lymphoma using blind bone marrow biopsy (BMB) as reference standard. To that end, 48 consecutive patients with newly diagnosed malignant lymphoma prospectively underwent whole-body MRI (T1-weighted and short inversion time inversion recovery [n=48] and DWI [n=44]) and BMB of the posterior iliac crest. Whole-body MRI (without and with DWI) was negative for bone marrow involvement in a considerable proportion of patients with a positive BMB. Therefore, whole-body MRI cannot replace BMB for bone marrow assessment in malignant lymphoma yet.

14:12 ***90***. **Comparison of DWIBS and 18F-FDG PET/CT in Newly Diagnosed Lymphoma**

Jing Gu[1], Yok-Lam Kwong[2], Tao Chan[1], Wing-Yan Au[2], Queenie Chan[3], JingBo Zhang[1,4], Raymond Liang[2], Pek-Lan Khong[1]
[1]Diagnostic Radiology, Queen Mary Hospital, The University of Hong Kong, Hong Kong, China; [2]Medicine, Queen Mary Hospital, The University of Hong Kong, Hong Kong, China; [3]Philips Healthcare, Philips Electronics Hong Kong Limited, Hong Kong; [4]Memorial Sloan-Kettering Cancer Center, United States

The aim of this study was to evaluate the diagnostic performance of DWIBS in detection of lymphoma compared with PET/CT, and to assess the correlation between ADC and SUV in lymphoma lesions. We found that (1) DWIBS provides satisfactory diagnostic accuracy in lymphoma compared with PET/CT, and with the advantage of no ionizing radiation. (2) There were significant differences in ADCmin and SUVmax between aggressive and indolent B-cell lymphoma. ADCmin may therefore be another useful quantitative marker for tumor characterization and classification. (3) Negative correlation was found between ADCmin and SUVmax suggesting an association between tumor cellularity and metabolic activity.

14:24 ***91***. **Apparent Diffusion Coefficient Predicts Biochemical Response in Neuroendocrine Liver Metastases Treated Using Targeted Radiolabelled Therapy**

Dow-Mu Koh[1], Keiko Miyazaki[2], Matthew Orton[2], Toni Wallace[1], David J. Collins[2], Martin O. Leach[2], Val Lewington[3]
[1]Department of Radiology, Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom; [2]CRUK-EPSRC Cancer Imaging Centre, Institute of Cancer Research, Sutton, Surrey, United Kingdom; [3]Department of Nuclear Medicine, Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom

We investigated diffusion-weighted MR imaging (DW-MRI) for assessing treatment response of liver metastases of neuroendocrine origin to targeted radiolabelled therapy 90Y-DOTATOC. The quantitative apparent diffusion coefficient (ADC) appears to be a promising response and prognostic biomarker. Responders were found to have a lower pre-treatment value compared with non-responders; and also demonstrated a significant increase in ADC at 2 months after the first cycle of treatment. Response defined by ADC changes also showed good agreement with biochemical response.

14:36 ***92***. **Diffusion-Weighted MR Imaging of Pulmonary Lesions: Effectiveness of Apparent Diffusion Coefficient Quantification and Lesion-To-Spinal Cord Signal Intensity Ratio in the Lesion Characterization**

Nevzat Karabulut[1], Vefa Çakmak[1]
[1]Radiology, Pamukkale University, School of Medicine, Denizli, Turkey

Diffusion-weighted imaging (DWI) of lung is a useful adjunct to conventional chest MR imaging sequences improving lesion characterization. Differentiation of malignant tumors from benign lesions can be achieved using apparent diffusion coefficient (ADC) quantification and lesion-to-spinal cord signal intensity ratio (LSR). Due to increased cellularity and less extracellular space impeding the water diffusion, malignant tumors tend to have reduced ADC and increased LSR. Our results show that ADC quantification is more accurate than LSR for the differentiation of lung lesions. Because DWI is a non-invasive technique improving lesion characterization, it should be incorporated into routine chest MR imaging protocols.

14:48 ***93*. Improving IVIM Derived F-Maps of Pancreatic Tumors with Automatic Duct and Vessel Segmentation**

Thomas Joseph Re[1,2], Mirium Klauss[3], Andreas Lemke[4], Frederik B. Laun[2], Dirk Simon[5], Riccardo Manfredi[1], Roberto Pozzi Mucelli[1], Stefan Delorme[2], Bram Stieltjes[2]

[1]Radiology, University of Verona, Verona, Italy; [2]Radiology, DKFZ, Heidelberg, BW, Germany; [3]Radiology, University of Heidelberg, Heidelberg, BW, Germany; [4]MS Computer Assisted Clinical Medicine, University of Heidelberg; [5]Software Development for Integrated Diagnostics and Therapy, DKFZ, Heidelberg, BW, Germany

Maps of IVIM model derived perfusion fraction f (f-maps) of the pancreas show potential for the identification of pancreatic adenocarcinoma lesions which appear hypointense in these images. Unfortunately, since bile and pancreatic ducts also appear as hypointense in f-maps, their presence adjacent to tumors can lead to tumor delineation errors. A novel approach which automatically segmented vessels and ducts in the f-maps based on integrated diffusion coefficient D data was tested in 43 patients and proved to be superior to both the ADC or f-map for tumor delineation.

15:00 ***94*. Higher Pre-Treatment Apparent Diffusion Coefficient Predicts Poorer Disease Survival in Patients with Colorectal Hepatic Metastasis**

Henry Ho Ching Tam[1], David J. Collins[2], Gina Brown[1], Ian Chau[3], David Cunningham[3], Martin O. Leach[2], Dow-Mu Koh[1]

[1]Department of Radiology, Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom; [2]CRUK-EPSRC Cancer Imaging Centre, Institute of Cancer Research, Sutton, Surrey, United Kingdom; [3]Department of Medical Oncology (Gastrointestinal), Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom

We report the use of DW-MRI for assessing response to chemotherapy and long-term outcome in patients with colorectal hepatic metastasis. Non-responders were found to have a higher pre-treatment apparent diffusion coefficient (ADC). High pre-treatment ADC was also associated with a shorter progression free survival time, independent of response to chemotherapy and other prognostic factors. This study demonstrates the potential of DW-MRI as a biologically relevant response and prognostic biomarker.

15:12 ***95*. Value of Diffusion Weighted Imaging (DWI) as an Early Imaging Biomarker for Prediction of Therapy Effect in Patients with Colorectal Metastases Following Selective Internal Radiotherapy (SIRT)**

Martin Zeile[1], Christian Wybranski[1], David Loewenthal[1], Maciej Pech[1], Frank Fischbach[1], Ricarda Ruehl[1], Holger Amthauer[1], Jens Ricke[1], Oliver Dudeck[1]

[1]Clinic for Radiology and Nuclear Medicine, University Clinic Magdeburg, Magdeburg, 39120, Germany

Clinical studies revealed the potential of diffusion weighted imaging (DWI) as a biomarker for predicting tumor response. 41 colorectal liver metastases in 18 patients who underwent SIRT were examined before, 1 to 3 days after and 6 weeks following radioembolization by MRI including DWI. Lesions were categorized in responding (RL) and non-responding (NRL) according to change in tumor volume after 6 weeks. On early MRI, NRL showed no change in apparent diffusion coefficient (ADC), while a significant decrease in ADC was noted for RL ($p<0.0001$). DWI was capable of predicting therapy response in patients with colorectal liver metastases following radioembolization.

15:24 ***96*. Medullar Architecture Mapping of the Human Kidney in Vivo Using an Optimized DTI Protocol at 3 T**

Petros Martirosian[1], Christina Schraml[2], Nina Franziska Schwenzer[2], Günter Steidle[1], Cristina Rossi[1], Andreas Boss[2], Vinod Kumar[3], Michael Erb[3], Uwe Klose[3], Thorsten Feiweier[4], Fritz Schick[1]

[1]Section on Experimental Radiology, University of Tübingen, Tübingen, Germany; [2]Department of Diagnostic and Interventional Radiology, University of Tübingen, Tübingen, Germany; [3]Section on Experimental Magnetic Resonance of CNS, University of Tübingen, Tübingen, Germany; [4]Department of Magnetic Resonance, Siemens Healthcare, Erlangen, Germany

The aim of the present study was to develop an optimized DTI protocol for the assessment of the renal medullar architecture in healthy volunteers. Examinations were performed on a 3T MR scanner, using a respiratory triggered diffusion-weighted EPI sequence with a monopolar diffusion preparation scheme. Diffusion-sensitizing gradients with b-values of 400s/mm^2 were applied along 30 different directions. Ten slices were acquired with a voxel size of 2×2×3mm^3. Tractography was performed in order to visualize the architecture of renal medulla. The presented protocol provides high SNR and high spatial resolution with good discrimination between cortex and medulla and allows for detailed tractography of renal medulla.

15:36 ***97*. Diffusion Tensor Imaging as a Biomarker of Diabetic Nephropathy**

Lan Lu[1], Gregory Lee[1], Vikas Gulani[1,2], John Sedor[3,4], Katherine Dell,[4,5], Chris Flask[1,2]

[1]Department of Radiology, Case Western Reserve University, Cleveland, OH, United States; [2]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States; [3]Department of Medicine, Case Western Reserve University, Cleveland, OH, United States; [4]Rammelkamp Renal Research Center, MetroHealth Medical Center, Cleveland, OH, United States; [5]Department of Pediatrics, Case Western Reserve University, Cleveland, OH, United States

Our understanding of and treatment options for Diabetic Nephropathy (DN) is limited by a lack of a non-invasive means to detect early-stage DN. In this study, we used Diffusion Tensor Imaging to quantitatively assess renal diffusion changes relative to estimated GFR (eGFR) in diabetic subjects. Our initial results suggest that medullary fractional anisotropy (FA) decreases with eGFR while Apparent Diffusion Coefficient is less sensitive. Further, FA differentiates subjects with mild DN (eGFR = 60-89) from healthy subjects (eGFR > 90), suggesting an opportunity for early detection of DN and progression as well as therapeutic intervention.

15:48 ***98*. Diffusion-Weighted MR Imaging of Kidneys Using Targeted-SPLICE**

Ning Jin[1], Jie Deng[2], Andrew C. Larson[1,3]
[1]Departments of Radiology and Biomedical Engineering, Northwestern University, Chicago, IL, United States; [2]Children's Memorial Hospital, Chicago, IL, United States; [3]Robert H. Lurie Comprehensive Cancer Center, Chicago, IL, United States

Diffusion-weighted (DW) imaging is particularly useful for functional interrogation of the kidney. Single-shot DW spin-echo echo-planner imaging (DW-SE-EPI) is commonly used for DW acquisition; however, this technique can experience image distortion and chemical shift artifacts. We recently developed targeted-SPLICE technique by combining the inner volume imaging technique with SPLICE for DWI without image distortion and blurring. The purpose of our study is to apply targeted-SPLICE technique for DWI in the kidneys and compare these targeted-SPLICE diffusion measurements to conventional DW-SE-EPI measurements. Targeted-SPLICE effectively reduced geometric distortion and image blurring and produced accurate diffusion parameter measurements in the kidney.

SPECIAL SESSION:
SMRT Forum: Safe Exposure Limits for Staff & Patients

Room A9 14:00 – 16:00 *Organizers & Moderators*: Penny Anne Gowland and Ben A. Kennedy

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- State international staff exposure limits;
- Explain means of interactions of magnetic fields of various relevant frequencies with the human body;
- Describe what is known about the interactions of magnetic fields with the developing fetus; and\
- Explain the issues around the EU directive

14:00 **Interactions with the Body**
Paul M. Glover, Ph.D.

14:20 **Staff Exposure Data**
Donald W. McRobbie, Ph.D.

14:45 **Current and future ramifications for the MR workplace**
Sija Geers-van Gemeren, Ph.D.

15:10 **The EU Directive**
Freddy Stahlberg, Ph.D.

15:35 Debate

16:00 Adjournment

CLINICAL INTENSIVE COURSE
MR Physics & Techniques for Clinicians

Room K1 16:30-18:30 *Organizers & Moderators*: Marcus T. Alley and Michael Markl

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Define and describe the fundamental principles of MR imaging, including the definition of spin magnetization, the Larmor relationship, relaxation phenomena, and the process of using the spin magnetization to produce an image;
- Explain imaging pulse sequences based upon spin and gradient echoes, including fast spin-echo and echo planar techniques;
- Design MR imaging protocols for diagnostic applications considering image contrast, spatial resolution, acquisition time, signal-to-noise ratio, and artifacts; and
- Describe the principles of parallel imaging, high-field imaging, perfusion imaging, diffusion imaging, and functional MR imaging.

16:30 **Spin Gymnastics I**
Walter Kucharczyk, M.D., F.R.C.P.C.

17:10 **Spin Gymnastics II**
Donald B. Plewes, Ph.D.

17:50 **K-space**
Anja C. Brau, Ph.D.

18:30 Adjournment

EDUCATIONAL COURSE:
Tools & Tips for Mouse Imaging & Spectroscopy

Room K2 16:30 – 18:30 *Organizers & Moderators*: Klaas Nicolay and Ivan Tkac

Upon completion of this course participants should be able to:

- Select optimal anesthesia and physiological monitoring;
- Design optimal protocols for efficient mouse screening;
- Describe the most efficient MRI and MRS techniques for mouse screening; and
- Optimize experimental protocols for maximum efficacy and high reproducibility.

16:30 **Anesthesia and Physiological Monitoring**
Brenda A. Klaunberg, V.M.D.

16:50 **Tips for Advanced MRI Screening of Mice**
Jason P. Lerch, Ph.D.

17:10 **MRI in Mouse Models of Brain Disorders**
Istvan Pirko, M.D.

17:30 **MRI and Stem Cell Trafficking**
Piotr Walczak, M.D.

17:50 **Methodology of MRS in Transgenic Mouse Models**
Malgorzata Marjanska, Ph.D.

18:10 **MR Techniques for Myocardial Studies in Mice**
Jeanine J. Prompers, Ph.D.

18:30 Adjournment

Parallel RF Transmission

Room A1 16:30-18:30 *Moderators:* Adam B. Kerr and Kawin Setsompop

16:30 ***99***. **Joint Design of Dual-Band Large-Tip-Angle RF and Gradient Waveforms in Parallel Excitation**
William A. Grissom[1], Adam B. Kerr, Pascal P. Stang[2], Greig C. Scott[2], Ileana Hancu[3], Mika W. Vogel[4], John M. Pauly[2]
[1]Electrical Engineering and Radiology, Stanford University, Stanford, CA, United States; [2]Electrical Engineering, Stanford University, Stanford, CA, United States; [3]GE Global Research, Niskayuna, NY, United States; [4]Advanced Medical Applications Laboratory, GE Global Research, Munich, Bavaria, Germany

We introduce a new framework for optimizing the phase encoding locations of a 2D or 3D parallel excitation pulse in the large-tip-angle regime. The framework is analogous to the hard pulse approximation, and yields a straightforward analytical relationship between the pulses' spin-domain rotations and

the phase encoding locations. This relationship can be exploited to optimize locations using gradient descent, or using optimization transfer for monotonic, parameter-free optimization. We apply our method to the design of dual-band (fat + water) spin echo parallel excitation pulses along 3D rungs trajectories.

16:42 ***100***. **Fast and Accurate Large-Tip-Angle RF Pulse Design for Parallel Excitation Using a Perturbation Analysis of the Bloch Equation**

Hai Zheng[1,2], Tiejun Zhao[3], Tamer Ibrahim[1], Fernando Emilio Boada[1]
[1]MR Research Center, University of Pittsburgh, Pittsburgh, PA, United States; [2]Department of Bioengineering, University of Pittsburgh, Pittsburgh, PA, United States; [3]Siemens Medical Systems, Malvern, PA, United States

The design of RF pulses in parallel excitation (PTX) commonly relies on the small-tip-angle approximation, which, although efficient, leads to distorted excitation patterns at large tip angles because of the intrinsic nonlinear nature of the Bloch equation. In this work, we introduce a fast and accurate method for large-tip-angle PTX RF pulse design based on a perturbation analysis (PTA) to the Bloch equation. Experimental data at 7T as well as computer simulations demonstrate the improvements produced by the proposed techniques without the need of prohibitively long calculation times.

16:54 ***101***. **Fast High-Flip PTx Pulse Design to Mitigate B1+ Inhomogeneity Using Composite Pulses at 7T**

Rene Gumbrecht[1,2], Joonsung Lee[1], Hans-Peter Fautz[3], Dirk Diehl[4], Elfar Adalsteinsson[1,5]
[1]Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States; [2]Department of Physics, Friedrich-Alexander-University, Erlangen, Germany; [3]Siemens Healthcare, Erlangen, Germany; [4]Siemens Corporate Technology, Erlangen, Germany; [5]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

Parallel RF transmission offers flexible control of ma magnetization generation and has been successfully applied at 7T for spatially tailored excitations and mitigation of in-plane B1+ inhomogeneity for slice-selection. Composite Pulses are known to have favorable robustness properties for large-flip-angle excitations in the presence of B1+ variations, but they have not yet been demonstrated on pTx systems. We propose a composite RF pulse design for pTx systems and demonstrate the method for B1+ mitigation in a 90º excitation pulse design.

17:06 ***102***. **K_t Points: Fast Three-Dimensional Tailored RF Pulses for Flip-Angle Homogenization Over an Extended Volume**

Martijn Anton Cloos[1], Nicolas Boulant[1], Michel Luong[2], Guillaume Ferrand[2], Christopher J. Wiggins[1], Eric Giacomini[1], Alain France[2], Dennis Le Bihan[1], Alexis Amadon[1]
[1]CEA, DSV, I2BM, NeuroSpin, LRMN, Gif-sur-Yvette, France; [2]CEA, DSM, IRFU, SACM, Gif-sur-Yvette, France

Transmit-SENSE gives the opportunity to implement short excitation pulses with good flip-angle homogeneity at high field. For slice-selective pulses, this was previously demonstrated using a spoke k-space trajectory. Here we present a novel pulse design returning sub-millisecond pulses with excellent flip-angle homogenization over an extended volume. Experimental results are shown at 7T, demonstrating a 950-µs excitation pulse producing a 15±1.1° flip-angle distribution over a 16-cm spherical phantom having the same electrical properties as a human head.

17:18 ***103***. **Inner-Volume-Imaging Using Three-Dimensional Parallel Excitation**

Johannes Thomas Schneider[1,2], Raffi Kalayciyan[1,3], Martin Haas[2], Wolfgang Ruhm[1], Olaf Doessel[3], Juergen Hennig[2], Peter Ullmann[1]
[1]Bruker BioSpin MRI GmbH, Ettlingen, Germany; [2]Dept. of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany; [3]Institute of Biomedical Engineering, Karlsruhe Institute of Technology, Karlsruhe, Germany

This study presents the first experimental realization of inner-volume-imaging using three-dimensional parallel excitation of arbitrarily shaped regions of interest. By using a temporally optimized 4-fold undersampled 3D k-space trajectory consisting of concentrical shells in combination with an 8-channel transceive RF-array, 3D selective excitation of an arbitrary volume could be achieved in only 5 ms. Featuring such short durations 3D-selective pulses are now on the verge of being used in common imaging sequences and have been successfully applied in first experiments of inner-volume-imaging in phantoms and fruits during this study.

17:30 ***104***. **SAR Reduction by K-Space Adaptive RF Shimming**

Hanno Homann[1], Kay Nehrke[2], Ingmar Graesslin[2], Olaf Dössel[1], Peter Börnert[2]
[1]Karlsruhe University, Karlsruhe, Germany; [2]Philips Research, Hamburg, Germany

Parallel transmission allows compensating for RF transmit field inhomogeneities and simultaneous SAR reduction by RF shimming. This study demonstrates that the trade-off between these two objectives can be overcome by using several different, adapted RF pulses: When sampling the center of the k-space, a highly uniform but relatively SAR-intensive excitation is performed to achieve optimal contrast. In the outer k-space, the homogeneity requirement is relaxed to reduce the average SAR. The concept is discussed theoretically; proof-of-principle is given based on phantom and in vivo images.

17:42 ***105***. **Parallel Transmit RF Design with Local SAR Constraints**

Joonsung Lee[1], Matthias Gebhardt[2], Lawrence L. Wald[3,4], Elfar Adalsteinsson[1,4]
[1]Electrical engineering and computer science, Massachusetts Institute of Technology, Cambridge, MA, United States; [2]Siemens Healthcare, Erlangen, Germany; [3]Department of Radiology, A. A. Martinos Center for Biomedical Imaging, Cambridge, MA, United States; [4]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

The model compression method for local SAR esitmation dramatically decreases the complexity of the prediction of the local SAR calculation and enables the incorporation of local SAR constaints in pTX MLS RF design.

17:54 ***106***. **RFuGE –an Accelerated Imaging Method Combining Parallel Transmit RF Encoding Plus Gradient Encoding with Compressed Sensing Reconstruction**

Muhammad Usman[1], Shaihan J. Malik[2], Ulrich Katscher[3], Philip G. Batchelor[1], Joseph V Hajnal[2]
[1]Imaging Sciences, King's College London, London, United Kingdom; [2]Robert Steiner MRI Unit, Imaging Sciences Department, MRC Clinical Sciences Centre, Hammersmith Hospital, Imperial College London, London, United Kingdom; [3]Sector Medical Imaging Systems Philips Research Europe, Hamburg, Germany

We describe a combination of Parallel Transmit generated radiofrequency encoding and undersampled gradient encoding that can be reconstructed using compressed sensing to achieve accelerated imaging with a non-linear encoding basis. The method, RF plus Gradient Encoding, (RFuGE) has been tested in simulation and successful reconstructions were achieved.

18:06 ***107***. **16-Channel Parallel Transmission in the Human Brain at 9.4 Tesla: Initial Results**

Xiaoping Wu[1], J. Thomas Vaughan[1], Kamil Ugurbil[1], Pierre-Francois Van de Moortele[1]
[1]CMRR, University of Minnesota, Minneapolis, MN, United States

It has been shown that parallel transmission (pTx), which consists of playing different RF pulses through independent transmit (Tx) channels, can be used to mitigate Tx B1 (B1+) nonuniformity and to achieve more homogeneous spatially selective RF excitation at high magnetic field. We have previously reported a successful implementation of Transmit SENSE in the human brain at 9.4 T with an 8 Tx channel system, which required addressing methodological issues such as k-space trajectory inaccuracies and large susceptibility induced δB0. Recently, our 9.4T system has been upgraded with a 16 Tx channel console. Here we report preliminary results of 2D (Transmit SENSE) and 3D (Spoke trajectories) pTx in the human brain at 9.4 T using a 16-channel RF coil.

18:18 ***108***. **Self-Refocused Adiabatic Pulse for Spin Echo Imaging at 7T**

Priti Balchandani[1], John Pauly[2], Daniel Spielman[1]
[1]Radiology, Stanford University, Stanford, CA, United States; [2]Electrical Engineering, Stanford University, Stanford, CA, United States

Adiabatic 180° pulses may be used to replace conventional 180° pulses in spin echo sequences to provide greater immunity to the inhomogeneous B_1-field at 7T. However, because the spectral profile of an adiabatic 180° pulse has non-linear phase, pairs of these pulses are used for refocusing, resulting in increased SAR and longer minimum echo times. We have used the adiabatic SLR method to generate a matched-phase 90° for an adiabatic 180° pulse to obviate the need for a second 180° pulse. The pulse pair was combined into a single self-refocused pulse to achieve the minimum echo time, and phantom and *in vivo* experiments were performed to validate pulse performance.

Diffusion Studies of Brain Anatomy

Victoria Hall 16:30-18:30 *Moderators:* Alexander L. G. Leemans and Carlo Pierpaoli

16:30 ***109***. **In Vivo Measurement of Cortical Anisotropy by Diffusion-Weighted Imaging Correlates with Cortex Type**

Alfred Anwander[1], André Pampel[1], Thomas R. Knösche[1]
[1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

High resolution diffusion-weighted imaging in conjunction with highly sensitive phase array acquisition coils can identify different anisotropic orientation depending on the cortex type. Motor cortex shows radial anisotropy while primary somatosensory cortex shows tangential anisotropy. This might relate to a strong wiring between neighboring cortical areas.

16:42 ***110***. **Skeleton Thickness Biases Statistical Power in Skeleton-Based Analyses of Diffusion MRI Data**

Richard A E Edden[1,2], Derek K. Jones[3]
[1]Russell H Morgan Department of Radiology and Radiological Science, The Johns Hopkins University, Baltimore, MD, United States; [2]FM Kirby Research Center for Functional MRI, Kennedy Krieger Institute, Baltimore, MD, United States; [3]CUBRIC, School of Psychology,, Cardiff University, Cardiff, Wales, United Kingdom

DTI provides rotationally invariant information. Additionally, DTI acquisitions are optimised to ensure that data are statistically rotationally invariant so that parameter variance is independent of the orientation of the fibre population within the brain. Against this backdrop, we focus on skeletonization-based methods for group comparisons of DTI data and show that they can reintroduce rotational dependence. Specifically, the power to detect group differences in a fibre can depend on its orientation. While the cause/solution to this problem are trivial, the effect on statistical inference is not – and should be viewed in the light of the increasing popularity of skeletonization-based methods.

16:54 ***111***. **Sex-Linked White Matter Microstructure of the Social and the Analytic Brain**

Kun-Hsien Chou[1], I-Yun Chen[2], Chun-Wei Lan[3], Ya-Wei Cheng[2], Ching-Po Lin[2,3], Woei-Chyn Chu[1]
[1]Institute of Biomedical Engineering, National Yang-Ming University, Taipei, Taiwan; [2]Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan; [3]Institute of Biomedical imaging and Radiological Sciences, National Yang-Ming University, Taipei, Taiwan

Empathizing, driven by the social brain, means the capacity to predict and to respond to the behavior of agents by inferring their mental status with an appropriate emotion. Systemizing, based on the analytic brain, is the capacity to predict and to respond to the behavior of non-agentive deterministic systems by analyzing input-operation-output relations and inferring the rules of systems. However WM associated with the social and analytic brain as indicated by sex differences remains to be investigated. In this study, we demonstrated WM microstructures with sexual dimorphism, which may reflected the neural underpinning of the social and analytic brain.

17:06 ***112***. **Diffusion Tensor Imaging of Brain White Matter Changes Across the Lifespan**

Catherine Lebel[1], Myrlene Gee[1], Richard Camicioli[2], Marguerite Wieler[2], Wayne Martin[2], Christian Beaulieu[1]
[1]Biomedical Engineering, University of Alberta, Edmonton, Alberta, Canada; [2]Neurology, University of Alberta, Edmonton, Alberta, Canada

Lifespan studies of the normal human brain link the development processes of childhood with the degenerative processes of old age. Many diffusion tensor imaging (DTI) studies evaluate changes over narrow age ranges; few examine the lifespan. We used DTI to measure age-related changes in 12 white matter tracts in 392 healthy volunteers aged 5-83 years. Fractional anisotropy increased until adulthood, then decreased, while mean diffusivity followed an opposite trend. Trend reversals occurred between 18-43 years. Frontal-temporal connections demonstrated prolonged development and late reversals, while the fornix and corpus callosum develop earliest and have the most prolonged periods of decline.

17:18 ***113***. **Partial Volume Effect as a Hidden Covariate in Tractography Based Analyses of Fractional Anisotropy: Does Size Matter?**

Sjoerd B. Vos[1], Derek K. Jones[2], Max A. Viergever[1], Alexander Leemans[1]
[1]Image Sciences Institute, University Medical Center, Utrecht, Netherlands; [2]CUBRIC, School of Psychology, Cardiff University, Cardiff, United Kingdom

Diffusion tensor imaging has been used extensively to investigate brain aging. Fiber tractography has shown a relation between age and fractional anisotropy (FA) along fiber tracts. Partial volume effects are known to affect tractography, and may also influence FA calculations along tracts. In this study, simulations and experiments have been performed to test whether tract volume is a covariate in FA calculations. A strong correlation between tract volume and FA has been found in both the simulations and experiments, proving that partial volume effects affect FA calculations, and that size is indeed a hidden covariate in tractography based FA analyses.

17:30 ***114***. **Microstructural Correlations of White Matter Tracts in the Human Brain**

Michael Wahl[1], Yi-Ou Li[1], Joshua Ng[1], Sara C. LaHue[1], Shelly R. Cooper[1], Elliott H. Sherr[2], Pratik Mukherjee[1]
[1]Radiology, University of California, San Francisco, San Francisco, CA, United States; [2]Neurology, University of California, San Francisco, San Francisco, CA, United States

In this 3T DTI study of 44 normal adult volunteers, we use quantitative fiber tracking to demonstrate that specific patterns of microstructural correlation exist between white matter tracts and may reflect phylogenetic and functional similarities between tracts. Inter-tract correlation matrices computed from tract-based measures of fractional anisotropy (FA), mean diffusivity, axial diffusivity, and radial diffusivity, reveal that there are significant variations in correlations between tracts for each of these four DTI parameters. Data-driven hierarchical clustering of FA correlational distances show that neocortical association pathways grouped separately from limbic association pathways, and that projection pathways grouped separately from association pathways.

17:42 ***115***. **A Novel Clustering Algorithm for Application to Large Probabilistic Tractography Data Sets**

Robert Elton Smith[1,2], Jacques-Donald Tournier[1,2], Fernando Calamante[1,2], Alan Connelly[1,2]
[1]Brain Research Institute, Florey Neuroscience Institutes (Austin), Heidelberg West, Victoria, Australia; [2]Department of Medicine, The University of Melbourne, Melbourne, Victoria, Australia

Current clustering methodologies are not able to process very large data sets, such as those generated using probabilistic tractography. We propose a novel clustering algorithm designed specifically to handle a very large number of tracks, which is therefore ideally suited for processing whole-brain probabilistic tractography data. A hierarchical clustering stage identifies major white matter structures from the large number of smaller clusters generated. The method is demonstrated on a 1,000,000 track whole-brain in-vivo data set.

17:54 ***116***. **A Scalable Approach to Streamline Tractography Clustering**

Eelke Visser[1,2], Emil Nijhuis[1,3], Marcel P. Zwiers[1,2]
[1]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, Nijmegen, Netherlands; [2]Department of Psychiatry, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; [3]Department of Technical Medicine, University of Twente, Enschede, Netherlands

Finding clusters among the many streamlines produced by tractography algorithms can improve interpretability and can provide a starting point for further analysis. A problem with many clustering methods is their handling of large datasets. We propose to overcome this problem by repeatedly clustering complementary subselections of streamlines. The execution time of the algorithm scales linearly with the number of streamlines, while working memory usage remains constants. The method produces anatomically plausible and coherent clusters in a single subject. When applied to a large group dataset, results are similar and consistent across subjects.

18:06 ***117***. **Validation of DTI Measures of Primary Motor Area Cortical Connectivity**

Yurui Gao[1], Ann S. Choe[2], Xia Li[3], Iwona Stepniewska[4], Adam Anderson
[1]BME, VUIIS, Nashville, TN, United States; [2]BME, VUIIS, United States; [3]EECS, VUIIS, United States; [4]Psychological Sciences at Vanderbilt, United States

Since DTI tractography is used to examine the neural connectivity between specialized cortical regions of the brain, it is important to evaluate the agreement between the connectivity derived from DTI tractography and corresponding histological information. We reconstruct the projection regions connecting to the primary motor cortex (M1) of the squirrel monkey, based on histological segmentation and compare these regions with the locations of the terminals of DTI fibers penetrating the same M1 region. Quantitative comparison shows an approximate agreement but also limits of applying DTI tractography to predict M1 connectivity.

18:18 ***118***. **High Resolution Tractography in Macaque Visual System – Validation Against in Vivo Tracing**

Laura M. Parkes[1,2], Hamied A. Haroon[1,2], Mark Augarth[3], Nikos K. Logothetis, [2,3], Geoff JM Parker[1,2]
[1]School of Cancer and Imaging Sciences, University of Manchester, Manchester, United Kingdom; [2]Biomedical Imaging Institute, University of Manchester, Manchester, United Kingdom; [3]Max Planck Institute for Biological Cybernetics, Tubingen, Germany

The aim is to validate the connections identified with high angular resolution diffusion imaging in the post-mortem macaque visual system against true connections from the many detailed in vivo tracer studies. A probabilistic tractography approach is used, and comparisons are made between identified connections at different thresholds of connection strength, and the true connections. The accuracy of connections increases up until an acceptance threshold of 5%, beyond which accuracy is not greatly affected. 72% of connections were correctly identified at 5% threshold. The majority of false connections involved areas of higher level processing, particularly parietal and temporal regions.

Alternative fMRI Contrast Mechanisms

Room A4 16:30-18:30 *Moderators:* Jia-Hong Gao and Alan W. Song

16:30 ***119***. **Detection of an Earthworm Axon Current with Simultaneous MRS**

Alexander Poplawsky[1], Raymond Dingledine[2], Xiaoping Hu[3]
[1]Neuroscience, Emory University, Atlanta, GA, United States; [2]Pharmacology, Emory University, Atlanta, GA, United States; [3]Biomedical Engineering, Emory University and Georgia Institute of Technology, Atlanta, GA, United States

Direct detection of axonal neural magnetic fields (NMFs) by magnetic resonance imaging has met with conflicting evidence. The objective of this study is to demonstrate the temporal signature of axonal NMFs in the free induction decay (FID), which provides the temporal resolution required to capture an axonal event. Simultaneous electrophysiology is used to time-lock earthworm action potentials to FID acquisition. Our data demonstrates clear evidence of a phase change that temporally corresponds to the electrophysiologically recorded action potential and is consistent with theoretical predictions.

16:42 ***120***. **Imaging Functional Decrease of the Cerebrospinal Fluid Volume Fraction with a Spin-Locking FMRI Technique**

Tao Jin[1], Seong-Gi Kim[1]
[1]Department of Radiology, University of Pittsburgh, Pittsburgh, PA, United States

A voxel of magnetic resonance imaging often contains blood, tissue water, as well as the cerebrospinal fluid (CSF). Recent studies have suggested that brain vascular activation could induce a change in the volume fraction of the CSF compartment that serves as a buffer for the brain cortex. However, current detection of CSF volume fraction and its functional change requires multi-compartment data fitting. In this work we aimed to image the CSF compartment directly using a spin-locking technique at 9.4 T. With a long spin-locking preparation, the parenchyma signal can be suppressed and a functional decrease of CSF volume fraction can be robustly detected during cat visual stimulation.

16:54 ***121***. **Time-Course of δR_2 During Visual Stimulation and Hypercapnia Diffusion-Weighted FMRI Experiments**

Daigo Kuroiwa[1], Hiroshi Kawaguchi[1], Jeff Kershaw[1], Atsumichi Tachibana[1], Joonas Autio[1], Masaya Hirano[2], Ichio Aoki[1], Iwao Kanno[1], Takayuki Obata[1]
[1]Department of Biophysics, Molecular Imaging Center, National Institute of Radiological Sciences, Chiba, Japan; [2]Advanced Application Center, GE Healthcare Japan, Hino, Tokyo, Japan

It has been suggested that the BOLD effect contributes to heavily diffusion-weighted (DW) fMRI signal changes. The BOLD effect is usually interpreted as a change in transverse relaxation rate (δR_2). In this study, δR_2 during visual stimulation (VS) and hypercapnia (HC) DW fMRI experiments was estimated using a multiple spin-echo EPI acquisitions after motion-probing gradients. δR_2 showed dependence on b-value during VS, but not during HC. The results suggest that δR_2 at high b-value may demonstrate a higher sensitivity to neuronal activation than at lower b-values.

17:06 ***122***. **Inter-Areal and Inter-Individual Variations in Diffusion-Weighted FMRI Signal**

Toshihiko Aso[1], Shin-ichi Urayama[1], Hidenao Fukuyama[1], Denis Le Bihan, [12]
[1]Human Brain Research Center, Kyoto University Graduate School of Medicine, Kyoto, Japan; [2]CEA NeuroSpin, Gif-sur-yvette, France

Neuronal activation can be detected with heavily sensitized diffusion-fMRI (DfMRI). The striking temporal precedence of the diffusion response to BOLD in the visual cortex suggests a non-vascular source. A visual working memory task was implemented to investigate DfMRI responses outside visual cortex. We found very similar response patterns between well separated cortices showing temporal precedence over BOLD, while large individual variations were observed with BOLD responses. Discrepancies between DfMRI and BOLD responses were also observed, such as negative BOLD signals accompanying positive DfMRI responses supporting the assumption that the DfMRI and BOLD responses have different origins.

17:18 ***123***. **Exploring the Reproducibility and Consistency of Diffusion-Weighted Functional Magnetic Resonance Imaging During Visual Stimulation Using Population-Based Activation Map**

Ruiwang Huang[1], Bida Zhang[2]
[1]State Key Lab of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing , 100875, China; [2]Siemens Mindit Magnetic Resonance, Siemens Healthcare MR Collaboration NE Asia,

Human brain functional studies have been generally performed with BOLD-fMRI, but the spatial location and distribution of the activation map is not accurate. Recently, it has been suggested that the diffusion-weighted functional magnetic resonance imaging (dFMRI) may be sensitive to the true neuronal activation. However, the influence of b-value on the activation region is not fully understood. Here we performed a visual stimulation study on twelve subjects with dFMRI (b-value=50/400/800/1200/1600s/mm2) and BOLD-fMRI, and constructed the population-based activation maps. The locations and distributions of dFMRI and BOLD-fMRI measurements were compared, and the consistency of dFMRI study was evaluated.

17:30 ***124***. **fMRI Using a Hyperpolarized Tracer Molecule**

Ute Goerke[1], Malgorzata Marjanska[1], Manda Vollmers[1], Isabelle Iltis[1], Pierre-Gilles Henry[1], Kamil Ugurbil[1]
[1]Radiology, Center for Magnetic Resonance Research, Minneapolis, MN, United States

For the first time, fMRI utilizing a hyperpolarized tracer ^{13}C-labeled urea was performed. Since urea does not cross the blood-brain barrier, it is an ideal marker for perfusion changes caused by neuronal activity. The presented results were obtained in rats with forepaw stimulation. Despite the extremely low tracer concentration in the blood in gray matter, focal activated regions were robustly detected in all ^{13}C fMRI experiments.

17:42 ***125***. **Neurovascular Coupling Relationship Between Spontaneous EEG and CBF Responses Is Sensitive to Anesthesia Depth**

Xiao Liu[1,2], Xiao-Hong Zhu[1], Yi Zhang[1], Wei Chen[1,2]
[1]CMRR, radiology, University of Minnesota, Minneapolis, MN, United States; [2]Biomedical Engineering, University of Minnesota, Minneapolis, MN, United States

In this study, hemodynamic response function (HRF) was estimated by "deconvolution" to describe the neurovascular coupling between spontaneous CBF and EEG signals in the rat brain acquired simultaneously under two anesthesia depths (1.8 and 2.0% isoflurane). We found that a small change in anesthesia depth by increasing 0.2% isoflurane could significantly alter HRF in two aspects: lengthening latency-to-peak and broadening dispersion. This result indicates that the neurovascular coupling quantified by HRF is sensitive to anesthesia depth and this phenomenon should have implication in quantifying the resting brain connectivity and stimulus-evoked BOLD in the anesthetized brains and understanding their underlying neurophysiology basis.

17:54 ***126***. **Behavioural Correlate of GABA Concentration in Visual Cortex**

Richard A. E. Edden[1,2], Suresh D. Muthukumaraswamy[3], Tom Freeman, Krish D. Singh[3]
[1]Russell H Morgan Department of Radiology and Radiological Sciences, The Johns Hopkins University, Baltimore, MD, United States; [2]FM Kirby Center for Functional fMRI, Kennedy Krieger Institute, Baltimore, MD, United States; [3]CUBRIC, School of Psychology, Cardiff University, United Kingdom

Edited MRS measurements of GABA concentration in visual cortex have recently been shown to correlate with functional metrics: the frequency of gamma ocillations, as measured by MEG; and BOLD signal change in fMRI. This study investigates whether these individual differences have behavioural consequences, using a psychophysical paradigm to measure orientation discrimination thresholds. Orientation discrimination has long been associated with GABAergic neurotransmission at a cellular level; we are able to draw a similar link at the level of individual performance differences.

18:06 ***127***. **Cortical Hemodynamics and GABAergic Inhibition. Resting GABA Levels in Human Visual Cortex Correlate with BOLD, ASL-Measured CBF and VASO-Measured CBV Reactivity**

Manus Joseph Donahue[1,2], Jamie Near[1,2], Peter Jezzard[1,2]
[1]Clinical Neurology, Oxford University, Oxford, United Kingdom; [2]Physics Division, FMRIB Centre, Oxford, United Kingdom

Neurovascular coupling between neuronal activity, energy metabolism and cerebral blood flow (CBF) is supported by synaptic excitation and inhibition. We show inverse correlations between synaptic inhibition (GABA concentration) and BOLD (R=0.68) and cerebral blood volume (CBV)-weighted VASO reactivity (R=0.75) in human visual cortex. A negative correlation between baseline GABA and baseline CBV (R=0.75) is found; however, a positive relationship between GABA and ASL reactivity (R=0.38) and baseline CBF (R=0.67) is found, which we attribute to blood velocity discrepancies. Results provide information on the relationship between cortical activity, GABAergic inhibition, and multimodal fMRI contrast. First two authors are equal contributors.

18:18 ***128***. **Hemodynamic and Metabolic Response to Hypoxia**

Ashley D. Harris[1], Richard A. E. Edden[2,3], Kevin Murphy[1], C John Evans[1], Chen Y. Poon[4], Neeraj Saxena[5], Judith Hall[5], Thomas T. Liu[6], Damian M. Bailey[7], Richard G. Wise[1]
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MR spectroscopy to examine lactate and ASL perfusion imaging are used to study the response to 12% hypoxia in healthy subjects. Lactate and cerebral blood flow increased during hypoxia. Both lactate and blood flow are negatively related to oxygen saturation. The relationship between increased perfusion and lactate accumulation appears to be more complex; however, by understanding these relationships, we may gain insight into cerebral pathologies and conditions that result in hypoxemia.

Imaging of Metal & Ultrashort T2 Species

Room A5 16:30-18:30 *Moderators:* Jiang Du and Brian A. Hargreaves

16:30 ***129***. **MR Imaging Near Orthopedic Implants with Artifact Reduction Using View-Angle Tilting and Off-Resonance Suppression**

Clemens Bos[1], Chiel J. den Harder[2], Gert van Yperen[2]
[1]MR Clinical Science, Philips Healthcare, Best, Netherlands; [2]MR CTO, Philips Healthcare, Best, Netherlands

Metal orthopaedic implants are known to cause substantial artifacts in MR imaging of joints, such as slice distortions and displacements of signal in the readout direction. View angle tilting aims to correct for the displacements in readout direction. Off-resonance suppression is proposed as an extension to view angle tilting. Using different slice selection gradients during excitation and refocusing limits the spectral and spatial range from which undesired signal

may originate. This combination of techniques has no inherent imaging time penalty and was demonstrated to reduce metal artifacts, both in vitro and in vivo.

16:42 ***130***. **SEMAC and MAVRIC for Artifact-Corrected MR Imaging Around Metal in the Knee**

Christina A. Chen[1], Weitian Chen[2], Stuart B. Goodman[1], Brian A. Hargreaves[1], Kevin M. Koch[3], Wenmiao Lu[1], Anja C. Brau[2], Christie E. Draper[1], Scott L. Delp[1], Garry E. Gold[1]

[1]Stanford University, Stanford, CA, United States; [2]GE Healthcare Applied Science Lab, Menlo Park, CA, United States; [3]GE Healthcare Applied Science Lab, Milwaukee, WI, United States

We have developed 2 three-dimensional MRI prototypes that correct for metal-induced artifacts, Slice Encoding for Metal Artifact Correction (SEMAC) and Multi-Acquisition Variable-Resonance Image Combination (MAVRIC). In 10 knees with metallic total knee replacements (TKR) scanned at 1.5T, SEMAC and MAVRIC both had significantly less artifact than conventional two-dimensional fast spin echo (FSE). In a model of the knee fitted to a TKR of known dimensions, SEMAC and MAVRIC had much smaller percent deviations from actual component dimensions than FSE, indicating their accuracy in measuring geometry in the presence of metal. MAVRIC and SEMAC are promising MR imaging techniques that may allow for improved musculoskeletal follow-up imaging of metallic implants and soft tissue structures surrounding metal in the knee.

16:54 ***131***. **Magnetic Resonance Imaging of Periprosthetic Tissues in the Presence of Joint Arthroplasty**

Matthew F. Koff[1], Kevin M. Koch[2], Hollis G. Potter[1]

[1]Department of Radiology and Imaging, Hospital for Special Surgery, New York, United States; [2]General Electric Healthcare, Waukesha, WI, United States

Significant in-plane and through-plane susceptibility artifacts occur when performing MRI around orthopedic hardware. This study evaluated standard of care 2D FSE imaging with the multi-acquisition variable-resonance image combination (MAVRIC) technique. Volunteers with joint replacements (hip, shoulder, or knee) were scanned using a 2D FSE sequence optimized for imaging around arthroplasty and a MAVRIC sequence. MAVRIC scans were effective in reducing the metal susceptibility artifact for all joints and also better highlighted the extent of osteolysis. Higher resolution FSE images were effective for detection of formation of fibrous membrane around arthroplasties. This study further supports the use of MAVRIC for clinical implementation.

17:06 ***132***. **Imaging of Metallic Implant Using 3D Ultrashort Echo Time (3D UTE) Pulse Sequence**

Jiang Du[1], Kelly Borden[1], Eric Diaz[1], Mark Bydder[1], Won Bae[1], Shantanu Patil[2], Graeme Bydder[1], Christine Chung[1]

[1]Radiology, University of California, San Diego, CA, United States; [2]Shiley Center for Orthopedic Research and Education, La Jolla, CA, United States

Magnetic resonance imaging (MRI) near metal implants suffers from severe artifacts due to large metal-induced field inhomogeneities. The steep field gradients near metal implants result in increased intra-voxel dephasing and a much shortened T2*. Clinical gradient echo (GE) sequences suffer from large signal loss. Spin echo (SE) type sequences only partly refocus the dephased spins, resulting in spatially dependent signal voids and pile-ups. Here we present a 3D ultrashort TE (UTE) sequence which employs short hard pulse excitation and 3D radial sampling with a nominal TE of 8 µs to image metallic implants with markedly reduced artifact.

17:18 ***133***. **kf ARC Reconstruction for Improving MRI Around Metal Using MAVRIC**

Peng Lai[1], Weitian Chen[1], Christina Chen[2], Kevin M. Koch[3], Anja CS. Brau[1]

[1]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [2]Stanford University, Stanford, CA, United States; [3]Applied Science Laboratory, GE Healthcare, Waukesha, WI, United States

This work developed a new method, kf ARC, for highly accelerated MAVRIC imaging around metal implants. The proposed method utilizes both k-space correlation and spectral correlation between adjacent spectral images to improve reconstruction. kf ARC was evaluated on 2 patients with metallic implants in comparison with conventional parallel imaging. Our results show that kf ARC can significantly improve image quality at high acceleration factors and is a promising approach to fast MAVRIC data acquisition.

17:30 ***134***. **Morphological and Quantitative Evaluation of Meniscal Calcifications by Novel 2D IR and 3D UTE MR Techniques**

Patrick Omoumi[1,2], Eric S. Diaz[1], Jiang Du[1], Sheronda S. Statum[1], Won C. Bae[1], Graeme Bydder[1], Christine B. Chung[1]

[1]University of California, San Diego, San Diego, CA, United States; [2]Cliniques Universitaire St Luc, Brussels, Belgium

Meniscal calcifications are frequent and likely alter the normal biomechanics of the meniscus. Although MR imaging is the non-invasive technique of choice for the evaluation of meniscal pathology, it does not allow the facile visualization of meniscal calcifications. This is due to a lack of contrast (both calcifications and menisci have relatively short T2 relaxation times), and a lack of saptial résolution with standard clinical sequences. We describe novel MR imaging techniques based on 2D-UTE inversion recovery and 3D-UTE data acquisition to address these factors. We assessed the ability of these sequences to allow the visualization, characterization and quantitative evaluation of meniscal calcifications.

17:42 ***135***. **Fiber Tracking of Dipolar Directions in the Meniscus**

Nikolaus M. Szeverenyi[1], Graeme M. Bydder[1]

[1]Radiology, University of California, San Diego, San Diego, CA, United States

This study examines a method to extract and use dipolar information to characterize an ex-vivo meniscus sample. A goat meniscus was embedded in a spherical epoxy ball and the MR signal intensity examined as a function of orientation to a 3T static field. Unaveraged dipolar interactions caused dramatic signal variations in sub-structures. After correcting for coil sensitivity and co-registering all images, a principle dipolar direction was extracted for each voxel. This directional data could be analyzed and viewed as a direction map, similar to DTI brain data. The intensity fluctuations provided a FA map. Fiber tracks were generated.

17:54 ***136***. **Ultrashort Echo Imaging (UTE) of Rotator Cuff Repair in an Ovine Model**

Matthew F. Koff[1], Hollis G. Potter[1]
[1]Department of Radiology and Imaging, Hospital for Special Surgery, New York, United States

The rotator cuff tendons typically display low signal on standard clinical images due to the highly ordered collagen within the tissue. Ultrashort echo (UTE) imaging creates contrast for visualization and for T2* quantitation. This study used T2* mapping to evaluate rotator cuff repair in an ovine model. Reparative surgery was performed to the supraspinatus tendon in sheep. Shoulders were scanned ex-vivo 8 weeks post-operatively. T2* values of repaired tendon were significantly longer than normal tendon. The T2* values decreased in magnitude along the length of the repair, but not significantly. This pilot study highlights the use of UTE for quantitative evaluation of soft tissue repair.

18:06 ***137***. **Detection of Dipolar Splitting in Rodent Tendons as a Function Axial Position with Double-Quantum Filtered Spectroscopic Imaging**

Henry H. Ong[1], Joseph J. Sarver[2], Jason E. Hsu[2], Louis J. Soslowsky[2], Felix W. Wehrli[1]
[1]Laboratory for Structural NMR Imaging, Department of Radiology, University of Pennsylvania School of Medicine, Philadelphia, PA, United States; [2]McKay Orthopaedic Research Laboratory, University of Pennsylvania, Philadelphia, PA, United States

Tendons are comprised of parallel collagen fibers that connect muscles to bone. Collagen-associated water has anisotropic rotational motion, which gives rise to residual dipolar splitting in 1H NMR. Double-quantum filtered (DQF) NMR and MRI can be used to observe the splitting and study the biophysical and structural properties of tendon. Here, we modified a DQF 1D spectroscopic imaging sequence to obtain 1H DQF spectra along the axis of the flexor digitorum profundus (FDP) tendons from rat hind limbs and show spectral differences in the region that wraps under the calcaneus, which experiences compressive forces.

18:18 ***138***. **Magnetization Transfer (MT) Segmentation of Foot Peripheral Nerves at 3 T.**

Giulio Gambarota[1], Bénédicte Mortamet[2], Nicolas Chevrey[3], Cristina Granziera[4], Gunnar Krueger[2], Nicolas Theumann[3], Ralf Mekle[3]
[1]GlaxoSmithKline Clinical Imaging Center, London, United Kingdom; [2]Healthcare Sector IM&WS S, Siemens Schweiz AG, Renens, Switzerland; [3]Radiology, University of Lausanne, Lausanne, Switzerland; [4]Neurology, Geneva University Hospital, Geneva, Switzerland

The ability of tracking peripheral nerves in foot could be of great benefit for a number of investigations, which include traumas, diabetes and infections. Previous approaches to nerve tracking have employed diffusion tensor imaging DTI. One limitation of DTI is the low signal-to-noise ratio due to short T2 (~30ms at 3T) of water protons in nerves. Here, we propose a novel approach to nerve tracking, which exploits the difference in MT ratio between muscle and foot nerves.

Artifacts & Correction: Non-Motion

Room A6 16:30-18:30 *Moderators:* Eric B. Beall and Bruno Madore

16:30 ***139***. **Z-Selective Multi-Spectral 3D Imaging: A MAVRIC-SEMAC Hybrid**

Kevin M. Koch[1], Kevin F. King[1], Brian A. Hargreaves[2], Graeme C. McKinnon[1]
[1]Applied Science Laboratory, GE Healthcare, Waukesha, WI, United States; [2]Department of Radiology, Stanford University, Palo Alto, CA, United States

Both the MAVRIC and SEMAC methods have been shown capable of significantly reducing susceptibility artifacts near metallic implants. Here, we demonstrate that advantageous features of both methods can be utilized in combination. In particular, the z-selectivity of the SEMAC can be interfaced with the encoding mechanisms and spectral overlap utilized by MAVRIC. In doing so, a technique that offers increased volume selectivity while maintaining smooth spectral image combinations is demonstrated. Demonstrations of this hybrid approach on phantom and in-vivo implant scenarios are presented.

16:42 ***140***. **Dipole-Based Filtering for Improved Removal of Background Field Effects from 3D Phase Data**

Samuel James Wharton[1], Richard Bowtell[1]
[1]Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, Nottingham, United Kingdom

A robust method for filtering 3D phase data dominated by rapidly spatially varying externally generated fields is presented. One or more dipole point sources situated outside of the region of interest are used to model and remove the unwanted background fields caused by remote tissue/air interfaces such as those that are present in the sinuses. The method was tested on simulated and experimentally acquired phase data and compared to other commonly used filtering methods, including Fourier filtering and polynomial fitting. The results show that the dipole-based filter outperformed the other methods in removing unwanted fields and preserving image contrast.

16:54 ***141***. **Improved Background Field Correction Using Effective Dipole Fitting**

Tian Liu[1], Ildar Khalidov[2], Ludovic de Rochefort[3], Pascal Spincemaille[2], Jing Liu[2], Yi Wang[1]
[1]Biomedical Engineering, Cornell University, New York, NY, United States; [2]Radiology, Weill Cornell Medical College, New York, NY, United States; [3]MIRCen, I2BM, DSV, CEA, Fontenay-aux-Roses, France

Effective dipole fitting removes susceptibility induced global background field. It assumes that each independent voxel outside a given region of interest (ROI) are responsible for the background field inside that ROI. It removes the field generated by these sources, while preserving the field arising from local susceptibility variations inside the ROI.

17:06 ***142***. **A Novel Approach for Separation of Background Phase in SWI Phase Data Utilizing the Harmonic Function Mean Value Property**

Ferdinand Schweser[1], Berengar Wendel Lehr[2], Andreas Deistung[2], Jürgen Rainer Reichenbach[2]
[1]Medical Physics Group, Department of Diagnostic and Interventional Radiology , Jena University Hospital, Jena, Germany; [2]Medical Physics Group, Department of Diagnostic and Interventional Radiology, Jena University Hospital, Jena, Germany

In this contribution, we present, for the first time, a non-heuristic, parameter-free approach for high-precision separation of local phase and background phase contributions for in vivo SWI-data.

17:18 ***143***. **Analysis of Quadratic Field Distortions Using the Fractional Fourier Transform**

Carlos Sing-Long[1,2], Vicente Parot[1,2], Carlos Lizama[3], Sergio Uribe, [2,4], Cristian Tejos[1,2], Pablo Irarrazaval[1,2]
[1]Department of Electrical Engineering, Pontificia Universidad Catolica de Chile, Santiago, Chile; [2]Biomedical Imaging Center, Pontificia Universidad Catolica de Chile, Santiago, Chile; [3]Department of Mathematics and Computer Science, Universidad de Santiago de Chile, Santiago, Chile; [4]Department of Radiology, Pontificia Universidad Catolica de Chile, Santiago, Chile

In Magnetic Resonance Imaging (MRI) the distortions produced by field inhomogeneities can be corrected with post processing techniques, e.g. linear correction and conjugate phase reconstruction methods. However, these methods do not provide a theoretical framework to analyze the distortions. In this work, we propose the Fractional Fourier Transform (FrFT) as a way to study the distortions produced by quadratic field inhomogeneities. We analyze some commonly used sequences to exemplify the usefulness of this method. We also show how this analysis can be used to reconstruct artifact-free images obtained from non homogeneous fields.

17:30 ***144***. **Generalized Non-Linear SENSE Shimming**

Daniel Nicolas Splitthoff[1], Maxim Zaitsev[1]
[1]Dept. of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany

With the SENSE Shimming (SSH) approach a method was introduced recently that allows for estimating B0 field inhomogeneities based on a reference image and a series of points on a single free induction decay (FID). In the original approach the temporal evolution of the FID data is explained by field inhomogeneities, using linear approximations. Effects caused by relaxation and those caused by inhomogeneities can therefore not be distinguished and values can only be given relative to a baseline measurement. We here present an extension to the method, which takes into account a larger range of the FID in order to explain not only B0 inhomogeneities but relaxation as well and which therefore allows for accurate field map estimation based on a reference image and a single FID. Since the signal equation is non-linear, the linear fitting of the original approach has to be replaced by a non-linear optimization. The feasibility of the method is shown on in vivo data.

17:42 ***145***. **On the Feasibility of Single-Shot EPI During Higher-Order Shim Settling**

Signe Johanna Vannesjö[1], Lars Kasper[1], Matteo Pavan[1], Christoph Barmet[1], Klaas Paul Pruessmann[1]
[1]Institute for Biomedical Engineering, ETH and University Zürich, Zürich, Switzerland

Susceptibility artefacts is a major problem in MRI, becoming more severe with higher field strengths and longer read-out trajectories. Updating the shim settings between acquisition of different slices allows for optimizing the shims to smaller subvolumes, but puts high requirements on the timing characteristics of the shim switching. Here the settling dynamics of the higher order shims were measured using a 3rd order dynamic field camera. Long-living (seconds) eddy currents were found, which had a significant effect on image quality. Based on measured k-space trajectories, it was possible to reconstruct phantom images acquired during eddy current settling.

17:54 ***146***. **Increasing Spoiling Efficiency in RF-Spoiled Gradient Echo Sequences by Averaging of Phase-Cycle Adapted K-Spaces**

Jochen Leupold[1], Jürgen Hennig[1]
[1]Dept. of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany

RF-spoiled gradient echo sequences (FLASH, SPGR, T1-FFE) require a spoiler gradient in order to suppress ghost artefacts. Here we show that two k-spaces can be adapted to the RF phase cycle such that averaging of them leads to elimination of these artefacts even if the spoiler gradient has only half of the moment that is requried for common RF-spoiled gradient echo acquisition.

18:06 ***147***. **Transient RF Spoiling for 3D Look-Locker Acquisitions**

Trevor Wade[1,2], Charles McKenzie[1,3], Brian Rutt[4]
[1]Imaging Research Laboratories, Robarts Research Institute, London, ON, Canada; [2]Biomedical Engineering, The University of Western Ontario, London, ON, Canada; [3]Medical Biophysics, The University of Western Ontario, London, ON, Canada; [4]Diagnostic Radiology and Richard M Lucas Center for Imaging, Stanford University, Stanford, CA, United States

Theoretical and experimental investigation of RF spoiling in the special case of accelerated 3D Look-Locker imaging has led to an improved value for the phase increment used in the standard RF spoiling scheme. Poor choice of phase increment leads to an inversion recovery curve that deviates significantly from the theoretical ideal, leading to an inaccurate estimate of the recovery time constant. Simulations were used to determine improved values for the phase increment based on minimizing summed squared differences, or time constant measurement accuracy. These were tested experimentally and found to be superior to previously reported values for most imaging parameters.

18:18 ***148***. **Parallel Imaging for Efficient Spike Noise Detection and Correction**

Feng Huang[1], Wei Lin[1], Yu Li[1], Arne Reykowski[1]
[1]Invivo Corporation, Gainesville, FL, United States

Spike noise is a term used to describe broadband electrical interference in an MRI system. The result of spike noise can be seen in k-space as a bright dot, which will translate into some type of striping in the final image. Usually, the scan has to be repeated if random spike occurs. A parallel imaging based method, COnvolution and Combination OperAtion (COCOA), has been proposed for non-rigid motion compensation. In this work, it is shown that COCOA can be used to robustly detect and correct random spikes in an efficient way. Hence repeated scan can be avoided.

Tumor Therapy Response

Room A7 16:30-18:30 *Moderators:* Dmitri Artemov and James O'Connor

16:30 ***149***. **Dynamic Contrast-Enhanced Magnetic Resonance Imaging for Early Therapy Evaluation of Combined Anti-EGFR Antibody and Irinotecan in Orthotopic Pancreatic Tumor Xenografts**

Hyunki Kim[1], Karri Folks[1], Lingling Guo[2], Jeffery Sellers[3], Naomi Fineberg[4], Cecil Stockard[3], William Grizzle[5], Donald Buchsbaum[6], Desiree Morgan[1], James George[2], Kurt Zinn[1]

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This study evaluated DCE-MRI as an early prognostic tool for effective anti-EGFR therapy with/without concurrent chemotherapy in an orthotopic pancreatic-cancer murine model, and developed a novel timing-independent DCE-MRI biomarker for early therapy assessment, based on characterization of non-linear tumor response observed during serial imaging.

16:42 ***150***. **Bortezomib Treatment Reduces Tumor Blood Flow and Perfusion as Measured by Dynamic Contrast-Enhanced ^{1}H MRI**

Ellen Ackerstaff[1], Xiaorong Sun[1,2], Mihai Coman (Deceased)[1], Ya Wang[1], Hung Tsung Hsiao[1], Fuqiu He[1], Ligang Xing[1,2], Sean Carlin[1], C Clifton Ling[1], Jason A. Koutcher[1], Gloria C. Li[1]

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The proteasomes inhibitor Bortezomib possesses anti-angiogenic and anti-tumor properties and appears to selectively interfere in the hypoxia pathway. Our study aims to determine biomarkers characterizing treatment response. We studied in a colorectal cancer model the effects of Bortezomib on the tumor vasculature by in vivo DCE MRI and on the tumor hypoxia response ex vivo using immunohistochemistry. Our data suggest that Bortezomib treatment modifies the tumor microenvironment by decreasing tumor perfusion. Our ex vivo data indicate a reduced hypoxia response in central regions of the tumor and an increased hypoxia response in the tumor rim in response to Bortezomib treatment.

16:54 ***151***. **Evaluation of the Relationship Between lSO_2 MR Measurement and Hypoxia : Impact of an Antiangiogenic Treatment on a Gliosarcoma Model**

Benjamin Lemasson[1], Thomas Christen[1,2], Raphaël Serduc[3], Cecile Maisin[1], Audrey Bouchet[3], Christopoh Segebarth[1], Géraldine Le Duc[3], Chantal Rémy[1], Emmanuel Louis Barbier[1]

[1]Inersm U836, Grenoble, France; [2]Université Joseph Fourier, Grenoble Institut des Neurosciences, Grenoble, France; [3]ESRF, Grenoble, France

Despite a highly vascular phenotype, most glioblastomas cells are in hypoxia. Monitoring of hypoxia could be useful for monitoring the effectiveness of anti-tumor therapies. In this study, we evaluate (i) the relationship between the oxygenation (lSO_2) estimated by MRI and tissue hypoxia estimated by immunohistology and (ii) the impact of an antiangiogenic (Sorafenib) treatment on the vasculature (Blood volume fraction; BVf) and the lSO_2 of gliosarcoma model (9L). lSO_2 estimate by MRI was correlated to tumor hypoxia observed by immunohistochimistry. Results of this study also suggest that lSO_2 could be a sensitive reporter of the hypoxic effects of antiangiogenic therapies.

17:06 ***152***. **Chronic Dosing with MLN0518 (Tandutinib), a Small Molecule PDGFRα/β Inhibitor, Reduces Tumour Growth, Hypoxia, and Perfusion in C6 Glioma Xenografts: An Investigation Using Susceptibility Contrast Enhanced MRI and Immunohistochemical Methods**

Jessica Katherine Rowena Boult[1], Simon Walker-Samuel[1], Daniel P. Bradley[2], Simon P. Robinson[1]

[1]CRUK and EPSRC Cancer Imaging Centre, The Institute of Cancer Research and Royal Marsden NHS Trust, Sutton, Surrey, United Kingdom; [2]Imaging Sciences Group, Millennium: The Takeda Oncology Company, Cambridge, MA, United States

In this study, susceptibility MRI with ultra-small paramagnetic iron oxide (USPIO) and immunohistochemical methods were used to evaluate vascular and hypoxic response of C6 glioma xenografts to chronic treatment with MLN0518, a small molecule PDGFRα/β inhibitor. MLN0518 chronically limits the growth of C6 xenografts and reduces both the mean perfused vessel fraction and hypoxic area. No significant alteration in VSI, fractional blood volume or ADC were observed by MRI following 10 days treatment. These results are consistent with histological vessel measurements and quantification of necrosis, neither of which altered at this timepoint.

17:18 ***153***. **DCE-MRI as a Predictor of Outcome in Head and Neck Squamous Cell Carcinoma Patients with Nodal Metastases**

A. Shukla-Dave[1], N. Y. Lee[1], J. F. Jansen[1], H. T. Thaler[1], H. E. Stambuk[1], M. G. Fury[1], E. Sherman[1], S. Karimi[1], Y. Wang[1], D. Kraus[1], S. G. Patel[1], J. P. Shah[1], D. G. Pfister[1], J. A. Koutcher[1]

[1]Memorial Sloan-Kettering Cancer Center, New York, NY, United States

Currently one of the greatest challenges in the management of head and neck squamous cell carcinoma (HNSCC) is to identify and select prior to therapy, patients who are likely to fail the chosen treatment, for consideration of alternative risk adjusted therapies. The present study assesses whether pretreatment DCE-MRI parameters can reliably predict outcome in HNSCC patients with nodal metastases. DCE-MRI was performed in 74 patients studied prior to chemotherapy and radiation therapy (n=61) or surgery (n=13). The results suggest that skewness of Ktrans was the strongest predictor of outcome in HNSCC patients with stage IV disease.

17:30 ***154***. **Diffusion-Weighted Imaging of Ovarian-Related Peritoneal Carcinomatosis: Assessment of Chemotherapy Response in Relation to Anatomical Site**

Stavroula Kyriazi[1,2], David J. Collins[1], Veronica A. Morgan[2], Sharon L. Giles[2], Nandita M. deSouza[1,2]
[1]CR-UK and EPSRC Cancer Imaging Centre, Institute of Cancer Research, Sutton, Surrey, United Kingdom; [2]Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom

Conventional biochemical and morphological criteria of chemotherapy efficacy in metastatic ovarian cancer are not sensitive in the early course of treatment and fail to reflect the frequently seen intra-patient differential response according to anatomical site of disease. The present study examines the value of Diffusion-Weighted Imaging in the early assessment of site-specific (peritoneal vs omental) chemotherapy response in ovarian-related carcinomatosis.

17:54 ***155***. **Intrinsic Susceptibility-Weighted MRI to Assess the Response of Combretastatin-A4-Phosphate During Radiotherapy for Prostate Cancer**

Roberto Alonzi[1], Peter J. Hoskin[1], N Jane Taylor[2], Quan S. Ng[1], Henry Mandeville[1], Uma Patel[1], J James Stirling[2], James A. d'Arcy[3], David J. Collins[3], Martin O. Leach[3], Anwar R. Padhani[2]
[1]Marie Curie Research Wing, Mount Vernon Cancer Centre, Northwood, London, United Kingdom; [2]Paul Strickland Scanner Centre, Mount Vernon Cancer Centre, Northwood, London, United Kingdom; [3]CRUK-EPSRC Cancer Imaging Centre, Institute of Cancer Research & Royal Marsden Hospital, Sutton, Surrey, United Kingdom

Radiotherapy may be delivered in combination with vascular targeting agents. The performance of imaging biomarkers for response assessment may be compromised by the differing or conflicting effects between drug and radiation on tumor tissues. Previous studies have shown that DCE-MRI only partially describes the vascular changes in this setting. This study has evaluated the ability for Intrinsic Susceptibility-Weighted MRI to assess the response of Combretastatin-A4-Phosphate during radiotherapy for prostate cancer. We conclude that R2* has the potential to be an alternative, clinically useable, response biomarker for assessment of vascular disruptive therapy in combination with radiotherapy in prostate cancer.

18:00 ***155.5*** **ADC Changes with Time in Focal and Diffuse Myleoma Bone Disease as Indicators Of Disease Response and Progression**

C. Messiou[1], D. Collins[1], V. Morgan1, S. Giles[1], C. Parry-Jones[1], F. Davies[2], G. Morgan[3], and N. deSouza[1]
[1]CRUK and EPSRC Cancer Imaging Centre,Department of Magnetic Resonace Imaging, Institute of Cancer Research/The Royal Marsden Hospital, Sutton, Surrey, United Kingdom, [2]Myeloma Target Treatment Team, Institute of Cancer Research/The Royal Marsden Hospital, Sutton, Surrey, United Kingdom, [3]Leukaemia and Molecular Genetics Team, Institute of Cancer Research/The Royal Marsden Hospital, Sutton, Surrey, United Kingdom

The predominance of fat in adult marrow demands a systematic approach to interpretation of diffusion weighted (DW) magnetic resonance imaging (MRI) in bone. In marrow disease return of normal fatty marrow following treatment results in increased restriction of water diffusion1 and leads to an ADC fall. Focal necrosis however results in a conflicting ADC rise. This study examines the time course of ADC changes in bone with treatment comparing progressors and responders in order to establish changes associated with response on DW MRI.

18:06 ***156***. **Dynamic Contrast-Enhanced Magnetic Resonance for the Monitoring of Neoadjuvant Chemoradiation Therapy in Rectal Adenocarcinoma: Initial Experience with 20 Patients**

Giuseppe Petralia[1], Gloria Castellazzi[2], Paul Summers[1], Roberto Di Filippi[1], Moreno Pasin[2], Maria Giulia Zampino[3], Maria Cristina Leonardi[4], Antonio Chiappa[5], Stefano Viotti[1], Luke Bonello[1], Massimo Bellomi[1]
[1]Radiology, Istituto Europeo di Oncologia, Milan, Lombardia, Italy; [2]Struttura Complessa di Radiologia/Diagnostica per immagini, Istituto Neurologico IRCCS- Fondazione Casimiro Mondino, Pavia, Lombardia, Italy; [3]Medical Care Unit, Department of Medicine, Istituto Europeo di Oncologia, Milan, Lombardia, Italy; [4]Radiotherapy, Istituto Europeo di Oncologia, Milan, Lombardia, Italy; [5]General and Laparoscopic Surgery, Istituto Europeo di Oncologia, Milan, Lombardia, Italy

We prospectively monitored changes in contrast agent pharmacokinetics values in advanced rectal adenocarcinoma over the course of neoadjuvant chemoradiation (NACR) therapy using dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) and evaluated whether DCE-MRI findings correlated with response to NACR in 20 patients. ANOVA revealed no inter-group differences (complete responders, non responders, local downstaging) for **mean** pre- and post-therapy values, and no changes in values during therapy. T-tests showed significant differences in post-therapy **median** Ktrans and IAUC60 and in fractional change of Kep between complete and non-responsive groups. Median values of Ktrans and Kep significantly decreased, whilst Ve significantly increased post-therapy.

18:18 ***157***. **Vascular Effects of the Vascular Targeting Agent NGR-HTNF in Patients with Advanced Solid Cancer: A Dynamic Contrast Enhanced Magnetic Resonance Imaging (DCE-MRI) Study**

Ingrid Desar[1], Carla M.L. van Herpen[1], J. J.A. van Asten[2], W. Fiedler[3], A.S. Govaerts[4], J. N.H. Timmer-Bonte[1], E. G.W. ter Voert[2], Antonio Lambiase[5], C. Bordignon[5], A. Heerschap[2], H. W.M. van Laarhoven[1]
[1]Medical Oncology, Radboud University Nijmegen Medical Center, Nijmegen, Netherlands; [2]Radiology, Radboud University Nijmegen Medical Center, Nijmegen, Netherlands; [3]Universitäts-Krankenhaus Hamburg-Eppendorf, Hamburg, Germany; [4]EORTC Headquarters, Brussels, Belgium; [5]Molmed, Milan, Italy

Vascular targeted TNF, NGR-hTNF, has antivascular properties. In a recent phase I study, it was not possible to select an optimal biological dose of NGR-hTNF from DCE-MRI measurements.(1) This study aims to examine the reasons for this. Our results suggests that this was caused by a combination of the following factors: (i) less adequate reproducibility in healthy liver tissue due to more than expected heterogeneity in vascular response, (ii) more than expected changes in healthy liver tissue which influences the amount of contrast between metastases and healthyliver tissue (iii) difference in the effect of NGR-hTNF between tumors related to tumor size and (iv) the development of soluble TNFá receptors.

Bowel & Female Pelvis

Room A8 16:30-18:30 *Moderators:* Georg M. Bongartz and Thomas Lauenstein

16:30 **Introduction: Bowel**
Thomas Lauenstein

16:42 ***158*. Feasibility of Small Bowel Flow Rate Measurement with MRI – A Volunteer Study**
Johannes M. Froehlich[1,2], Michael A. Patak[1], Constantin von Weymarn[2], Nicole Graf[3], Aleksis Doert[2], Edwin Willemse[2], Christoph A. Binkert[2], Andreas Gutzeit[2]
[1]Institute of Diagnostic, Interventional and Pediatric Radiology, University Hospital, Bern, Switzerland; [2]MR Research, Kantonsspital Winterthur, Winterthur, Switzerland; [3]Clinical Trials Center, University Hospital, Zürich, Switzerland

The aim of our prospective volunteer study was to develop and validate a new MR technique based on phase-contrast pulse sequences to measure intraluminal flux of the gastrointestinal content in single segments of the small bowel. Time-resolved small bowel flux was successfully measured in single distended small bowel loops within all 10 volunteers. A mean flow-rate of 0.188 ml/sec (range 0.027-0.516ml/sec) with a standard deviation of 0.144ml/sec resulted. Phase-contrast sequences together with low gadolinium concentrations allow measuring even low flow-rates within the small bowel highlightening its physiology as validated with a high degree of accuracy (R=0.999) in a phantom study.

16:54 ***159*. Validation of Software Assisted Small Bowel Motility Analysis**
Michael A. Patak[1], Stephan Raible[2], Zsolt Szuecs-Farkas[1], Roger Cattin[2], Hanspeter Bouquet[3], Urs Bill[3], Jonas Steinhauser[1], Peter Vock[1], Johannes M. Froehlich[1]
[1]Institute of Diagnostic, Interventional and Pediatric Radiology, Inselspital, University Hospital, Bern, BE, Switzerland; [2]Virtual Perception Group, University of Applied Sciences, Bern, BE, Switzerland; [3]Sohard AG, Bern, Switzerland

MR analysis of small bowel motility is a new technique to identify and localize functional pathologies. A newly developed software prototype permitting semi-automatic measurement was evaluated in comparison to measurement by hand. 52patients, overall 110evaluations were included. Overall 97/110(88.2%) of the motility curves were in agreement with each other with 86/110(78.2%) presenting a parallel shifting of the curves. No significant difference(p=0.65) was found for the peristaltic frequencies, while the amplitudes differed significantly(p=0.011). The newly developed software prototype for quantification of small bowel peristalsis proves as a valuable tool for fast, standardized and accurate measurement of small bowel motility.

17:06 ***160*. Macromolecular Dynamic Contrast Enhanced (DCE) MRI Characterizes Hyperpermeability of the Intestinal Microvasculature in a Colitis Model**
Katrien Vandoorne[1], Tegest Aychek[2], Steffen Jung[2], Michal Neeman[1]
[1]Biological Regulation, Weizmann Institute, Rehovot, Israel; [2]Immunology, Weizmann Institute, Rehovot, Israel

In this work, we imaged and characterized blood vessels in the colon in an animal colitis model, where C57 black mice were exposed to DSS in the drinking water for 7 days, and developed a protocol for detection of alterations of the microvasculature in colitis. We showed with non-invasive macromolecular DCE-MRI, plasma protein leakage to the colon, highlighting the focal patches of colitis in post contrast 3D rendering. Macromolecular DCE-MRI demonstrated to be able to identify severe colitis and the loss of plasma proteins.

17:18 ***161*. Assessment of Reflux-Induced Esophageal Compliance Using Concurrent Magnetic Resonance Imaging and High-Resolution Manometry**
Jelena Curcic[1], Andreas Steingoetter[1,2], Reto Treier[1], Elad Kaufman[3,4], Zsofia Forras-Kaufman[3], Mark Fox[3,5], Werner Schwizer[3], Michael Fried[3], Peter Boesiger[1]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland; [2]Institute of Radiology, Klinikum rechts der Isar, Technical University Munich, Munich, Germany; [3]Division of Gastroenterology and Hepatology, University Hospital Zurich, Zurich, Switzerland; [4]Institute for Surgical Pathology, University Hospital Zurich, Zurich, Switzerland; [5]Nottingham Digestive Diseases Centre and Biomedical Research Unit, University Hospital, Nottingham, United Kingdom

The prevalence of the gastro-esophageal reflux disease (GERD) amounts to 10% to 20% worldwide and is higher in the western than in the eastern countries. However, the influence of aggressive gastric acid on the esophageal muscles is poorly described. Concurrent magnetic resonance imaging (MRI) and high-resolution manometry (HRM) were used to assess the esophageal compliance induced by reflux events in healthy volunteers and GERD patients. The results show significant esophageal distention difference but only small pressure difference between two groups. This indicates that esophageal distention may be a sensitive parameter for assessment of esophageal compliance even without invasive manometry measurement.

17:30 **Introduction: Female Pelvis**
Georg M. Bongartz

17:42 ***162*. Evaluation of Magnetic Resonance Diffusion and Spectroscopy Measurements as Predictive Biomarkers in Stage 1 Cervical Cancer**
Maria A. Schmidt[1], Geoffrey S. Payne[1], Veronica A. Morgan[1], Sharon Giles[1], Jane Bridges[2], Thomas Ind[2], Nandita deSouza[1]
[1]CRUK/ESPRC Cancer Imaging Centre, Institute of Cancer Research and Royal Marsden NHS Foundation Trust, MRI Unit , Sutton, England, United Kingdom; [2]Gynaecological Oncology, Royal Marsden NHS Foundation Trust and Chelsea & Westminster Hospital, London, United Kingdom

This study applies functional MRI techniques (DWI and MRS) to cervical tumors with different histological characteristics (type, degree of differentiation and presence or absence of lymphovascular invasion) in order to investigate their potential as predictive biomarkers. There was a statistically significant difference between the ADC of well/moderately differentiated tumors compared with poorly differentiated tumors. There was no significant difference

between the ADCs of the tumors when separated by other characteristics. There was no significant difference in tCho between any of the tumor categories investigated and no correlation between tumor ADC and tCho.

17:54 ***163***. **Oxygenation in Cervical Cancer and Normal Uterine Cervix Assessed Using BOLD MRI at 3 Tesla: Initial Experiences**

Rami Robert Hallac[1], Yao Ding[1], Qing Yuan[1], Roderick W. McColl[1], Jayanthi Lea[2], Robert D. Sims[1], Paul T. Weatherall[1], Ralph P. Mason[1]
[1]Radiology, UT Southwestern Medical Center at Dallas, Dallas, TX, United States; [2]Ob-Gyn Oncology, UT Southwestern Medical Center at Dallas, Dallas, TX

BOLD MRI is sensitive to tumor vascular oxygenation and may provide an indication of tumor hypoxia. We have studied normal volunteers and women with locally advanced cervical cancer to evaluate the response to breathing oxygen. Tumors showed a BOLD signal intensity response between 2.5 and 20 % at 3 T. Normal cervical tissue and uterine lining also responded, but muscle tended to show no signal enhanced in T2* weighted signal. T2* maps showed ÄR2* = 4.23±3.2s-1 in normal cervix. Overall the procedure was well tolerated providing a non-invasive approach to investigating tumor oxygenation.

18:06 ***164***. **Diffusion Tensor Imaging at 7 Tesla as a Probe of Uterine Fibroid Morphology**

Michael Jonathan Thrippleton[1], Kirsty Irene Munro[1], Mark E. Bastin[2], Maurits A. Jansen[2], Gavin D. Merrifield[2], Scott I K Semple[3], Anca Oniscu[1], Andrew W. Horne[1], Alistair R. Williams[1], Graham McKillop[4], Ian Marshall[2], David E. Newby,[3,5], Hilary OD Critchley[1]
[1]Centre for Reproductive Biology, University of Edinburgh, Edinburgh, Lothian, United Kingdom; [2]Department of Medical Physics, University of Edinburgh; [3]Clinical Research Imaging Centre, University of Edinburgh; [4]Department of Radiology, Royal Infirmary of Edinburgh; [5]Centre for Cardiovascular Science, University of Edinburgh

We are developing MR biomarkers for assessing the mechanism and effectiveness of new medical treatments for uterine fibroids — benign growths of uterine muscle, present in up to 70% of women of reproductive age. In this abstract, we describe the results of development work aimed at probing the water diffusion properties of the ex-vivo fibroid uterus at 7 T; we measure the water diffusion parameters of fibroid tissue subtypes and compare diffusion eigenvector maps with macroscopic tissue appearance.

18:18 ***165***. **MR Imaging Evaluation of PCOS in Adolescents**

Matthew Austin[1], Alice Park[2], R. Jeffrey Chang[3], Michele A. Brown[4]
[1]Radiology, San Diego, CA, United States; [2]University of California San Diego, San Diego, CA, United States; [3] University of California San Diego, San Diego, CA, United States; [4] University of California San Diego, San Diego, CA, United States

This study compares MRI appearance of the ovary in adolescent girls with and without PCOS. Subjects were 32 girls between the ages of 12 and 19 years; 16 girls with clinical and biochemical evidence of PCOS and 16 girls without PCOS. Two radiologists independently recorded ovarian volume, follicle count per ovary, and follicle size. Average follicle count per ovary and ovarian volume were higher in PCOS subjects compared to non-PCOS subjects. MR imaging appearance of the ovary differs between adolescent girls with and without PCOS. MR imaging may help evaluate young patients in whom transvaginal ultrasound is contraindicated.

Peaks of the Heart

Room A9 16:30-18:30 *Moderators:* Lidia Szczepaniak and Robert G. Weiss

16:30 **Introduction**

Robert G. Weiss

16:42 ***166***. **Reduced Myocardial Creatine Kinase Reaction Rates in Human Heart Failure: First Measurements at 3T**

Michael Schär[1,2], AbdElmonem M. El-Sharkawy[1], Paul A. Bottomley[1,3], Robert G. Weiss[1,3]
[1]Russel H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Philips Healthcare, Cleveland, OH, United States; [3]Division of Cardiology, Department of Medicine, The Johns Hopkins University School of Medicine, Baltimore, MD, United States

A triple repetition time saturation transfer method is applied to measure pseudo-first-order rate-constant k_f of the creatine kinase reaction in the hearts of 16 patients with heart failure and 9 healthy subjects for the first time at 3T. In heart failure, k_f is reduced to 65% of the normal value, in agreement with prior reports at 1.5T using a different technique. Furthermore, the intrinsic ^{31}P T1 of phosphocreatine did not differ significantly between these subjects, possibly permitting elimination of one protocol step. The resulting two repetition time saturation transfer method, TwiST, yields the same cardiac k_f measures in less time.

16:54 ***167***. **In Vivo Creatine Kinase Kinetics in Diabetic Heart: Relationship to Cardiac Work.**

Adil Bashir[1], Robert J. Gropler[1]
[1]Mallinckrodt Institute of Radiology, Washington University in St. Louis, St. Louis, MO, United States

In vivo measurements of creatine kinase kinetics provide a better measure of cardiac energy metabolism than PCr to ATP ratio. Using optimized magnetization transfer approach we have measured energy production in rat hearts at two levels of cardiac performance and found it to be closely coupled with work load in normal rat hearts. In diabetic hearts the PCr concentration was lower at rest and the energy production for cardiac work was maintained by higher CK rate constant. When cardiac work was increased the CK flux in diabetic animals did not increase in proportion to the work indicating impaired energy production.

17:06 ***168***. **Hyperpolarised [2-^{13}C]Pyruvate Uniquely Reveals the Role of Acetylcarnitine as a Mitochondrial Substrate Buffer in the Heart**

Marie Allen Schroeder[1], Helen J. Atherton[1], Philip Lee[2], Michael S. Dodd[1], Lowri E. Cochlin[1], Kieran E. Clarke[1], George K. Radda[1,2], Damian J. Tyler[1]
[1]Physiology, Anatomy and Genetics, University of Oxford, Oxford, Oxfordshire, United Kingdom; [2]Biomedical Sciences Institute, Singapore Bioimaging Consortium, Singapore, Singapore

Mitochondrial acetylcarnitine may be involved in balancing the glucose-fatty acid cycle in the heart. Here, we used hyperpolarised [2-^{13}C]pyruvate with magnetic resonance spectroscopy to monitor the incorporation of acetyl-CoA formed by pyruvate dehydrogenase into the acetylcarnitine pool, and the metabolites of the Krebs cycle, in real-time and *in vivo*. Our results demonstrated that most pyruvate-derived acetyl-CoA entering the Krebs cycle does not immediately condense with oxaloacetate, but is first converted to acetylcarnitine. Examination of acetylcarnitine production from pyruvate-derived acetyl-CoA *in vivo* revealed that acetylcarnitine provides a rapidly mobilised mitochondrial buffer for oxidative substrate and may be fundamental in maintaining high, constant ATP levels in the heart.

17:18 ***169***. **Quantification of Myocardial Triglycerides: Ex-Vivo and In-Vivo Evaluations by Two-Point Water-Fat Imaging and 1H Spectroscopy**

Chia-Ying Liu[1], Alban Redheuil[1], Ronald Ouwerkerk[2], Charles Steenbergen[3], Shenghan Lai[4], Joao Lima[1], David Bluemke[5]
[1]Department of Radiology, Johns Hopkins Hospital, Baltimore, MD, United States; [2]The National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, Bethesda, MD, United States; [3]Department of Pathology, The Johns Hopkins University, Baltimore, MD, United States; [4]Department of Epidemiology, Johns Hopkins School of Hygiene and Public health, Baltimore, MD, United States; [5]Radiology and Imaging Sciences, National Institutes of Health, Bethesda, MD, United States

The concept of fat contained within the myocardium, has recently received attention because of its potential role in diabetic myocardial disease, obesity, and HIV infected individuals. Measurements of myocardial triglycerides in humans have been accessed using proton MR spectroscopy (1H MRS). We studied the accuracy of the dual-echo Dixon MRI in quantifying the fatty content of the myocardium in autopsies and patients. 1H MRS as an independent method was also applied for comparison.

17:30 ***170***. **Human Cardiac Creatine Kinase Flux Measurement at 3T Using 31P Magnetization Transfer MRS**

Adil Bashir[1], Robert J. Gropler[1]
[1]Mallinckrodt Institute of Radiology, Washington University in St. Louis, St. Louis, MO, United States

31P magnetization transfer MRS can measure energy turnover in the myocardium through the creatine kinase (CK) reaction. The in vivo application of this technique has been lagging especially for human studies. We have developed an optimized strategy to measure adenosine diphosphate (ATP) production in human heart via CK system. This is the first demonstration of the technique for human studies at 3T. The high field magnet provides reduction in total experiment time and improved spectral resolution over 1.5T magnet. Our results also demonstrate that the energy production in diabetic heart is impaired.

17:42 ***171***. **Cardiac Spectroscopy in Chronic Fatigue Syndrome (CFS) Correlates with Autonomic Abnormalities on Standing and Stratifies Oxidative Function in Skeletal Muscle**

Kieren Grant Hollingsworth[1], David Emerys Jones[2], Roy Taylor[1], Julia Lindsay Newton[3], Andrew Mark Blamire[1]
[1]Newcastle Magnetic Resonance Centre, Newcastle University, Newcastle upon Tyne, Tyne and Wear, United Kingdom; [2]Institute of Cellular Medicine, Newcastle University, Newcastle upon Tyne, Tyne and Wear, United Kingdom; [3]Institute for Ageing and Health, Newcastle University, Newcastle upon Tyne, Tyne and Wear, United Kingdom

Studies of muscle metabolism in chronic fatigue syndrome (CFS) have often had contradictory results and suggested the presence of mixed phenotypes. Recent evidence has suggested that cardiac output is adversely affected in CFS. 12 female CFS/ME patients and 8 controls were recruited. Cardiac phosphorus spectroscopy, muscle exercise phosphorus spectroscopy and impedance cardiography were acquired. Cardiac PCr/ATP ratio was related to changes in cardiac index on standing and reduced PCr/ATP ratio was found to correlate with impaired oxidative function (half-times for PCr and ADP recovery). Cardiac spectroscopy was found to be useful in stratifying oxidative function in CFS.

17:54 ***172***. ***In Vivo* ^{17}O MRS Imaging for Assessing Myocardial Oxygen Metabolism in Rat Heart at 9.4T**

Xiao-Hong Zhu[1], Yi Zhang[1], Wei Chen[1]
[1]Center for Magnetic Resonance Research, Department of Radiology,, Minneapolis, MN, United States

Heart, similar to brain, is a highly aerobic organ which consumes a large portion of oxygen utilized by the entire body. The myocardial oxygen metabolism provides essential energy for performing myocyte contraction/relaxation and maintaining normal cardiac functions. It is, thus, important to develop an *in vivo* MR imaging approach capable of noninvasively imaging the myocardial oxygen metabolic rate (MVO_2). Recently, high-field *in vivo* ^{17}O MRS imaging (MRSI) has been applied to imaging the rat brain oxygen metabolism. In this study, we exploit the feasibility of the ^{17}O approach for imaging rat MVO_2 at 9.4T with a brief inhalation of ^{17}O-labeled oxygen gas under basal and workload conditions.

18:06 ***173***. **Myocardial Fat Content: Single Breath-Hold ^{1}H-MR Spectroscopy at 3 T**

Belen Rial[1], Stefan Neubauer[1], Matthew D. Robson[1], Jurgen E. Schneider[1]
[1]Cardiovascular Medicine, Oxford University, Oxford, Oxfordshire, United Kingdom

Proton MR Spectroscopy provides a window into myocardial metabolism. Cardiac and respiratory motion still degrades the sensitivity of the method and hence metabolite detection. Some techniques for reducing this problem have recently emerged, however a compromise between feasible scan duration and easy implementation of these techniques in a clinical scanner has not been reached yet. In this study we demonstrate feasible single breath-hold ^{1}H-MR spectroscopy in the human heart at 3 T, obtaining one unsuppressed-water spectrum and three metabolite spectra, which allowed reliable quantification of fat as percentage of water content in the myocardium of healthy volunteers.

18:18 ***174***. **Myocardial Lipids and Myocardial Function in Insulin Resistant Population.**

Martin Krssak[1,2], Yvonne Winhofer[2], Christian Göbl[2], Martin Bischof[2], Gert Reiter[3], Alexandra Kautzky-Willer[2], Anton Luger[2], Michael Krebs[2], Christian Anderwald[2]
[1]Radiology, Medical University of Vienna, Wien, Austria; [2]Internal Medicine III, Medical University of Vienna, Wien, Austria; [3]Siemens Healthcare Austria, Graz, Austria

Myocardial lipid accumulation and myocardial function were measured by 1H MR spectroscopy and imaging in a group of non-diabetic insulin sensitive and metabolically matched non-diabetic insulin resistant women. No differences were found between these two groups, but hampered myocardial function and increased myocardial lipid accumulation was found in a group patients with type 2 diabetic mellitus, who served as a negative controls. Our results suggest that increased myocardial lipid content and restricted myocardial capacity are not linked to insulin resistance per se, but might develop after the manifestation of type-2 diabetes.

Molecular & Cellular Imaging Study Group
Room K1 18:45 - 20:45

18:45 Business Meeting

18:55 **Scientific Meeting – "Advances in 19F Reporters & Cell Tracking Methods"**

18:55 **A Renaissance for 19F NMR: Novel Concepts & Opportunities in Cellular & Molecular Imaging**
Ralph Mason, Ph.D., Department of Radiology, UT Southwestern Medical Center, Dallas, TX, USA

19:25 **MRI-based Cell Tracking of Human Stem Cell Therapy in 20XX**
Erik Shapiro, Ph.D., Departments of Diagnostic Radiology and Biomedical Engineering, Yale University, New Haven, CT, USA

19:55 **MR Cell Tracking in Reperfused Myocardial Infarction with Microvascular Obstruction & Haemorrhage: Fluorine-19 MR Could be a Better Solution**
Yuxiang Ye, Department of Experimental Physics, University of Wurzburg, Wurzburg, Germany

20:07 **Towards *in vivo* Visualization of Pancreatic Beta-Cells in the Mouse: Molecular Imaging at 16.4 T**
Sven Gottschalk, Ph.D., High Field MR Center, Max Planck Institute for Biological Cybernetics, Tubingen, Germany

20:19 **Remote MR Sensing of pH & Cell Viability Using lipoCEST-filled Microcapsules**
Kannie Chan, Ph.D., Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, USA

20:31 ***In vivo* SWIFT Imaging of SPIO Labeled Stem Cells Grafted in the Heart**
Shelly Zhang, Department of Radiology, University of Pennsylvania, Philadelphia, PA, USA

20:45 Adjourn

High Field Systems & Applications Study Group
Room K2 18:45 - 20:45

18:45 Business Meeting and Introduction of Election Winners

19:00 Vendor Update (5min talk, 5 min discussion)

19:00 GE, Gregory Hurst, Ph.D., GE Healthcare, Chagrin Falls, OH, USA

19:10 Siemens, Karsten Wicklow, Ph.D., Siemens AG, Erlangen, Germany

19:20 Philips, TBA

19:30 **High Field Applications in a Clinical Setting**
Peter Luijten, Ph.D., UMC Utrecht, Utrecht, The Netherlands

19:50 **RF Safety for High Field: Guidelines**

Mikhail Kozlov, Ph.D. and Robert Turner, Ph.D., Director, Department of Neurophysics Max-Planck-Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

20:10 Panel Discussion

20:30 Adjourn

Diffusion & Perfusion Study Group
Victoria Hall 18:45 - 20:45

18:45 Welcome and Introduction of New Committee

18:50 Discussion: Future Diffusion Workshop

19:55 **Debate: Should the Diffusion-Perfusion Study Group be Split?**
Pro - John Detre, M.D., Professor, University of Pennsylvania, Philadelphia, PA, USA
Con – Michael Moseley, Ph.D., Professor, Stanford University, Stanford, CA, USA

20:45 Adjourn

MR Flow & Motion Quantitation Study Group
Room A4 18:45 - 20:45

18:45 Business Meeting and Introduction of New Committee Members

19:00 Scientific Program

19:00 **Myocardial Motion Analysis with Tissue Phase Mapping**
Daniela Föll, M.D., University Hospital Freiburg, Baden-Württemberg, Germany

19:15 **4d Flow - Visualization and Post-Processing**
Tino Ebbers, Ph.D., Linköping University, Linköping, Sweden

19:40 **Review of CSF Flow Research & Potential Applications: Are We Getting There?**
Noam Alperin, Ph.D., University of Miami, Miami, FL, USA

19:55 Discussion

20:40 Adjourn

MR of Cancer Study Group
Room A5 18:45 - 20:45

18:45 Food and Beverage

19:00 Business Meeting

19:15 Scientific Meeting

19:15 **It's Not All About Science: Today's Financial Challenges & Possibilities for the Young MR Cancer Scientist**
Research Scientist Tom Scheenen, Ph.D., The Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands

19:30 **The Science & Legacy of Professor Mildred Cohn (1913-2009)**
Professor Hadassa Degani, Ph.D., Weizmann Institute of Science, Rehovot, Israel

19:45 **The "Academic Rat Race": Challenges for New Principal Investigators in the United States**
Associate Professor Kristine Glunde, Ph.D., Johns Hopkins University School of Medicine, Baltimore, MD, USA

20:00 **Hot Topic Debate:**
From Pre-Clinical Experiments & Pilot Studies into a Validating Clinical Study – Translational Bottlenecks

20:30 Adjourn

Musculoskeletal Study Group
Room A7 18:45 - 20:45

18:45 **Skeletal Muscle Energetics in Health & Disease; A Semi Historical Perspective**
Sir George K. Radda, D.Phil., University of Oxford, Oxford, UK

19:05 **NIH Osteoarthritis Initiative – Update**
Erika Schneider, Ph.D., Cleveland Clinic, Cleveland, OH, USA

19:25 **The International Workshops on Imaging Based Measures of Osteoarthritis – Goals, Achievements & a Preview**
David Wilson, D.Phil., University of British Columbia, Vancouver, BC, Canada

19:45 **Cartilage - Bone Interactions in Osteoarthritis**
Sharmila Majumdar, Ph.D., University of California, San Francisco, CA, USA

20:05 **Ultrashort Echo Time MR Imaging of Short T2 Tissues in Articular Cartilage of the Osteochondral Junction**
Christine Chung, M.D., University of California, San Diego, CA, USA

20:25 **New Developments in Musculoskeletal Imaging Using SWIFT-Class Sequences**
Jutta Ellermann, M.D., Ph.D., University of Minnesota, Minneapolis, MN, USA

20:45 Adjourn

Psychiatric MR Spectroscopy & Imaging Study Group
Room A8 18:45 - 20:45

18:45 Business Meeting

19:00 **Scientific Meeting – "Innovative Applications of MRS Tailored to Specific Psychiatric Disorders"**

19:00 **The Importance of Creatine to Cognitive Development & Mental Health**
Kim M. Cecil, Ph.D., Professor of Radiology, Pediatrics and Neuroscience, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA

19:25 **MRS Studies of Mood Disorders**
Perry F. Renshaw, M.D., Ph.D., MBA, Professor of Psychiatry, University of Utah, Salt Lake City, UT, USA

19:50 **Some Recent Developments in Spectral Editing: Preliminary Results in Schizophrenia**
Peter B. Barker, D.Phil, Professor of Radiology, Johns Hopkins University, Baltimore, MD USA

20:15 Panel Discussion

20:40 Adjourn

White Matter Study Group
Room A9 18:45 - 20:45

18:45 Business Meeting

19:00 Brief Presentations (2 Minutes Talk Followed by Discussion) by White Matter Study Group Poster Competition Participants On Their Posters

19:45 **Panel Discussion: Will Advanced White Matter MR Techniques (mcT2, qMT, DSI, etc.) Ever Reach Wide-Spread Clinical Utility?**

20:30 **Location and Theme of the Next White Matter Study Group Workshop**
Sean Deoni, Ph.D., Brown University, Providence, RI, USA

20:45 Adjourn

TUESDAY

SUNRISE EDUCATIONAL COURSE
CLINICAL INTENSIVE COURSE
Hot Topics in Body MRI

Room K1 07:00 – 08:00 *Organizers*: Talissa Altes, Elmar Max Merkle and Bachir Taouli

EDUCATIONAL OBJECTIVES
Upon completion of days 1 and 2 participants should be able to:

- Explain the physics of DWI methods in body imaging;
- Apply DWI technique in their practice;
- Design female pelvic and prostate MR protocols including DWI; and
- Describe current results of DWI in oncology

Advanced Body Diffusion 1
Moderators: **Bachir Taouli, M.D., and Harriet C. Thoeny, M.D.**

07:00 **Advanced Diffusion Physics Applied to Body Imaging**
Thomas L. Chenevert, Ph.D.

07:30 **Diffusion Imaging of Focal and Diffuse Renal Diseases**
Harriet C. Thoeny, M.D

SUNRISE EDUCATIONAL COURSE
CLINICAL INTENSIVE COURSE
Tissue Contrast in MSK MRI - From Physics to Physiology

Room K2 07:00 – 08:00 *Organizer & Moderator*: Bernard J. Dardzinski

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe contrast mechanisms in MSK imaging, most notably in imaging of articular cartilage;
- Describe the physics of advanced MR sequences;
- Identify the most suitable new MR sequences for four important indications;
- Implement current MR protocols for daily practice and be aware of the most useful indications for these techniques.

07:00 **Relaxation Mechanisms in Collagen Rich Tissues**
Greg J. Stanisz, Ph.D.

07:30 **Clinical Aspects of Tendon Disorders**
Eugene G. McNally, M.D., F.R.C.R., F.R.C.P.I.

SUNRISE EDUCATIONAL COURSE

Image Reconstruction

Victoria Hall 07:00 – 08:00 *Organizer & Moderator*: Elfar Adalsteinsson

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the main steps involved in efficient non-Cartesian image reconstruction;
- Formulate a generalized signal model incorporating gradient encoding, coil sensitivity and Bo inhomogeneity;
- List the pro's and con's of Cartesian and non-Cartesian parallel MRI;
- Compare compressed sensing, HYPR, and k-t BLAST with respect to their use of prior knowledge;
- Describe the principles of separating water and fat signals; and
- Name three different approaches for motion correction and appraise their potential to become routine methods

Non-Cartesian Trajectories and Off-Resonance Correction

07:00 **Fast Image Reconstruction from Non-Cartesian Data**
Craig H. Meyer, Ph.D.

07:30 **Off-Resonance Effects and Correction**
Bradley P. Sutton, Ph.D.

SUNRISE EDUCATIONAL COURSE

Imaging Biomarkers

Room A1 07:00 – 08:00 *Organizers & Moderators*: Jeffrey L. Evelhoch and Sabrina M. Ronen

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe what a biomarker is and how MR can be used as a biomarker;
- Explain how biomarkers are qualified to be fit for their intended purpose;
- List requirements for use of MR biomarkers in both preclinical studies and clinical trials; and
- Give examples of how imaging biomarkers are being used in at least two of the following areas: multiple sclerosis, oncology, cardiovascular diseases and neurodegenerative diseases.

07:00 **What Imaging Biomarkers Are and How They Are Used**
John C. Waterton, Ph.D.

07:30 **Non-Imaging Biomarkers and Regulatory Aspects of Imaging Biomarkers**
H. Cecil Charles, Ph.D.

SUNRISE EDUCATIONAL COURSE

Brain: An Absolute Beginner's Guide to Anatomical & Functional MRI

Room A4 07:00 – 08:00 *Organizer & Moderator*: Geoffrey J.M. Parker

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Identify the neuroanatomical and neurophysiological parameters which are accessible to MR measurement;
- Describe the underlying physics of MR neuroimaging techniques;
- Describe the data acquisition and analysis techniques most commonly used for anatomical and functional MRI of the brain;
- Recognize the potential value of advances such as parallel imaging, fast imaging techniques and high magnetic field strengths for imaging the brain; and
- Name typical clinical applications for which specific MRI techniques are suited.

07:00 **Beginners Guide to Quantitative MRI**
Ralf Deichmann, Ph.D.

SUNRISE EDUCATIONAL COURSE

Potentials & Challenges of High-Field MRS

Room A5 07:00 – 08:00 *Organizers & Moderators*: Rolf Gruetter and Ivan Tkac

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe advantages and potentials of MRS at very high fields;
- Identify problems and challenges of high field MRS;
- Define the MRS detectable neurochemical profile of the brain;
- Describe principles of metabolite quantification;
- Assess spectral quality and identify main sources of spectral quality deterioration; and
- Explain the importance of B0 shimming at high fields.

What High-Field MRS Can Provide

07:00 **Potentials of High-Field Spectroscopy**
Wolfgang Dreher, Ph.D.

07:30 **How To Get Meaningful MRS Data**
Robin A. de Graaf, Ph.D.

SUNRISE EDUCATIONAL COURSE

Modeling & Quantitative Analysis for Body DCE MRI

Room A6 07:00 – 08:00 *Organizers*: Henry Rusinek and Min-Ying Lydia Su

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe various DCE models used for different organs including kidney, liver, breast, and prostate;
- Describe analysis methods used to measure vascularity, permeability, and blood flow;
- Implement Monte Carlo noise simulation method to predict parameter bias and precision;
- Compare conventional compartmental kinetic models and distributed models;
- Apply procedures for converting MRI signal intensity to tracer concentration; and
- Explain current method for measuring vascular input function and analyzing its impact on obtained DCE parameters.

***Moderators*: David L. Buckley and Douglas C. Noll**

07:00 **Principles of Modeling & Simulations**
Steven P. Sourbron, Ph.D.

07:30 **Tracer Kinetics**
Tong San Koh, Ph.D.

SUNRISE EDUCATIONAL COURSE

From Bench to Bedside to Bench: Translation of Animal Models to Clinical Practice & From Clinical Practice to Animal Models

Room A7 07:00 – 08:00 *Organizers & Moderators*: Pia C. Maly Sundgren and Afonso C. Silva

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the main MRI methods used in experimental studies to understand the underlying disease mechanisms;
- Identify what is known about the underlying disease mechanisms, and which type of MRI investigations could be used for diagnosis and clinical investigation;
- Describe the main MRI methods used in the clinical setting to diagnose the condition, and the rationale behind this; and
- Make the translation from what is - and can be - done in experimental studies to what can be done clinically, and where animal models bring new insight to disease.

Traumatic Brain Injury

07:00 **MRI Assessment of Cerebral Blood Flow and Macrophage Accumulation in Mouse Models for Traumatic Brain Injury**
Lesley May Foley, B.Sc.

07:30 **Translation of Traumatic Brain Injury into Human and Clinical Practice**
Susan Durham, M.D.

SUNRISE EDUCATIONAL COURSE

Cardiovascular Imaging: Disease or Problem Based Teaching, Practical Protocols

Room A8 07:00 – 08:00 *Organizers & Moderators*: Victor A. Ferrari, Vivian S. Lee and Mitsue Miyazaki

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Recognize recent advancements and requirements in 3T cardiovascular MRI, as compared to present 1.5T MRI;

- Evaluate the strengths and limitations of current cardiovascular MRI techniques when applied to clinical diagnostic examinations;
- Describe current clinical techniques for assessment of ischemic heart disease and various cardiac diseases using new methods;
- Select the potential clinical applications of time-resolved techniques, and the technical challenges that will need to be resolved for wider applications; and
- Apply current approaches optimally to these diseases.

Advances in 3T Cardiovascular MR

07:00 **Clinical Need for High Field Strength in CMR**
Ahmed Gharib, M.D.

07:20 **B0 and B1 Shimming**
Michael Schär, Ph.D.

07:40 **Advanced Pulse Sequences**
Krishna S. Nayak, Ph.D.

SUNRISE EDUCATIONAL COURSE

Trials & Tribulations: Multicenter Trial Headaches & Their Cures

Room A9 07:00 – 08:00 *Organizers & Moderators:* Nicola de Stefano & Jeffrey Joseph Neil

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe multiple methods for setting up and maintaining site quality and certification for multicenter imaging trials;
- Explain the issues related to performing research involving INDs or IDEs;
- Evaluate the sensitivity, specificity and reliability of current imaging methods to detect relevant quantitative changes within the brain; and
- Describe the underlying principles for adopting and evaluating potential surrogate imaging markers for assessment of drug efficacy.

Basic Prerequisites for Multicenter/Multiscanner Trials

07:00 **QA and Site Certification**
Robert C. McKinstry, M.D., Ph.D.

07:30 **Trial execution: methods to drive standardization**
Matt A. Bernstein, Ph.D.

PLENARY SESSION

Clinical Needs & Technological Solutions: Osteoarthritis

Room A1 08:15-09:30 *Organizers & Moderators:* Christine Chung and Hollis G. Potter

08:15 ***175***. **Models for Studying Cartilage Biology in the Context of Osteoarthritis**

Mary B. Goldring[1]
[1]Weill Cornell Medical College, Hospial for Special Surgery, New York, NY, United States

Human cartilage is complex tissue of matrix proteins varying from superficial to deep layers and from loaded to unloaded zones. During OA development normally quiescent chondrocytes with low matrix turnover undergo phenotypic modulation causing matrix destruction and abnormal repair. We have been investigating mechanisms by which GADD45β, a stress response signaling molecule involved in cartilage development, and ESE-1, an inflammation-induced transcription factor, regulate collagen remodeling during osteoarthritis. Studies using human surgical specimens and mouse models of OA will elucidate how these factors disrupt cartilage homeostasis, leading to the development of targeted therapies that block cartilage damage, promoting effective repair.

08:40 ***176***. **Mechanisms of OA/ Imaging Appearance**

Garry E. Gold[1]
[1]Stanford University, Stanford, CA, United States

Osteoarthritis is a common form of arthritis that currently has no disease-modifying treatment. Patients receive pain medication until end-stage treatment with total joint replacement. Risk factors for osteoarthritis include joint trauma, obesity, and malalignment. Currently, clinical management of osteoarthritis and testing of new treatments is done primarily using x-ray. Recent advances in MRI have great potential to detect osteoarthritis before irreversible changes in the joint have occurred. MRI can also image complications of joint replacements. A review of osteoarthritis and an assessment of the potential of MRI to improve treatment will be presented.

09:05 ***177***. **Imaging Markers for Early Matrix Depletion**

Sharmila Majumdar[1]
[1]University of California, San Francisco, San Francisco, CA, United States

Articular cartilage is composed of chondrocytes surrounded by a large extracellular matrix (ECM) composed of water and two groups of macromolecules: proteoglycan (PG) and collagen fibers. ECM changes are said to precede morphological changes in articular cartilage and may prove to be early biomarkers of osteoarthritis. In MRI, these macromolecules restrict motion of water protons, affecting relaxation times and contrast agent uptake. ECM changes such as PG loss, as reflected in measurements of: 1) T1ρ of water protons, 2) Delayed Gadolinium-enhanced MRI of cartilage (dGEMRIC) and collagen content and orientation changes probed using T2 relaxation time measures will be discussed.

CLINICAL INTENSIVE COURSE

(Admission limited to Clinical Intensive Course registrants only)

Advances in Multiple Sclerosis I

Room K1 08:15-09:15 *Organizers*: Walter Kucharczyk and Pia C. Maly Sundgren

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Explain brain plasticity;
- Describe cases when MRI could appropriately be used as a biomarker for MS; and
- Explain the rationale for using (or not) different dosages of contrast in MS patients.

Moderators: **Nicola de Stefano and Alex Rovira**

08:15 **MRI in MS - State of the Art**
Frederik Barkhof, M.D., Ph.D.

08:40 **fMR Imaging for Evaluation of Brain Plasticity in MS**
Alberto Bizzi, M.D.

09:05 Discussion

CLINICAL INTENSIVE COURSE
(Admission limited to Clinical Intensive Course registrants only)
Foot, Ankle & Knee Imaging: Case-Based Teaching

Room K2 08:15-10:05 *Organizer*: Juerg Hodler

Moderator: **Lynne S. Steinbach, M.D.**

08:15 **Foot and Ankle: Case-based**
Kathryn J. Stevens, M.D.

09:10 **Knee: Case-based**
Hollis G. Potter, M.D.

CLINICAL INTENSIVE COURSE
(Admission limited to Clinical Intensive Course registrants only)
Basic Neuro: Intracranial Infections: Case-Based Teaching

Room K1 09:15-10:05 *Moderators:* Walter Kucharczyk and Pia C. Maly Sundgren

EDUCATIONAL OBJECTIVES
Upon completion of this session, participants should be able to:

- List the MR imaging characteristics of prions and viral infections in the brain and spine; and
- List MR imaging characteristics of bacterial, fungi and parasites in the brain and spine.

Moderators: **Walter Kucharczyk and Majda M. Thurnher**

09:15 **Prions and Virus**
Walter Kucharczyk, M.D., F.R.C.P.C.

09:40 **Bacterial, Fungi and Parasites**
E. Turgut Tali, M.D.

CLINICAL INTENSIVE COURSE
Cardiac MRI: Case-Based Teaching

Room K1 10:30-12:30 *Organizer:* Georg M. Bongartz

EDUCATIONAL OBJECTIVES
Upon completion of this session, participants should be able to:

- Design appropriate scanning protocols for cardiac MR imaging;
- Describe the basic clinical indications for cardiac MRI;
- Discriminate various cardiac diseases by their typical properties in MRI;
- Identify the pitfalls and challenges of the various Cardiac MRI techniques; and

- Compare and optimally apply the pulse sequences used for cardiac perfusion, function, viability, and velocity imaging in MRI.

Moderators: Orlando P. Simonetti and Matthias Stuber

10:30 **Acute and Chronic Ischemic Disease**
Jeanette Schulz-Menger, M.D.

10:50 **Valvular Disease**
Jens Bremerich, M.D.

11:10 **Non-Ischemic Cardiomyopathy**
Victor A. Ferrari, M.D.

11:30 **Congenital Heart Disease**
Albert de Roos, M.D.

11:50 **Cardiac Tumors**
Gunnar Lund, M.D.

12:10 Panel Discussion

CLINICAL INTENSIVE COURSE
Diffuse Liver Disease

Room K2 10:30-12:30 *Organizers:* Talissa Altes, Elmar Max Merkle and Bachir Taouli

EDUCATIONAL OBJECTIVES
Upon completion of this session, participants should be able to:

- Describe the current results of ultrasound elastography and serum markers for detection of liver fibrosis and cirrhosis ;
- Evaluate the results of MRI to diagnose and quantify liver fat and iron;
- Describe the results of MRI to detect liver fibrosis and cirrhosis; and
- Explain the performance of MRI to detect HCC.

Moderators: **Bachir Taouli, M.D. and Scott B. Reeder, M.D., Ph.D.**

10:30 **Non Invasive Detection of Liver Fibrosis with Transient Elastography and Serum Markers**
Laurent Castéra, M.D.

11:00 **Fat-Iron in the Liver**
Scott B. Reeder, M.D., Ph.D.

11:30 **Fibrosis-Cirrhosis**
Bernard E. Van Beers, M.D., Ph.D.

12:00 **HCC Detection**
Claude B. Sirlin, M.D.

CLINICAL INTENSIVE COURSE
MRS in Clinical Practice

Room A9 10:30-12:30 *Organizers:* Walter Kucharczyk and Pia C. Maly Sundgren

EDUCATIONAL OBJECTIVES
Upon completion of this session, participants should be able to:

- Explain when MRS can be useful in the work-up of brain tumors… and its pitfalls;
- Describe the role of MRS in differentiation of metabolic disorders;
- Describe the role of MRS in diagnosis and treatment of psychiatric disorders; and
- Describe the potential role of MRS to help define who is going to advance to severe dementia and who will have a "normal" aging.

Moderators: **Jeffry R. Alger and John D. Port**

10:30 **MRS in Metabolic Disorders**
Alberto Bizzi, M.D.

10:55 **MRS in Brain Tumor Diagnosis**
Jeffry R. Alger, Ph.D.

11:20 **MRS in Schizophrenia and Other Psychiatric Disease**
John D. Port, M.D., Ph.D.

11:55 **MRS in Mild Cognitive Impairment**
Kejal Kantarci, M.D.

fMRI Calibration & Quantitation

Room A1 10:30-12:30 *Moderators:* Richard Hoge and Silvia Mangia

10:30 ***178***. **Per-Subject and Per-Brain-Region Hyperoxic (HO) and Hypercapnic (HC) BOLD Calibration to Investigate Neurovascular Metabolism Coupling Linearity**
Clarisse Ildiko Mark[1], G. B. Pike[1]
[1]McConnell Brain Imaging Center, Montreal Neurological Institute, McGill University, Montreal, Quebec, Canada

Estimates of the coupling relationship (n) between changes in cerebral metabolic rate of oxygen ($\Delta CMRO_2$) and blood flow (ΔCBF) under neuronal activation, key in interpreting BOLD results, are highly sensitive to variability in individual subjects BOLD calibration (M)-values and brain regions. We thereby sought to acquire precise calibration data under robust control of HC and HO levels, together with visual stimulation of varying frequency and voluntary motor tasks. Based on low-variability M-values, our findings demonstrate a tightly coupled and linear flow-metabolism relationship in the visual cortex, an indication that oxygen demand from activated neurons across visual-frequencies is met by oxidative metabolism.

10:42 ***179***. **Baseline BOLD Correlation Accounts for Inter-Subject Variability in Task-Evoked BOLD Responses**
Xiao Liu[1,2], Xiao-Hong Zhu[1], Wei Chen[1,2]
[1]CMRR, radiology, University of Minnesota, Minneapolis, MN, United States; [2]Biomedical Engineering, University of Minnesota, Minneapolis, MN, United States

To investigate whether subjects' ongoing brain activity can affect their response to external stimulation, fMRI BOLD signals were acquired from human visual cortex under conditions with/without visual stimulation. It was found that correlation strength but not fluctuation magnitude of spontaneous (baseline) BOLD signals is positively correlated ($R^2 = 0.68$, p-value $= 2.3 \times 10^{-4}$) with the amplitude of evoked BOLD responses to visual stimulus. This finding suggests that synchronization strength of ongoing brain activity may have an important effect on evoked brain activity, even at the early stage of sensory systems. Moreover, this study provides a neurophysiology basis for quantitatively understanding large inter-subject BOLD variability commonly observed in many fMRI studies.

10:54 ***180***. **Calibration of the Amplitude of FMRI Contrast (β) Using Fractional Volume of Gray Matter: The Spatial and Inter-Subject β Calibrations**
Wanyong Shin[1], Hong Gu[1], Qihong Zou[1], Pradeep Kurup[1], Yihong Yang[1]
[1]Neuroimaging Research Branch, National Institute on Drug Abuse, National Institutes of Health, Baltimore, MD, United States

The amplitude of BOLD contrast during brain activation (commonly called β) is widely used in fMRI study to monitor the neuronal activity. However, it is observed that β varies substantially over subjects, which is referred as inter-subject β variation. In this study, we propose a new calibrated fMRI method based on fractional volume of gray matter measurement using FRASIER method in which the spatial β variations and the inter-subject β variations are calibrated, and we show that the statistical power is significantly improved after the calibration in an fMRI study with a visual task.

11:06 ***181***. **Robustly Accounting for Vascular Reactivity Differences Across Subjects Using Breath-Hold**
Kevin Murphy[1], Ashley D. Harris[1], Richard G. Wise[1]
[1]CUBRIC, Cardiff University Brain Research Imaging Centre, School of Psychology, Cardiff, United Kingdom

Separating BOLD vascular and metabolic responses is often achieved using hypercapnic challenges. A simple way of elevating blood CO_2 concentrations to measure vascular reactivity is breath-holding. Two aspects of this vascular reactivity measure are often neglected: breath-holds are usually modelled as blocks even though CO_2 accumulates over time and increases in CO_2 differ between subjects, both of which must be considered when using vascular

reactivity as a calibration tool. This study determines that the appropriate model for the BOLD breath-hold response is derived from end-tidal CO_2 traces and that individual differences in CO_2 increases must be taken into account.

11:18 ***182***. **The Relationship Between M in "calibrated fMRI" and the Physiologic Modulators of fMRI**

Hanzhang Lu[1], Joanna Hutchison[2], Feng Xu[1], Bart Rypma[2]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Center for BrainHealth, University of Texas at Dallas, Dallas, TX, United States

The "calibrated fMRI" technique requires a hypercapnia or hyperoxia calibration experiment in order to estimate the factor "M". It would be desirable to be able to obtain the M value without the need of a gas challenge calibration. According to the analytical expression of M, it is a function of two baseline physiologic parameters, baseline CBF and baseline venous oxygenation, both of which have recently been shown to be significant modulators of fMRI signal. Here we studied the relationship among M, baseline CBF and baseline venous oxygenation, and assessed the possibility of estimating M from the baseline physiologic parameters.

11:30 ***183***. **Hemodynamic Responses Following Brief Breath-Holding and Visual Stimulation Reconcile the Vascular Compliance and Sustained Oxygen Metabolism Origins for the BOLD Post-Stimulus Undershoot in Human Brain**

Jun Hua[1], Robert Stevens[1], Alan J. Huang[1], James J. Pekar[1], Peter C.M. van Zijl[1]
[1]Department of Radiology, The Johns Hopkins University, Baltimore, MD, United States

BOLD studies of visual stimulation show a post-stimulus undershoot, whereas breath-hold studies don't. BOLD/CBF/CBV/arterial-CBV dynamics following visual stimulation and breath-hold were measured to investigate which mechanism (vascular/metabolic) dominates the undershoot. After visual stimulation, arterial-CBV/CBF returned to baseline in ~8s/15s, respectively, while BOLD undershoot lasted for ~30s, during which elevated post-arterial-CBV (2.4+/-1.8%) and CMRO2 (10.6+/-7.4%) were observed. Following breath-hold, BOLD/CBF/CBV/arterial-CBV all recovered within ~20s and no BOLD undershoot, elevated post-arterial-CBV and CMRO2 were observed. These data suggest that both delayed post-arterial-CBV return and enduring oxygen consumption affect the undershoot, with contributions estimated as 20+/-16% and 79+/-19%, respectively, under our experimental conditions.

11:42 ***184***. **BOLD Impulse Response Functions and Baseline-Dependent Response Adaptation**

Basavaraju G. Sanganahalli[1], Peter Herman[1,2], Hal Blumenfeld[3], Fahmeed Hyder[4]
[1]Diagnostic Radiology, Yale University, New Haven, CT, United States; [2]Human Physiology, Semmelweis University, Budapest, Hungary; [3]Neurology, Neurosurgery and Neuroscience, Yale University, New Haven, CT, United States; [4]Diagnostic Radiology and Biomedical Engineering, Yale University, New Haven, CT, United States

BOLD impulse response functions (IRFs) show variability (i.e, presence/absence of a delayed undershoot) across different conditions (e.g., stimuli, regions). Could these BOLD-IRF differences be due to the system's variable adaptive properties, which are known to differ with baseline? Extracellular data were compared with BOLD signal (11.7T) during forepaw stimulation under domitor and α-chloralose anesthesia in rats. BOLD-IRFs were nearly identical in the early phase but different in the late phase. Domitor, where responses are more adapted, featured a long time-constant undershoot. These results suggest that the late phase could potentially represent differences in adaptive properties across baseline states.

11:54 ***185***. **ATP Production by Oxidative Metabolism and Blood Flow Augmentation by Non-Oxidative Glycolysis in Activated Human Visual Cortex**

Ai-Ling Lin[1], Jia-Hong Gao[2], Timothy Q. Duong[1], Peter T. Fox[1]
[1]Research Imaging Institute, University of Texas Health Science Center at San Antonio, San Antonio, TX, United States; [2]Brain Research Imaging Center, University of Chicago, Chicago, IL, United States

The purpose of the study was to investigate the contributions of oxidative verses non-oxidative metabolism to (1) ATP (energy) production (J_{ATP}); and (2) cerebral blood flow (CBF) augmentation, during neuronal activation. Cerebral oxygen metabolic rate, blood flow and lactate concentration were determined using concurrent fMRI and ^{1}H MRS with visual stimulations at different flickering frequencies. Our results provide additional supportive evidences that (1)the energy demand for brain activations is small and is met through oxidative metabolism; and (2) CBF can be regulated by non-oxidative glycolysis, rather than by oxygen demand.

12:06 185.5W **Modeling the Effect of Changes in Hematocrit, O2 Extraction Fraction, and Blood Volume Distribution on the BOLD Signaland Estimates of CMRO2 Change with a Calibrated BOLD Method**

V. Griffeth[1,2], and R. Buxton[3]
[1]Department of Bioengineering, University of California, San Diego, La Jolla, California, United States, [2]Medical Scientist Training Program, University of California,San Diego, La Jolla, California, United States, [3]Department of Radiology, University of California, San Diego, La Jolla, California, United States

We applied a calibrated-BOLD methodology to assess effects of caffeine consumption on coupling of CBF and cerebral metabolic rate of O_2 ($CMRO_2$responses to a visual stimulus. We found a large increase in Δ$CMRO_2$ after administration of caffeine, both as a fraction of the current baseline state and in a more absolute sense referred to the pre-caffeine baseline. More modest changes were found in the CBF response. The decrease of the CBF/$CMRO_2$ coupling ratio *n* offsets the effects of the reduced baseline CBF due to caffeine and the larger fractional change of CBF with stimulation leaving the BOLD response unchanged.

12:18 ***186***. **Negative Cerebral Blood Flow and BOLD Responses to Somatosensory Stimulation in Spontaneously Hypertensive Rats**

Renata Ferranti Leoni[1,2], Draulio Barros de Araujo[2], Afonso Costa Silva[3]
[1]Cerebral Microcirculation Unit , National Institute of Neurological Diseases and Stroke - NINDS/NIH, Bethesda, MD, United States; [2]Department of Physics and Mathematics, University of Sao Paulo, Ribeirao Preto, Sao Paulo, Brazil; [3]Cerebral Microcirculation Unit, National Institute of Neurological Diseases and Stroke - NINDS/NIH, Bethesda, MD, United States

The presence of sustained negative fMRI response to focal brain stimulation can be explained either by decreased local neuronal activity (neuronal surround inhibition) or by decreased cerebrovascular reserve (vascular steal effect). Here we measured the CBF and BOLD responses to somatosensory stimulation in spontaneously hypertensive rats (SHR) and normotensive controls, to test the origin of negative fMRI responses. 20/30 SHR, but only 3/25 normotensive rats, presented robust negative CBF and BOLD responses. We conclude that the negative fMRI responses were largely related to a vascular steal effect and not due to neuronal surround inhibition.

Diffusion: Pulse Sequences

Victoria Hall 10:30-12:30 *Moderators:* Roland Bammer and Jenifer A. McNab

10:30 **Debate: Journeys into Space: k or q**

Delving Deeper into q (Space)
Derek K. Jones

Reaching into Outer (k) Space
Michael Moseley

10:42 ***187***. **Improving SNR Per Unit Time in Diffusion Imaging Using a Blipped-CAIPIRINHA Simultaneous Multi-Slice EPI Acquisition**

Kawin Setsompop[1,2], J Cohen-Adad[1,2], J A. McNab[1,2], B A. Gagoski[3], V J. Wedeen[1,2], L L. Wald[1,2]
[1]Radiology, A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States; [2]Harvard Medical School, Boston, MA, United States; [3]EECS, Massachusetts Institute of Technology, Cambridge, MA, United States

The acquisition of simultaneous slices using EPI has the potential to increase the number of diffusion directions obtained per unit time, thus allowing more diffusion encoding in HARDI and DSI acquisitions in a clinically relevant scan time. In this work, we apply simultaneous multi-slice method using a novel blipped-CAIPIRINHA technique to lower the g-factor penalty of parallel imaging. We validate the method using g-factor maps and bedpostx with HARDI acquisitions in the brain. We show that with this technique a 10 minutes, 64-direction HARDI acquisition can be acquired in ~3 minutes at no appreciable loss in SNR or diffusion information.

10:54 ***188***. **Diffusion Weighted Image Domain Propeller EPI (DW IProp EPI)**

Stefan Skare[1,2], Samantha J. Holdsworth[1], Roland Bammer[1]
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A new pulse sequence for diffusion imaging is presented, called image domain Propeller EPI (iProp-EPI). Here, propeller blades are acquired in the image domain ,distinct from other propeller-driven pulse sequences, such as PROPELLER and SAP-EPI, where blades are defined in k-space. iProp-EPI has significantly reduced distortions compared with EPI; is immune to spatially-varying non-linear phase changes; can correct for motion; and may be useful for multi-channel coils since the overlap between the blades results in a higher SNR in the image center where its most needed

11:06 ***189***. **Hadamard Slice-Encoding for Reduced-FOV Single-Shot Diffusion-Weighted EPI**

Emine Ulku Saritas[1], Daeho Lee[1], Ajit Shankaranarayanan[2], Dwight G. Nishimura[1]
[1]Department of Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States

High in-plane resolution and the ability to acquire a large number of slices are essential for diffusion-weighted imaging (DWI) of small structures, such as the spinal cord. Recently, a reduced-FOV method that uses 2D echo-planar RF excitation pulses to achieve high in-plane resolution was proposed. In this work, we present a Hadamard slice-encoding scheme to double the number of slices without any SNR or time penalty, with significant improvements to increase the SNR efficiency and reduce the inter-slice crosstalk. We validate our results with in vivo high-resolution axial DWI of the spinal cord.

11:18 ***190***. **Concurrent Higher-Order Field Monitoring Eliminates Thermal Drifts in Parallel DWI**

Bertram Jakob Wilm[1], Christoph Barmet[1], Carolin Reischauer[1], Klaas Paul Pruessmann[1]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

Concurrent higher-order field monitoring is introduced to diffusion weighted imaging, which was enabled by using ^{19}F NMR for a 3rd order dynamic field camera. Concurrent field monitoring captures the full field dynamics during each diffusion weighted acquisition simultaneously with the imaging coils' data. Integrating this field information into image reconstruction eliminates the effects of thermal drifts along with those induced by eddy currents and other gradient imperfections. To benefit from a shortened TE and reduced susceptibility artifacts, higher-order reconstruction was extended to encompass parallel imaging by incorporating coil sensitivities in the encoding matrix.

11:30 ***191***. **Novel Strategy for Accelerated Diffusion Imaging**

Stephan E. Maier[1], Bruno Madore[2]
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A method is presented here to exploit inherent redundancies in multi-b multi-direction datasets, for accelerated diffusion imaging. The approach is clearly not meant as an alternative to established acceleration methods such as parallel imaging and partial-Fourier imaging, but rather as a complement to these methods for additional imaging speed. We show how Fourier analysis along the b-factor and encoding direction parameter axes provides new insights into more efficient sampling of diffusion data with virtually no loss of information.

11:42 ***192***. **Comparison Between Readout-Segmented (RS)-EPI and an Improved Distortion Correction Method for Short-Axis Propeller (SAP)-EPI**

Stefan Skare[1], Samantha J. Holdsworth[1], Kristen Yeom[1], Patrick David Barnes[1], Roland Bammer[1]
[1]Radiology, Stanford University, Palo Alto, CA, United States

Short-Axis readout Propeller EPI (SAP-EPI) and Readout-Segmented EPI (RS-EPI) have been proposed for use in high resolution diffusion-weighted (DW) imaging. SAP-EPI and RS-EPI share common characteristics, in that k-space is traversed by several EPI 'segments' in order to reduce the distortion and blurring that typically hampers EPI images. Previous work comparing RS-EPI and SAP-EPI concluded that SAP-EPI suffers from more blurring compared with RS-EPI despite attempts to correct for distortion. With an improved distortion correction method, we demonstrate that SAP-EPI results in similar image resolution to RS-EPI for a given SNR normalized for scan time/slice.

11:54 ***193***. **First Experimental Observation of Both Microscopic Anisotropy (UA) and Compartment Shape Anisotropy (CSA) in Randomly Oriented Biological Cells Using Double-PFG NMR**

Noam Shemesh[1], Evren Özarslan[2], Peter J. Basser[2], Yoram Cohen[1]
[1]School of Chemistry, Tel Aviv University, Tel Aviv, Israel; [2]Section on Tissue Biophysics and Biomimetics, NICHD, National Institutes of Health, Bethesda, MD, United States

Randomly oriented compartments pose an inherent limitation for single-pulsed-field-gradient (s-PFG) methodologies such as DTI and q-space, and microstructural information (such as compartment shape and size) is lost. In this study, we demonstrate that the double-PFG (d-PFG) methodology can overcome the inherent limitations of s-PFG and extract accurate compartmental dimensions in fixed yeast. The size extracted from the fit is in excellent agreement with the size obtained from light microscopy. Moreover, we show that using different mixing times, the d-PFG experiment differentiates between spherical yeast and eccentric cyanobacteria. Our findings may be important in characterizing grey matter and other CNS tissues.

12:06 ***194***. **In Vivo Pore Size Estimation in White Matter with Double Wave Vector Diffusion Weighting**

Martin A. Koch[1], Jürgen Finsterbusch[1]
[1]Systems Neuroscience, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

Diffusion weighting with two gradient pulse pairs of independent direction (double wave vector diffusion weighting) can provide tissue structure information which is not easily accessible otherwise, such as cell size or shape. For free diffusion, it is irrelevant whether the diffusion gradients in the two weightings are parallel or antiparallel with respect to each other. In restricted diffusion, differences between these situations occur at short mixing times. Here, a DWV sequence with short mixing time is used to estimate the pore size in the human corticospinal tracts in vivo, and analytical expressions for cylindrical pores are used for data analysis.

12:18 ***195***. **Optimal Diffusion-Gradient Waveforms for Measuring Axon Diameter**

Ivana Drobnjak[1], Bernard Siow[2], Daniel C. Alexander[1]
[1]Center for Medical Image Computing, Department of Computer Science, University College London, London, United Kingdom; [2]Center for Advanced Biomedical Imaging, University College London, London, United Kingdom

Measuring microstructure parameters of brain tissue in vivo is a challenge in diffusion MRI. Non-standard diffusion-gradient pulses may provide more sensitivity to microstructure features. Here, we optimize the shape of the diffusion-gradient waveform, constrained only by hardware limits and fixed orientation, to give the best estimate of axon radius based on a simple model of the diffusion within white matter. Our results suggest that square-wave oscillating gradients maximize sensitivity to pore size over the set of PGSE sequences. They also show that the frequency of the waves increases as the radius size decreases.

Pulmonary MRI: More Than Just A Lot of Hot Air

Room A4 10:30-12:30 *Moderators:* Talissa Altes and Yannick Crémillieux

10:30 ***196***. **Hyperpolarized 129Xe MR Imaging of Alveolar-Capillary Gas Transfer in Human Volunteers**

Zackary I. Cleveland[1,2], Gary P. Cofer[1,2], Gregory Metz[3], Denise Beaver[3], John Nouls[1,2], Sivaram Kaushik[1,2], Monica Kraft[3], Jan Wolber[4], Kevin T. Kelly[5], H Page McAdams[2], Bastiaan Driehuys[1,2]
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We demonstrate single breath-hold, 3D MRI of hyperpolarized 129Xe dissolved in the pulmonary tissues of humans. Dissolved 129Xe produces acceptable image quality because magnetization is efficiently replenished by diffusion from the airspaces. While ventilation images (3.0×3.0&×15 mm3 resolution) of healthy volunteers were generally homogeneous, dissolved 129Xe images (12.5×12.5×15 mm3) displayed higher signal intensities in the gravitationally dependent portions slices. Dissolved 129Xe images of COPD patients were also heterogeneous but displayed different, less directional, patterns. These

results suggest that dissolved 129Xe MRI is sensitive to the gravity-dependent distribution of pulmonary perfusion and possibly disease related redistributions of pulmonary capillary blood volume.

10:42 ***197***. **Simultaneous Imaging of Ventilation Distribution and Gas Exchange in the Human Lung Using Hyperpolarized Xe129 MRI**

John P. Mugler, III[1], Talissa A. Altes[1], Iulian C. Ruset[2,3], Isabel M. Dregely[2], Jaime F. Mata[1], G Wilson Miller[1], Stephen Ketel[3], Jeffrey Ketel[3], F William Hersman[2,3], Kai Ruppert[1]

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This work demonstrates the feasibility of using MRI of hyperpolarized Xe129 to acquire images in a single, short breath-hold period that simultaneously depict ventilation distribution and gas exchange in the human lung with matched spatial resolution. The method presents new opportunities for quantifying relationships among gas delivery, exchange and transport, and shows significant potential to provide new insights into lung disease.

10:54 ***198***. **Mapping of ^{3}He Apparent Diffusion Coefficient Anisotropy at Sub-Millisecond Diffusion Times in Sham-Instilled and Elastase-Instilled Rat Lungs**

Xiaojun Xu[1,2], Juan Parra-Robles[3], Alexei Ouriadov[1], Giles E. Santyr[1,4]

[1]Imaging Laboratories, Robarts Research Institute, London, Ontario, Canada; [2]Department of Physics, University of Western Ontario, London, Ontario, Canada; [3]University of Sheffield, Sheffield, United Kingdom; [4]Department of Medical Biophysics, University of Western Ontario, London, Ontario, Canada

^{3}He diffusion in the lungs is restricted by airway and alveoli walls and therefore is highly dependent on lung microstructure. ^{3}He ADC has been shown to be sensitive to changes in terminal airway anatomy, specifically alveolar damage due to emphysema in both humans and animal models. At the terminal airway, ^{3}He diffusion has been demonstrated to be anisotropic, described by longitudinal diffusion coefficient (D_L) and transverse diffusion coefficient (D_T). The purpose of this work was to measure and compare D_L and D_T maps in sham-instilled and elastase-instilled Wistar rats at two sub-millisecond (360 μs and 800 μs).

11:06 ***199***. **Evaluation of Emphysema Progression in Chronic Obstructive Pulmonary Disease (Copd); 3He 3D Adc Measurements Compared with Ct and Lung Function Test, Preliminary Results.**

Frederik Hengstenberg[1,2], Torsten Dorniok[1], Sergei Karpuk[3], Jørgen Vestbo[2], Rahim Rizi[4], Per Åkeson[1], Peter Magnusson[1], Lise Vejby Søgaard[1]

[1]Danish Research Centre for Magnetic Resonance, Copenhagen University Hospital Hvidovre, Hvidovre, Denmark; [2]Department of Cardiology and Respiratory Medicine, Copenhagen University Hospital Hvidovre, Hvidovre, Denmark; [3]Institute of Physics, University of Mainz, Mainz, Germany; [4]Department of Radiology, University of Pennsylvania, PA, United States

There is a need for developing a more sensitive biomarker for monitoring progression of pulmonary emphysema in COPD. In this study with 20 COPD patients and 5 healthy control subjects the use of the 3He apparent diffusion coefficient (ADC) in assessing progression was investigated in a one year longitudinal study comparing ADC measurements, CT densitometry and lung function tests. In a subgroup of emphysema patients a significant increase of ADC was detected, reflecting disease progression.

11:18 ***200***. **Functional Lung Imaging of Childhood Asthma Using Radial MRI with Hyperpolarized Noble Gas**

Sean Fain[1], Rafael O'Halloran[2], Eric Peterson[3], James Holmes[4]

[1]Medical Physics, University of Wisconsin - Madison, Madison, WI, United States; [2]Radiology, Stanford University, Stanford, CA, United States; [3]Biomedical Engineering, University of Wisconsin - Madison, Madison, WI, United States; [4]Applied Science Lab, GE Healthcare, Madison, WI, United States

Assessment of lung function in pediatrics poses significant challenges due to variable ability to cooperate with respiratory maneuvers. Radial dynamic 3D imaging using multi-echo VIPR (ME-VIPR) acquisition with HP He-3 and I-HYPR reconstruction is used in a protocol designed to minimize breath-hold time for whole lung coverage with good isotropic resolution, and sufficient temporal resolution to adapt to the subject's ability to perform respiratory maneuvers. Diffusion-weighted MRI with HP He-3 MRI also provides a means to assess microstructure of the lung parenchyma without ionizing radiation. Preliminary results in 40 pediatric subjects at-risk for asthma are presented.

11:30 ***201***. **Simultaneous Acquisition of 3He Ventilation Images, ADC, T2* and B1 Maps in a Single Scan with Compressed Sensing**

Salma Ajraoui[1], Juan Parra-Robles[1], Helen Marshall[1], Martin H. Deppe[1], Steve R. Parnell[1], Jim M. Wild[1]

[1]University of Sheffield, Sheffield, United Kingdom

A novel interleaved sequence is presented in this work that allows acquisition of 3He ventilation, ADC, T2* and B1 maps simultaneously in-vivo. B1 maps were used to corrected the ventilation image for the artifacts due to the B1 inhomogeneities, while Compressed Sensing scheme was used to accelerate the temporal resolution. The sequence was tested in three healthy volunteers and the values of parameters obtained are in accordance with previously published results.

11:42 ***202***. **Measurement of Gas Flow and Oxygenation in Small Animal Lungs Using Hyperpolarized Gas**

Stephen J. Kadlecek[1], Puttisarn Mongkolwisetwara[1], Kiarash Emami[1], Masaru Ishii[2], Jianliang Zhu[3], Elaine Chia[1], John M. Woodburn[1], Rahim R. Rizi[1]

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Measurement of pulmonary oxygen concentration in small animals using hyperpolarized gas is shown to be complicated by gas redistribution during the short breath-hold. This additional complexity can be incorporated into a model which yields information about airway obstruction and is potentially itself of diagnostic value.

11:54 ***203***. **Lung MR Imaging with Ultra-Short TE at 3.0T System: Capability for Pulmonary Functional Loss Due to COPD**

Yoshiharu Ohno[1], Hisanobu Koyama[1], Keiko Matsumoto[1], Yumiko Onishi[1], Daisuke Takenaka[1], Munebu Nogami[1], Nobukazu Aoyama[2], Hideaki Kawamitsu[2], Makoto Obara[3], Marc van Cauteren[3], Masaya Takahashi[4], Kazuro Sugimura[1]
[1]Radiology, Kobe University Graduate School of Medicine, Kobe, Hyogo, Japan; [2]Radiology, Kobe University Hospital, Kobe, Hyogo, Japan; [3]Philips Healthcare, Tokyo, Japan; [4]Radiology, The University of Texas Southwestern Medical Center, Dallas, TX, United States

Regional T2* measurement can be easier performed by using 3.0 T system than 1.5 T system in routine clinical practice. We hypothesized that direct T2* measurement in the lung has potential to play a new method for pulmonary functional loss assessment at 3.0 T system. The purpose of this study was to determine the capability of Lung MR imaging with ultra-short TE (uTE MRI) at 3T MR system for measurement of regional T2* in the lung and pulmonary functional assessment in normal and COPD subjects.

12:06 ***204***. **Lung Imaging in the Mouse with SWIFT**

Curtis Andrew Corum[1,2], Djaudat Idiyatullin[1], Steen Moeller[1], Ryan Chamberlain[1], Deepali Sachdev[2,3], Michael Garwood[1,2]
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Lung and especially lung parenchyma are especially difficult to image with MRI. T2* times are in the sub-millisecond range and may require specialized hardware and methods to for optimum visualization or quantitative information. Many lung pathologies such as inflamation (asthma), primary and metastatic neoplasms (cancer) would benefit from more robust and higher SNR methodologies. SWIFT is a recently developed 3D radial imaging sequence, sensitive to ultra-short T2 and T2* signals. We demonstrate for the first time, free breathing prospectively gated 1H SWIFT images of the mouse lung. Lung parenchyma has significant signal and information content while bronchi appear dark.

12:18 ***205***. **Dynamic Oxygen-Enhanced MRI in Patients with Pulmonary Arterial Hypertension**

Olaf Dietrich[1], Daniel Maxien, Sven Thieme, Maximilian F. Reiser[1], Konstantin Nikolaou
[1]Josef Lissner Laboratory for Biomedical Imaging, Department of Clinical Radiology, LMU Ludwig Maximilian University of Munich, Munich, Germany

Dynamic oxygen-enhanced MRI (O_2-MRI) of the lung was applied in 11 healthy volunteers and in 20 patients with pulmonary arterial hypertension (PAH). Data was evaluated pixelwise by fitting a piecewise exponential model function with 4 parameters (relative enhancement, signal delay, wash-in/out times) to the signal time course. The individual parameter distributions were compared between volunteers and patients. The median values of the determined parameters were similar in both groups, but the ranges (16th to 84th percentile) of relative signal enhancement, signal delay and wash-out time constant were significantly increased in PAH patients.

Cell Tracking

Room A5 10:30-12:30 *Moderators:* Paula J. Foster and Erik M. Shapiro

10:30 ***206***. **A Multimodality Investigation of the Dynamics, Trafficking and Properties of Iron Oxide Core High-Density Lipoprotein in Experimental Atherosclerosis**

Torjus Skajaa[1,2], David Peter Cormode[1], Peter Jarzyna[1], Courtney Blachford[3], Amanda Delshad[1], Edward A. Fisher[3], Ronald E. Gordon[4], Zahi A. Fayad[1], Willem J.M Mulder[1]
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FeO-HDL is a lipoprotein derived nanoparticle platform detectable by MRI, optical imaging and TEM. In the current study FeO-HDL was synthesized, applied to various cell lines in vitro and to apoE-KO and wild type mice in vivo. Characterization of FeO-HDL revealed close resemblance to native HDL. In vitro experiments confirmed the aforementioned and showed excellent biocompatibility. Upon intravenous administration in vivo MRI experiments on apoE-KO mice revealed their uptake in the lesioned vessel wall, which was confirmed histologically. Lipid exchange measurements showed lipid transfer from FeO-HDL to native lipoproteins. Conclusively we have shown that FeO-HDl closely resembles native HDL.

10:42 ***207***. **The Effects of Iron Oxide Labelling on the *in Vitro* Chondrogenic Potential of Three Human Cell Types**

Sushmita Saha[1], Steven Frederick Tanner[2], Jennifer Kirkham[1], David Wood[1], Stephen Curran[3], Xuebin B. Yang[1]
[1]Department of Oral Biology, University of Leeds, Leeds, W-Yorkshire, United Kingdom; [2]Division of Medical Physics, University of Leeds, Leeds, W-Yorkshire, United Kingdom; [3]Smith and Nephew Research Centre, York, United Kingdom

MRI has been used to monitor the distribution of labelled cells in studies related to cell therapy in regenerative medicine. There has been debate on the effects of the Super-Paramagnetic Iron Oxide (SPIO) label on cellular differentiation along the chondrogenic lineage. Whilst previous studies have employed tissue staining to infer cartilage formation; here we use the quantitative reverse transcription polymerase chain reaction technique to assess the effects of the SPIO label on chondrogenic gene expression. The study has shown that inhibition of gene expression resulting from SPIO labelling is dependent on the target cell used.

10:54 ***208***. **Non-Invasive Monitoring of Human Dendritic Cell Migration in the CB17 Scid Mouse by Cellular MRI**

Gregory A. Dekaban[1], Xizhong Zhang[2], Vasiliki Economopoulos[3], Jennifer Noad[3], Roja Rohani[3], Adele Wang[4], Megan Levings[4], Ronan Foley[5], Paula Foster[3]

[1]BioTherapeutics Research Laboratory, Robarts Research Institute, London , Ontario, Canada; [2]BioTherapeutics Research Laboratory, Robarts Research Institute, London, Ontario, Canada; [3]Imaging Research Laboratories, Robarts Research Institute; [4]Department of Surgery, University of British Columbia; [5]Department of Pathology and Molecular Medicine, McMaster University

The successful migration of adequate numbers of in vitro-generated human dendritic cells (DC) from the site of injection to a draining lymph node is a necessary and crucial step in order for a DC-based vaccine to be a successful immunotherapy for cancer and infectious disease. Currently, less than 5% of injected DC migrate to a draining lymph node. How well a preparation of DC migrates is best assessed by conducting migration assays in vivo. Here we demonstrated that migration of human DC labeled with superparamagnetic iron oxide nanoparticles can be tracked to lymph nodes of CB17 scid mice.

11:06 ***209***. **Comparison of Rate of Islet Loss in Syngeneic, Allogeneic and Xenogeneic Grafts in Rat Using Quantification of Iron Oxide Labeled Islet Cells by 3D Radial UTE MRI.**

Lindsey Alexandra Crowe[1], Frederic Ris[2], Sonia Nielles-Vallespin[3], Peter Speier[3], Michel Kocher[4], Solange Masson[2], Christian Toso[2], Domenico Bosco[2], Thierry Berney[2], Jean-Paul Vallée[1]

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In-vivo 3D difference ultra-short echo time (dUTE) imaging gives quantitative positive contrast images for serial examination by automatic segmentation of iron oxide labeled islet cell clusters transplanted into the liver. Coverage of the whole liver in the absence of cardiac and respiratory motion artifact, and isotropic resolution is obtained with uniform background suppression. Three types of grafts: syngeneic, allogeneic and xenogeneic, were studied over time in rat, with success of islet graft, effect of magnetofection and rate of islet loss measurably different. The method shows promise for robust long term tracking of cell rejection in patients.

11:18 ***210***. **Long-Term MR Imaging of Immunocompetent and Immunodeficient Mice Reveals Distinct Differences in Contrast Clearance in the Brain**

Stacey Marie Cromer Berman[1,2], Assaf A. Gilad[1,2], Jeff W. M. Bulte[1,2], Piotr Walczak[1,2]

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One important obstacle for correct interpretation of long-term MRI cell tracking is the possibility of persisting hypointense signal even after death of transplanted cells. In order to evaluate this challenge, SPIO-labeled neural stem cells were allografted into the brains of immunocompetent Balb/C mice, inducing cell rejection (dead cells) and immunodeficient Rag2 mice, with no cell rejection (live cells). The transplanted cells were monitored in vivo by MRI for 93 days. Unexpectedly, the MR hypointensities cleared more rapidly in non-rejecting Rag2 mice than in rejecting Balb/C mice, indicating that cell proliferation and migration may dominate clearance of MR signal.

11:30 ***211***. **MRI Tracking of Endogenous Neural Precursors Odor Induced Accumulation in the Mitral Cell Layer of the Rodent Olfactory Bulb**

James P. Sumner[1], Der-Yow Chen[1], Stephen Dodd[1], Elizabeth Wayne[1,2], Yun Chen[1,3], Dragan Maric[1], Alan P. Koretsky[1]

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In the adult mammals, neural progenitor cells (NPCs) migrate to the olfactory bulb and differentiate into neurons. These cells are believed to be involved in processing olfactory signals. Here we demonstrate that high resolution MRI can be utilized to evaluate the affects of odor enrichment on new neurons in the olfactory bulb with anatomical layer specificity. We found that amyl acetate enrichment resulted in the accumulation of NPCs in the mitral cell layer. This in vivo method illustrates the advantages of using high resolution anatomical imaging in combination with cell tracking.

11:42 ***212***. **Using ^{19}F MR to Monitor Delivery and Engraftment of Therapeutic Stem Cells *in Vivo*: Accuracy Evaluation**

Yibin Xie[1], Steven M. Shea[2], Yingli Fu[3], Wesley D. Gilson[2], Tina Ehtiati[2], Ronald Ouwerkerk[4], Dorota Kedziorek[3], Meiyappan Solaiyappan[3], Gary Huang[3], Steffi Valdeig[3], Frank Wacker[3], Dara L. Kraitchman[3]

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The delivery and engraftment of therapeutic stem cells can be monitored by both ^{19}F MRI and c-arm CT using alginate-poly-L-lysine-alginate microcapsules loaded with perfluorooctylbromide (APA-PFOB). MR tracking is advantageous for high sensitivity and absence of ionizing radiation. However it suffers from lower resolution. This study evaluates accuracy of tracking encapsulated mesenchymal stem cells using ^{19}F MRI relative to c-arm CT. Results show a high identification and agreement in the spatial locations and volumes of the injection sites between MRI and CT demonstrating that MRI provides an accurate alternative to CT for tracking of encapsulated stem cells *in vivo*.

11:54 ***213***. **Surprising Results in the Use of MPIOs to Label Bone-Marrow Resident Monocytes for Immune Cell Tracking by MRI**

Bradley Hann[1,2], Kevin S. Tang[3], Kevin M. Bennett[2], Erik M. Shapiro,[3,4]
[1]Biological Health System Engineering, Arizona State College, Tempe, AZ, United States; [2]School of Biological and Health Systems Engineering, Arizona State University, Tempe, AZ, United States; [3]Department of Biomedical Engineering, Yale University, New Haven, CT, United States; [4]Department of Diagnostic Radiology, Yale University School of Medicine, New Haven, CT, United States

The accumulation and presence of MPIOs in bone marrow was studied over seven days. High-resolution, serial in-vivo MRI was performed on mice injected with various quantities of MPIOs. MRI signal changes were monitored in bone marrow and muscle to study MPIO trafficking. In vivo labeling efficiency of bone marrow-resident monocytes was then quantified using flow cytometry. Unexpected results were obtained. It was found that MPIOs did not label monocytes in marrow. An alternative explanation for the success of MPIOs in immune cell trafficking is presented, centered around re-entrance of MPIOs into the circulation long after initial clearance from the vasculature.

12:06 ***214***. **MRI Visualization of Anatomical Connections in Vivo Using a Gadolinium Chelated Neural Tracer**

Carolyn W. H. Wu[1,2], Ning Liu[3], Der-Yow Chen[2], Vasalatiy Olga[4], Alan P. Koretsky[2], Gary L. Griffiths[4], Roger B. Tootell[3,5], Leslie G. Ungerleider[3]
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A shortcoming of conventional neuroanaomy approaches to study neuronal circuitry is that it requires visualizing transported tracer in the post-mortem tissue. The goal of the study is to expand the MRI contrast media available for in vivo target-specific, mono-synaptic, neuronal tract tracing, by testing a new compound that conjugates conventional neuro-anatomical tracer CTB with GdDOTA. We show that CTBGdDOTA is a MRI neural tracer that allows in vivo visualization of mono-synaptically connected brain circuits, that is target-specific, bi-directional, very reproducible, and stable over a relatively long period of time. This agent opens the possibility for repetitive, chronic, and longitudinal studies.

12:18 ***215***. **In Vivo Monitoring of Bacterial Infections Using High-Field MR Microscopy**

Volker Sturm[1], Tobias Hertlein[2], Thomas Basse-Lüsebrink[1], Daniel Haddad[3], Knut Ohlsen[2], Peter Jakob[1,3]
[1]Experimental Physics 5, University of Würzburg, Würzburg, Germany; [2]Institute for Molecular Infection Biology, University of Würzburg, Würzburg, Germany; [3]Research Center for Magnetic Resonance Bavaria e.V., Würzburg, Germany

In vivo monitoring of bacterial infection allows effective testing of potential new drugs and active compounds. Therefore we investigate native (T2) and marker (19F) based MRI methods for those requirements. Here the T2 maps have been proved to be able to visualize the inflammation formation in a mouse muscle abscess model at even early stages (day 2), while the 19F- marker accumulate in the area of infection. The latter has the potential to deliver new insights into the process of host-pathogen interaction, even though the exact mode of accumulation had to be investigated further.

Gradients, Shims & Novel Systems

Room A6 10:30-12:30 *Moderators:* Labros S. Petropoulos and Michael S. Poole

10:30 ***216***. **Concurrent Higher-Order Field Monitoring for Routine Head MRI: An Integrated Heteronuclear Setup**

Christoph Barmet[1], Bertram Jakob Wilm[1], Matteo Pavan[1], Georgios Katsikatsos[1], Jochen Keupp[2], Giel Mens[3], Klaas Paul Pruessmann[1]
[1]Institute for Biomedical Engineering, ETH and University, Zurich, Switzerland; [2]Philips Research Europe, Hamburg, Germany; [3]Philips Healthcare, Best, Netherlands

A higher-order concurrent field monitoring setup is introduced for routine head MRI. It enables the tracking of dynamic field evolution up to 3rd order concurrently with data acquisition. This is particularly important for non-reproducible field contributions, e.g. due to magnet heating, breathing or external fields. The field information allows for the correction of image artifacts at the reconstruction stage.
A heteronuclear approach – monitoring is performed on the 19F nucleus – guarantees perfect separation of monitoring and imaging experiment. As a result, scan protocols and procedures can remain unchanged, which greatly simplifies translation into clinical practice.

10:42 ***217***. **Coherent Excitation Scheme to Operate Pulsed NMR Probes for Real-Time Magnetic Field Monitoring**

Pekka Sipilä[1,2], Gerhard Wachutka[2], Florian Wiesinger[1]
[1]GE Global Research, Munich, Bavaria, Germany; [2]Institute for Physics of Electrotechnology, Munich University of Technology, Munich, Bavaria, Germany

Description of an apparatus for improving image quality during MRI-scan by measuring the magnetic fields with pulsed NMR probes. Closely interleaved excitation pulses, of which phase is in coherence with the precessing spins, offer high SNR also during short TR and high-resolution imaging. This offers more general functionality with respect to MR imaging parameters, and has not been achievable with previous magnetic field monitoring NMR probe designs. The applicability of the developed feedback based coherent excitation scheme to operate NMR probes for monitoring k-space trajectories is shown with a spiral acquisition scheme.

10:54 ***218***. **Fast MPI Demonstrator with Enlarged Field of View**

Bernhard Gleich[1], Jürgen Weizenecker[2], Holger Timminger[1], Claas Bontus[1], Ingo Schmale[1], Jürgen Rahmer[1], Joachim Schmidt[1], Jürgen Kanzenbach[1], Jörn Borgert[1]
[1]Philips Technologie GmbH, Forschungslaboratorien, Hamburg, Germany; [2]Fakultät für Elektro- und Informationstechnik, University of Applied Sciences, Karlsruhe, Germany

Magnetic particle imaging (MPI) is a new tomographic imaging modality that directly and quantitatively images iron oxide nanoparticle concentration without anatomical background signal. It combines high sensitivity with the ability of fast volumetric imaging. Current demonstrators either provide fast imaging or a large field of view. Here, a solution is proposed, that allows for both, fast imaging with large FOVs.

11:06 ***219***. **Development of a Simultaneous PET-MRI Breast Imaging System**

Bosky Ravindranath[1], Sachin S. Junnarkar[2], David Bennett[3], Xiaole Hong[3], Ken Cheng[3], Sean Stoll[2], Martin L. Purschke[2], Sri Harsha Maramraju[1], Dardo Tomasi[2], Sudeepti Southekal[1], Paul Vaska[2], Craig Woody[2], David J. Schlyer[2]
[1]Biomedical Engineering, Stony Brook University, Brookhaven, NY, United States; [2]Brookhaven National Laboratory, Upton, NY, United States; [3]Aurora Imaging Technology Inc., North Andover, MA, United States

At Brookhaven National Laboratory, we are developing a MRI compatible dedicated breast PET scanner that will enable simultaneous PET-MRI imaging of the breast. We have developed and tested a prototype version of the PET system that has an average resolution less than 2 mm FWHM. Good quality MRI images were obtained with the PET system operating unshielded inside the field of view of a 1.5 T dedicated breast MRI. Our next goal is to acquire simultaneous PET-MRI images using the prototype PET and dedicated breast MRI system.

11:18 ***220***. ***In Vivo* Simultaneous MR/PET Images of the Rat Brain and Mouse Heart at 9.4 Tesla**

Sri-Harsha Maramraju[1,2], S.-David Smith[2], Martin Purschke[2], Sean Stoll[2], Bosky Ravindranath[1], Sergio Rescia[2], Sachin Junnarkar[2], Sudeepti Southekal[1], Paul Vaska[2], Craig Woody[2], David Schlyer[2]
[1]Biomedical engineering, Stony Brook University, Stony Brook, NY, United States; [2]Brookhaven National Laboratory, Upton, NY, United States

We have developed a MRI compatible PET tomograph for use inside a 9.4 T microMRI scanner. This synergistic integration resulted in simultaneous acquisition of MR and PET imaging of rodents with minimal mutual interference between the two systems. New MRI coils have been built that fit inside the PET detector and obtain high quality MR images. Simultaneous MR and PET images of a rat striata phantom, rat brain and gated mouse cardiac images have been acquired, providing the flexibility to perform both rat brain and mouse cardiac studies using the same PET detector inside MRI.

11:30 ***221***. **A Single-Axis Composite Shim Coil Insert for Spectroscopy in the Medial Temporal Lobe of the Human Brain**

Parisa Hudson[1], Chad T. Harris[1], William B. Handler[1], Timothy J. Scholl[1], Blaine A. Chronik[1]
[1]Department of Physics and Astronomy, The University of Western Ontario, London, Ontario, Canada

High field magnetic resonance imaging (MRI) and spectroscopy (MRS) of the human brain suffer from large field inhomogeniety, caused by the presence of air inside the brain, due to the susceptibility differences between air and tissue. To correct for the large inhomogeneities that are consistent between subjects, we present a new approach that utilizes very efficient, short, single-axis composite shim coils used together with existing system shims. These coils require less power, occupy less space, and perform better than a set of general purpose, high order shims.

11:42 ***222***. **Zero- To Third-Order Dynamic Shim Updating of the Human Brain at 7 Tesla**

Christoph Juchem[1], Terrence W. Nixon[1], Piotr Diduch[2], Scott McIntyre[1], Douglas L. Rothman[1], Piotr Starewicz[2], Robin A. de Graaf[1]
[1]MR Research Center, Yale University, New Haven, CT, United States; [2]Resonance Research Inc., Billerica, MA, United States

The first realization of full zero- to third-order DSU with full preemphasis and B_0 compensation is presented which allowed high quality shimming of the human brain at 7 Tesla. The achievable magnetic field homogeneity could be largely improved not only in comparison to global (i.e. static) zero- to third-order shimming, but also when compared to state-of-the-art zero- to second-order DSU.

11:54 ***223***. **Motor Design for an MR-Compatible Rotating Anode X-Ray Tube**

Prasheel Lillaney[1], Robert Bennett[1], Rebecca Fahrig[1]
[1]Radiology, Stanford Univeristy, Stanford, CA, United States

This work discusses the development of an alternate motor design for rotating anode x-ray tubes to be used in hybrid x-ray/MR image guidance systems. The novel aspect of our design is that we propose to use the MR fringe field to generate torque in our motor. A proof of concept of our design has been assembled and can rotate at a maximum speed slightly above 450 RPM in a 45 mT external field. With further research and optimization of parameters we are confident that we can meet the design constraints for typical x-ray tube motors.

12:06 ***224***. **Portable MRI Magnets and Spinning Micro-Detectors**

Dimitrios Sakellariou[1], Cédric Hugon[1], Alan Wong[1], Pedro Aguiar[1], Guy Aubert[2], Jacques-François Jacquinot[3]
[1]DSM/IRAMIS/LSDRM/SIS2M, CEA - Saclay, Gif-sur-Yvette, Essone, France; [2]DSM / IRFU / Neurospin, CEA - Saclay; [3]DSM / IRAMIS / SPEC, CEA - Saclay

The message of my presentation is that permanent magnet engineering together with ideas from solid-state NMR can give place to innovation in medical Magnetic Resonance. We demonstrate a new strategy to develop portable MRI magnets and show the first example of a high uniformity one-sided system. We also use spinning micro-detectors as a means to achieve high resolution microscopy by magic angle sample spinning in the stray field of a magnet. Ideas on magic angle field spinning will be the common denominator for these projects. Ideas and preliminary instrumentation will be presented.

12:18 ***225***. **Active Localized Shielding for Devices Within MRI Gradient Coils**

Chad Harris[1], William Handler[1], Blaine Alexander Chronik[1]
[1]Physics and Astronomy, University of Western Ontario, London, Ontario, Canada

There are an increasing number of applications in which non-MRI active or passive devices are being introduced into the MRI system and required to operate normally while exposed to the static, RF, and audio-frequency (i.e. gradient) magnetic fields produced during normal scanning. In this study, we focus on gradient fields and consider the possibility of designing a very localized, active shield to cancel the time-varying magnetic fields for an arbitrary device located within the inside diameter of the gradient system.

Contrast Mechanisms in Quantitative Cartilage MRI

Room A7 10:30-12:30 *Moderators:* Matthew F. Koff and Mikka Niemenen

10:30 ***226***. **Imaging of the Zone of Calcified Cartilage (ZCC) Using 3D Ultrashort TE Pulse Sequences**

Jiang Du[1], Won C. Bae[1], Sheronda Statum[1], Renie Biswas[1], Michael Carl[2], Atsushi Takahashi[2], Christine B. Chung[1], Graeme M. Bydder[1]
[1]Radiology, University of California, San Diego, CA, United States; [2]Global Applied Science Laboratory, GE Healthcare Technologies, Menlo Park, CA, United States

The zone of calcified cartilage (ZCC) is a highly modified mineralized region of articular cartilage that forms an important interface between cartilage and bone. It is a region that may change dramatically in osteoarthritis (OA). However, all current clinical sequences show a signal void for the ZCC because of its short T2 and thin structure. Here we present 3D UTE sequences for ZCC imaging using three contrast mechanisms: dual echo acquisition and echo subtraction, single adiabatic inversion recovery (SIR) and dual inversion recovery (DIR). The feasibility of these techniques was tested on five cadaveric patellae on a clinical 3T scanner.

10:42 ***227***. **Ultrashort TE Enhanced T_2^* Mapping of Cartilage: a Pilot Clinical Study**

Ashley Williams[1], Yongxian Qian[2], Constance R. Chu[1]
[1]Cartilage Restoration Laboratory, University of Pittsburgh, Pittsburgh, PA, United States; [2]Magnetic Resonance Research Center, University of Pittsburgh, Pittsburgh, PA, United States

This work demonstrates the feasibility of *in vivo* 3-D UTE-T_2^* mapping of cartilage and examines the sensitivity of UTE-T_2^* to early cartilage degeneration compared to arthroscopic grading as the standard. UTE-T_2^* and standard T_2 knee images were acquired on 10 subjects at 3T. Deep zone UTE-T_2^* values were significantly higher in softened cartilage compared to healthy (arthroscopic grade 1vs0, $p<0.01$). Superficial zone UTE-T_2^* showed a trend for higher values in softened tissue compared to healthy ($p=0.17$). Standard T_2 values showed no differences between healthy and softened cartilage. UTE-T_2^* mapping captures signal from deep cartilage better than standard T_2 .

10:54 ***228***. **Change in the DTI Parameters of the Articular Cartilage with Progressive Proteoglycan Depletion**

José G. Raya[1], Gerd Melkus[2], Silvia Adam-Neumair[3], Olaf Dietrich[4], Maximilian F. Reiser, Peter Jakob[2], Christian Glaser
[1]Josef Lissner Laboratory for Biomedial Imaging, , University of Munich, Munich, Germany; [2]Deparment of experimental physics V, University of Würzburg, Germany; [3]Department of Clinical Radiology, University of Munich, Germany; [4]Josef Lissner Laboratory for Biomedial Imaging, Department of Clinical Radiology, University of Munich, Germany

DTI has great potential for the early diagnosis of osteoarthritis since it is sensitive to the proteoglycan (PG) content and the integrity of the collagen network. In this work we investigate the effect of progressive PG depletion on the DTI parameters. DTI and T2 of human bone-on-cartilage samples as well as their PG content were measured before and after proteoglycan depletion. ADC showed a linear ($r^2=0.86$, $P<0.007$) dependence with the PG loss. The diffusion anisotropy (FA and first eigenvector) remained unchanged. Measurements of the T2 relaxation time demonstrated that the collagen structure of the cartilage was unaffected by PG depletion.

11:06 ***229***. **Loading and Knee-Alignment Have Significant Influence on Cartilage T2 in Porcine Knee Joints**

Toshiyuki Shiomi[1], Takashi Nishii[1], Hisashi Tanaka[2], Youichi Yamazaki[3], Kenya Murase[3], Akira Myoui[1], Hideki Yoshikawa[1], Nobuhiko Sugano[1]
[1]Department of Orthopaedic Surgery, Osaka University Medical School, Suita, Osaka, Japan; [2]Department of Radiology, Osaka University Medical School, Osaka, Japan; [3]Department of Medical Physics and Engineering, Osaka University Medical School, Osaka, Japan

We developed a non-metallic pressure device to be used during MRI under variable loading or knee alignment conditions in excised porcine knee joints, and assessed the influence of loading and knee alignment on T2 mapping of the knee femoral cartilage.

11:18 ***230***. **Quantitative Mri Reveals Early Cartilage Degeneration in Acl-Injured Knees**

Xiaojuan Li[1], Daniel Kuo, Keerthi Shet, Christoph Stehling, Jonathan Cheng, Thomas Link, Benjamin Ma, Sharmila Majumdar
[1]Radiology, University of California, San Francisco, San Francisco, CA, United States

Patients with anterior cruciate ligament (ACL) injuries have a high risk of developing post-traumatic osteoarthritis. The goals of this study were: 1) to longitudinally evaluate cartilage matrix changes using T1ρ and T2 quantification; 2) to study the relationship between meniscal damage and cartilage degeneration. 12 patients with acute ACL-injures and 10 healthy controls were studied. Significantly elevated T1rho were observed at 1-year follow up. T1rho were more sensitive than T2 in detecting early changes in cartilage matrix in ACL-injured knees. Lesions in posterior horn of medial meniscus were correlated with accelerated cartilage degeneration in medial femoral condyle.

11:30 ***231***. **MRI of Bioregenerative Approaches in Cartilage Repair: Differentiation of Repair Tissue After Matrix-Associated Autologous Chondrocyte Transplantation Using a Hyaloronic Acid-Based or a Collagen-Based Scaffold with Advanced Morphological Scoring and Bioch**

Goetz Hannes Welsch[1,2], Tallal Charles Mamisch[3], Lukas Zak[4], Matthias Blanke[2], Alexander Olk[2], Stefan Marlovits[4], Siegfried Trattnig[1]

[1]MR Center, Department of Radiology, Medical University of Vienna, Vienna, Austria; [2]Department of Trauma and Orthpaedic Surgery, University Hospital of Erlangen, Erlangen, Germany; [3]Department of Orthopaedic Surgery, University of Basel, Basel, Switzerland; [4]Center for Joints and Cartilage, Department of Trauma Surgery, Medical University of Vienna, Vienna, Austria

Aim of the study was to compare cartilage repair tissue at the femoral condyle noninvasively after matrix-associated autologous chondrocyte transplantation (MACT) using Hyalograft® C (HC), a hyaloronic acid-based scaffold, to cartilage repair tissue after MACT using CaReS®, a collagen-based scaffold, with morphological and biochemical MRI. Differences in the surface of the repair tissue using morphological MRI and higher T2 values for the cartilage repair tissue depicted by biochemical T2 maps indicate differences in the composition of the repair tissue that was based on a collagen scaffold (CaReS®), compared to the hyaloronic acid-based scaffold (HC), even two years post-implantation.

11:42 ***232***. ***In Vivo* Quantification of Cartilage Regeneration in an Equine Model at 3T Following Gene Therapy**

Daniel James Clark[1], Guang Jia[1], Maria Isabel Menendez[2], Seongjin Choi[1], Craig James Miller, Steffen Sammet[1], David C. Flanigan[3], Alicia Louise Bertone[2], Michael V. Knopp[1]

[1]Radiology, College of Medicine, The Ohio State University, Columbus, OH, United States; [2]Veterinary Clinical Sciences, College of Veterinary Medicine, The Ohio State University, Columbus, OH, United States; [3]Orthopedics, OSU Sports Medicine Center, The Ohio State University, Columbus, OH, United States

Currently, there is no established human sized model for cartilage regeneration. This study is the first to assess the time course of healing *in vivo* using quantitative MRI in live ponies with cartilage thicknesses comparable to humans in a 3T clinical scanner. We use several innovative, quantitative methods including delayed contrast-enhanced MRI of cartilage (dGEMRIC), dynamic contrast-enhanced MRI (DCE-MRI), and T_2 mapping. The results of this study strongly suggest that *in vivo* quantitative MRI can be used to monitor cartilage healing and characterize the physiological state of repaired tissue.

11:54 ***233***. **High Resolution Cartilage and Whole Organ Knee Joint Assessment: 3D Radial Fat-Suppressed Alternating TR SSFP**

Jessica Leigh Klaers[1], Ethan K. Brodsky[1,2], Walter F. Block[1,3], Richard Kijowski[2]

[1]Medical Physics, University of Wisconsin - Madison, Madison, WI, United States; [2]Radiology, University of Wisconsin - Madison, Madison, WI, United States; [3]Biomedical Engineering, University of Wisconsin - Madison, Madison, WI, United States

Effective cartilage imaging and whole organ joint assessment requires both high isotropic resolution and fat suppression or separation. We present a single pass, 3D radial fat-suppressed Alternating TR (FS ATR) SSFP acquisition which provides ultra-high isotropic resolution of 0.33 mm (voxel volume of 1/27 mm3) throughout the entire knee joint and contrast the method against a two pass, 3D radial Linear Combination SSFP (LC-SSFP) method. 3D radial FS-ATR offers complete visualization of the articular cartilage surface, further enhancing the ability to appreciate submillimeter cartilage defects which is useful for longitudinal research studies of cartilage degeneration and simultaneous whole organ assessment.

12:06 **234**. **Diffusivity and Kinetics of Gadopentetate in Articular Cartilage in Vitro**

Elli-Noora Salo[1], Mikko J. Nissi[1,2], Katariina Aino Maria Kulmala[1], Juha Töyräs[1,3], Miika T. Nieminen[4,5]

[1]Department of Physics, University of Kuopio, Kuopio, Finland; [2]Department of Clinical Radiology, Kuopio University Hospital, Kuopio, Finland; [3]Diagnostic Imaging Centre, Kuopio University Hospital, Kuopio, Finland; [4]Department of Medical Technology, University of Oulu, Oulu, Finland; [5]Department of Diagnostic Radiology, Oulu University Hospital, Oulu, Finland

In the dGEMRIC method, full equilibrium of gadopentetate is required to quantify the proteoglycan content of articular cartilage. In this study, the diffusivity and kinetics of gadopentetate was studied by limiting equilibration only through the articular surface or deep cartilage. The distribution of gadopentetate in bovine cartilage samples was followed for 18 hours with repeated T_1 mapping at 9.4 T. The results showed that full equilibration takes longer than previously assumed. Diffusion was faster through the articular surface. With equilibration through the articular surface, the superficial cartilage reached near-equilibrium relatively quickly, possibly allowing early visualization of superficial degenerative changes.

12:18 ***235***. **The in Vivo Transport of Anionic Contrast Agent Into Human Femoral Knee Cartilage**

Eveliina Lammentausta[1], Carl Johan Tiderius[2], Leif E. Dahlberg[2]

[1]Department of Clinical Sciences, Malmö, Joint and Soft Tissue Unit, University of Lund, Malmö, Sweden; [2]Department of Orthopaedics, Malmö University Hospital, Malmö, Sweden

The aim of the study was to investigate the distribution of Gd-$DTPA^{2-}$ into human knee cartilage in vivo at areas of different loading conditions. T1 relaxation time was measured before and regularly after triple does (0.3mM/kg) injection of Gd-$DTPA^{2-}$ for five healthy volunteers. Contrast agent transport was analyzed for three regions in femur and one in tibia, for deep and superficial cartilage separately. Different transport patterns were observed between weight-bearing and non-weight-bearing regions. The transport into deep cartilage was remarkably slower indicating transport only through cartilage surface.

New Angles on B1 Mapping

Room A8 10:30-12:30 *Moderators:* Ulrich Katscher and Yudong Zhu

10:30 **Introduction**
Hans-Peter Fautz, Ph.D.

10:54 ***236***. **Fast 2D B1 Mapping by K-Space Processing of Tagging Patterns**
Wayne R. Dannels[1], Andrew J. Wheaton[1]
[1]Toshiba Medical Research Institute, Mayfield Village, OH, United States

Measuring B1 transmit fields in vivo has importance in areas such as high field imaging, parallel transmission design, and quantitative imaging. A new method of acquisition and data analysis is presented for generating 2D B1 maps in vivo in as little as one TR. In this method saturation tag lines are applied before rapid imaging, tag lines are separated from the underlying image with k-space processing, and RF angles are computed from the tagging efficiency ratio.

11:06 ***237***. **Improved Phase-Based Adiabatic B1 Mapping**
Franciszek Hennel[1], Sascha Köhler[1]
[1]Bruker BioSpin MRI, Ettlingen, Germany

A method for the mapping of the radio-frequency transmission field is proposed that derives B1 values from the phase of the signal. The sequence consists of a block pulse to produce a B1-dependent nutation, followed by an inverse adiabatic half passage (IAFP) that converts the nutation phase to signal phase. Two ways to compensate the undesired dephasing caused by the IAFP are proposed: a rewinder RF pulse, or a matched adiabatic echo. The method provides an increased dynamic range compared to known phase-based B1-mapping sequences.

11:18 ***238***. **Flip Angle Taxonomy: Measuring Transmit (B1) Profile Distribution Without Imaging.**
Roman Fleysher[1], Lazar Fleysher[1], Joel A. Tang[2], Daniel Sodickson[1]
[1]Radiology, New York University, School of Medicine, New York, United States; [2]Chemistry, New York University, New York, United States

A method of measuring transmit (micro-) coil profile (B1) distribution is presented. In as much as it does not use spatial encoding, it reaches fine resolution in B1 at very high signal-to-noise ratios. The procedure can be used to alleviate systematic errors in spectroscopic data analysis caused by transmit field non-uniformity or can be employed for a quick evaluation of transmit (micro-) coil performance.

11:30 ***239***. **Permittivity Determination Via Phantom and in Vivo B1 Mapping**
Ulrich Katscher[1], Philipp Karkowski[1], Christian Findeklee[1], Tobias Voigt[2]
[1]Philips Research Europe, Hamburg, Germany; [2]Institute of Biomedical Engineering, University of Karlsruhe, Karlsruhe, Germany

Tissue permittivity might serve as diagnostic parameter, e.g., for oncology. However, the diagnostic use of the permittivity is significantly hampered by the lack of suitable methods to determine the permittivity in vivo. A possible approach for the determination of permittivity in vivo is given by analyzing the B1 map in the framework of standard MRI, called "Electric Properties Tomography" (EPT). Hitherto, studies were focussed on the ability of EPT to reconstruct the electric conductivity and local SAR. This study demonstrates the ability of EPT to determine the permittivity via numerous phantom and in vivo experiments.

11:42 ***240***. **Simultaneous 3D B1 and T1 Mapping Using the New Method of Slopes (MoS)**
Sofia Chavez[1], Greg Stanisz[1,2]
[1]Imaging Research, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [2]Medical Biophysics, University of Toronto, Toronto, Ontario, Canada

A new 3D method for simultaneous B1 and T1 mapping is presented. It relies on the quasi-linear relationship between the measured SPGR signal and nominal flip angle near the origin and near the signal null. The B1 mapping estimation is similar to that already existing in the literature with a more practical implementation requiring flip angles < 180° which are readily available on most scanners. The B1 mapping data with an additional acquisition of the SPGR signal at a low flip angle allows for the proposed T1 mapping. MoS yields accurate T1 values (within 10% of IR esimates) for an entire brain volume in ~12 min.

11:54 ***241***. **Comparison Between RF Spoiling Schemes in the Actual Flip-Angle Imaging (AFI) Sequence for Fast B_1 Mapping**
Vasily L. Yarnykh[1]
[1]Department of Radiology, University of Washington, Seattle, WA, United States

The Actual Flip-angle Imaging (AFI) method allows fast B1 mapping based on the spoiled steady-state principle. The combination of diffusion-based gradient and RF spoiling mechanisms was recently shown to considerably improve accuracy of this method. Two RF spoiling techniques were proposed for AFI in the literature: a standard phase incrementing scheme with a constant value of the phase increment and a modified scheme with two intermittently applied phase increments dependent on the ratio n=TR2/TR1. This study compares the spoiling behavior of the AFI sequence and accuracy of B1 measurements between the above RF spoiling schemes.

12:06 ***242***. **SVD Based Calibration of Transmit Arrays**

David Otto Brunner[1], Klaas Paul Pruessmann[1]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

Using transmit-receive arrays the acquisition of transmit and receive sensitivities are both of crucial importance but there are also great difficulties involved in bootstrapping such a process. In regions of low excitation, the receive sensitivities cannot be estimated correctly, leading to strong noise enhancement in the reconstructed images as well as in the transmit calibration data. This noise then propagates into the calculated transmit profiles hindering transmit calibration. In this work we present an acquisition and reconstruction technique that solves this entangled problem and allows finding concomitantly the signal optimal global RF shims and local receive channel combinations.

12:18 ***243***. **RF Field Profiling Through Element Design for High Field Volume Coils**

Can Akgun[1], Lance DelaBarre[1], Carl J. Snyder[1], Gregor Adriany[1], Anand Gopinath[2], Kamil Ugurbil[1], John Thomas Vaughan[1]
[1]University of Minnesota-Center for Magnetic Resonance Research, Minneapolis, MN, United States; [2]University of Minnesota-Department of Electrical and Computer Engineering, Minneapolis, MN

Multi-channel volume coils can be comprised of an array of transmission line elements operated as independent coils in multiple-channel transmit and receive configurations. In these designs, microstrip transmission elements have been implemented as magnetic field propagating elements. However, at high fields, RF in-homogeneities and inefficiencies require the optimization of these elements. In this study, two different microstrip designs with varying impedance lines; one producing peak B1+ in the center and the other extending usable B1+ along the coil are investigated. Simulation and image results for 8-channel volume coils incorporating these element designs were obtained using a phantom at 7T.

GOLD CORPORATE MEMBER LUNCHTIME SYMPOSIUM
Philips

Victoria Hall 12:30 - 13:30

CLINICAL INTENSIVE COURSE
Hot Topics: Emerging & Cross-Cutting Techniques in Pediatric Imaging

Room K1 13:30-15:30 ***Organizers & Moderators:*** **Patricia Ellen Grant and Claudia M. Hillenbrand**

EDUCATIONAL OBJECTIVES
Upon completion of this session, participants should be able to:

- Identify the main issues related to basic clinical pediatric (neuro-) radiology and translational imaging research in children;
- Explain the basic steps and concepts associated with (a) cardiovascular MR planning and imaging, and (b) assessment of body organ integrity or disease (i.e., via perfusion and diffusion) in the pediatric population;
- Evaluate the progress in fetal and neonatal imaging and to explain progress in advanced neuroimaging;
- Demonstrate additional knowledge of clinically adaptable pediatric imaging strategies; and
- Transfer and implement optimized pediatric protocols in their clinical or research practice. .

Part I: Emerging Techniques in Advanced Pediatric Neuroimaging

13:30 **MR Imaging and Post-processing of the Developing Fetal Brain**
Marie Schaer, M.D., Ph.D.

14:00 **Neonatal Imaging - Opportunities and Challenges**
Robert C. McKinstry, M.D., Ph.D.

14:30 **Pediatric Neuroimaging & Spectroscopy: From Screening to Quantitative Follow-Up**
Timothy P. Roberts, Ph.D.

15:00 **fMRI and Assessment of Disease Involvement & Investigation of the Connectivity By Analyzing the Resting State in Pediatric Patients**
Robert J. Ogg, Ph.D.

CLINICAL INTENSIVE COURSE
MR of Inflammatory Arthropathy

Room K2 13:30-15:30 ***Organizers:*** **Juerg Holder and Hollis G. Potter**

EDUCATIONAL OBJECTIVES
Upon completion of this session, participants should be able to:

- Recognize clinical findings and cellular mechanisms in inflammatory abnormalities;
- Describe the most relevant inflammatory abnormalities on MR images; and
- Optimize imaging protocols based on to clinical needs.

Moderators: **Claude Henri Manelfe and Bassem Georgy**

13:30 **Inflammatory Arthropathy: Clinical Assessment**
Steven R. Goldring, M.D.

14:10 **Ankylosing Spondylitis**
Anne G. Jurik, M.D.

14:50 **Psoriatic Arthritis**
Sabine Weckbach, M.D.

Thermotherapy, HIFU & Preclinical Interventions

Room A4 13:30-15:30 *Moderators:* Dennis L. Parker and Viola Rieke

13:30 ***244***. **Velocity Navigator Triggering for Motion Compensated PRF Thermometry**

Florian Maier[1], Axel Joachim Krafft[1], Jürgen W. Jenne[2,3], Rüdiger Dillmann[4], Wolfhard Semmler[1], Michael Bock[1]
[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany; [2]Clinical Cooperation Unit Radiation Oncology, German Cancer Research Center (DKFZ), Heidelberg, Germany; [3]Mediri GmbH, Heidelberg, Germany; [4]Institute of Anthropomatics, Karlsruhe Institute of Technology, Karlsruhe, Germany

Proton resonance frequency shift thermometry is sensitive to motion. Artifacts are caused by tissue displacement and susceptibility changes. In this work, a novel navigator technique for triggering MR thermometry image acquisition is presented. Non-velocity and velocity encoded navigator signals were acquired without lengthening of TR. Based on the phase variation of non-encoded values and the estimated velocity, trigger events were generated. The measurements indicate that the proposed triggered segmented EPI pulse sequence allows for motion compensated thermometry of periodically moving tissue.

13:42 ***245***. **Fat-Referenced MR Thermometry in Heterogeneous Tissue Using IDEAL**

Lorne Hofstetter[1], Desmond Teck Beng Yeo[2], Cynthia Davis[2], Thomas K. Foo[2]
[1]GE Global Research, Niskayuna , NY, United States; [2]GE Global Research, Niskayuna, NY, United States

Time-varying, non-temperature dependent phase changes affect the accuracy of conventional phase difference proton resonance frequency shift (PRFS) temperature mapping in the breast. We demonstrate a fat-referenced PRFS technique capable of correcting for this phase variation. This new approach reduced temperature measurement error in the left breast by a factor of 3.6 and in the right breast by a factor of 2.5 when compared to conventional phase difference techniques (n = 1).

13:54 ***246***. **The Effects of Spatial Sampling Choices on MR Temperature Measurements**

Nick Todd[1], Josh De Bever[2], Urvi Vyas[3], Allison Payne[4], Dennis L. Parker[5]
[1]Physics, University of Utah, Salt Lake City, UT, United States; [2]Robotics, University of Utah, Salt Lake City, UT, United States; [3]Bioengineering, University of Utah, Salt Lake City, UT, United States; [4]Mechanical Engineering, University of Utah, Salt Lake City, UT, United States; [5]Radiology, University of Utah, Salt Lake City, UT, United States

MR temperature maps are necessarily a discrete representation of a physical quantity that is continuously varying in both space and time. The HIFU focal spot size can be smaller than the imaging voxel dimensions. Due to averaging effects, it is likely that different choices for the sampling grid location, voxel size, and scan time will lead to variations in the measured temperature distribution. In this abstract we present simulation and experimental results quantifying the effects of the sampling scheme on maximum temperature and thermal dose, and show the effects of zero-filled-interpolation post-processing on the measured maximum temperature and thermal dose.

14:06 ***247***. **Reference-Less PRFS MR Thermometry Using a Thin Open Border and the Harmonic Functions Theory: 2D Experimental Validation**

R Salomir[1], M Viallon[1], Joerg Roland[2], Sylvain Terraz[1], Denis Morel[3], CD Becker[1], P Gross[2]
[1]Radiologie, Hopital Universitaire de Genève, Geneva, Switzerland; [2]Siemens Medical Solutions, Erlangen, Germany; [3]Anesthesiology, University Hospitals of Geneva, Geneva, Switzerland

A new method for reference-less MR thermometry is described based on the fundamental theoretical frame of harmonic functions. The method was implemented for a thin open border and validated for 2D situation with HIFU heating in phantoms and in vivo rabbit thigh, and also with baseline acquisition in volunteers liver. Measurement accuracy in liver under free breathing was as good as 0.5°C for 0.3 seconds temporal resolution. The method is insensitive to periodic or accidental motion, tissue expansion or drift, and to external perturbation from interventional device.

14:18 ***248***. **Hybrid Multi-Baseline and Referenceless PRF-Shift Thermometry**

William A. Grissom[1,2], Andrew B. Holbrook[3], Viola A. Rieke[2], Michael Lustig[1], Juan A. Santos[1], Aravind Swaminathan, Michael V. McConnell, Kim Butts Pauly[2]
[1]Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Radiology, Stanford University, Stanford, CA, United States; [3]Bioengineering, Stanford University, Stanford, CA, United States

We introduce a new temperature estimation method that is a hybrid of multi-baseline and referenceless methods. From multi-baseline methods the hybrid method inherits the ability to estimate temperature in the presence of rapidly-varying background anatomical phase. From referenceless methods the hybrid method inherits robustness to smooth main field shifts during thermal therapy. The method is demonstrated in the heart and liver.

14:30 ***249***. **MRI Monitoring of Skull-Base Heating in Transcranial Focused Ultrasound Ablation**

Yuexi Huang[1], Junho Song[1], Kullervo Hynynen[1,2]
[1]Sunnybrook Health Sciences Centre, Toronto, ON, Canada; [2]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada

In transcranial focused ultrasound ablation, the heating of the outer skull surface has been reduced by a hemispherical design of phased-array transducers and active cooling of the skull surface with water circulation. However, the potential heating of the skull base has not been brought into much attention. In this work, experiments were performed with a MR-guided transcranial focused ultrasound system on a full human skull sample to investigate the heating of the skull base. MR thermometry was applied to measure the temperature change of the phantom adjacent to the skull base. The distance of the foci to the bone was varied to measure a safety margin for avoiding significant skull base heating.

14:42 ***250***. **Temperature Measurement Nearby an Iceball Using the Proton Resonance Frequency Method: Recalculation of Susceptibility Artifacts.**

Antje Kickhefel[1], Rares Salomir[2,3], Jörg Roland[4], Patrick Gross[4], Fritz Schick[5], Clifford R. Weiss[6]
[1]Eberhard-Karls-University Tübingen, Tübingen, Baden-Württemberg, Germany; [2]University Hospitals of Geneva, Switzerland; [3] University Hospitals of Geneva; [4]Siemens Healthcare, Erlangen, Germany; [5]Eberhard-Karls-University Tübingen, Tübingen, Baden-Württemberg, Germany; [6]Department of Radiology, The Johns Hopkins University School of Medicine, Baltimore, United States

The study demonstrates that susceptibility artifacts in GRE phase image induced by ice ball can be corrected allowing the PRF method to be used to monitor the near zero temperature during cryoablation. Susceptibility artifacts were corrected in post-processing. First the susceptibility contrast between frozen and melted meat was determined and second the magnetic perturbation was calculated using a convolution filter in the k-space. The susceptibility artifacts were fully corrected. In conclusion, using an in-line post processing system, this method could be applied during clinical MR-guided cryotherapy, and allow for the non-invasive monitoring of near zero temperatures.

14:54 ***251***. **PRF Based MR-Thermometry on Abdominal Organs: A Pragmatic Comparison of Referenceless Vs Multi-Baseline**

Baudouin Denis de Senneville[1], Sébastien Roujol[1,2], Chrit Moonen[1], Mario Ries[1]
[1]Laboratory for Molecular and Functional Imaging: from Physiology to Therapy, CNRS/ University Bordeaux 2, Bordeaux, Aquitaine, France; [2]LaBRI, CNRS/ University Bordeaux 1, Talence, Aquitaine, France

Reliable temperature and thermal-dose measurements using PRF based MR-thermometry for MR-guided ablation therapy on abdominal organs require a robust correction of artefacts induced by the target displacement through an inhomogeneous and time-variant magnetic field. The presented study combines the two most promising candidates for this role, the multi-baseline and the referenceless method, with a real-time in-plane motion correction which permits thermal-dose calculations and evaluates the practical aspects of both methods in an ex-vivo RF-ablation and an in-vivo high-intensity focused ultrasound ablation of a porcine kidney.

15:06 ***252***. **Quantitative Perfusion Analysis for Transcatheter Intraarterial Perfusion MR Imaging**

Dingxin Wang[1], Johnathan Chung[2], Robert Lewandowski[2], Richard Tang[2], Rachel Klein[2], Reed Omary[1,3], Andrew Larson[1,3]
[1]Departments of Radiology and Biomedical Engineering, Northwestern University, Chicago, IL, United States; [2]Department of Radiology, Northwestern University, Chicago, IL, United States; [3]Robert H. Lurie Comprehensive Cancer Center, Northwestern University, Chicago, IL, United States

In this study, we presented a new quantitative TRIP-MRI perfusion analysis approach, and evaluated its efficacy in a gel perfusion phantom and in rabbits with VX2 liver tumors during TAE. Our results successfully evaluated the efficacy of this proposed perfusion analysis method for TRIP-MRI datasets in the perfusion phantom, and demonstrated the use of quantitative TRIP-MRI to monitor reductions in liver tumor perfusion during TAE.

15:18 ***253***. **MR-Based Dosimetry of ^{166}holmium-Loaded Microspheres for Internal Radiation Therapy Treatment Planning**

Peter Roland Seevinck[1], Tim C. de Wit[2], Gerrit Hendrik van de Maat[1], Maarten A.D. Vente[3], Mattijs Elschot[3], Mark Konijnenberg[4], Johannes F.W. Nijsen[3], Chris JG Bakker[1,2]
[1]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands; [2]Dept. of Radiology, University Medical Center Utrecht, Utrecht, Netherlands; [3]Dept. of Nucleair Medicine, University Medical Center Utrecht, Utrecht, Netherlands; [4]Research and Development, Mallinckrodt Medical BV, Covidien, Petten, Netherlands

The potential of MRI for dose calculations of Holmium-166 loaded microspheres to enable MR-based treatment planning of transcatheter radioembolization of hepatic malignancies was investigated. MRI and SPECT experiments were conducted using an anthropomorphic agarose gel phantom containing tumor-simulating gel samples with known amounts of ^{166}Ho-PLLA-MS. Excellent agreement was observed both qualitatively and quantitatively when comparing MR-based to SPECT-based dose maps to reference data obtained with a dose calibrator. In conclusion, MR-based dosimetry of ^{166}Ho-PLLA-MS was demonstrated to be feasible, indicating the potential of MR-based dosimetry for planning, guidance and evaluation of transcatheter radioembolization treatment of hepatic malignancies with ^{166}Ho-PLLA-MS.

Diffuse Liver Disease

Room A5 13:30-15:30 *Moderators:* Shahid M. Hussain and Meng Yin

13:30 ***254***. **Noninvasive Assessment of Liver Stiffness with Tagged MRI**

Sohae Chung[1], Elodie Breton[1], Lorenzo Mannelli[1], Hersh Chandarana[1], Leon Axel[1]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States

A pathological hallmark of the progression to cirrhosis is the development of liver fibrosis, so that monitoring the appearance and progression of liver fibrosis can be used to guide therapy. Fibrosis of the liver is known to result in increased mechanical stiffness, so that the assessment of liver stiffness is a key feature. In this study, we describe a new MRI liver assessment method by using the pulsations of the heart as an intrinsic motion source and by using magnetization-tagged MRI (tMRI) as a noninvasive method to image the motion of the liver for the assessment of liver stiffness.

13:42 ***255***. **Magnetic Resonance Elastography: Feasibility of Liver Stiffness Measurements in Healthy Volunteers at 3Tesla.**

Lorenzo Mannelli[1], Martin J. Graves[1], Peter Beddy[1], Ilse Joubert[1], Andrew N. Priest[2], David J. Lomas[1]
[1]Radiology, Addenbrooke's Hospital and University of Cambridge, Cambridge, England, United Kingdom; [2]Medical Physics, Addenbrooke's Hospital and University of Cambridge, Cambridge, England, United Kingdom

In this study we evaluated liver stiffness in healthy volunteers using magnetic resonance elastography (MRE) at 3T with the same technique that has been successfully applied at 1.5T. This preliminary work demonstrates the feasibility of liver stiffness evaluation at 3T without modification of the approach used at 1.5T.

13:54 ***256***. **Influence of Perfusion on Tissue Stiffness Assessed with MR Elastography**

Meng Yin[1], Kevin J. Glaser[1], Arunark Kolipaka[1], Lizette Warner[2], Jayant A. Talwalkar[3], Armando Manduca[1], Richard L. Ehman[1]
[1]Department of Radiology, Mayo Clinic, Rochester, MN, United States; [2]Division of Nephrology & Hypertension, Mayo Clinic, Rochester, MN, United States; [3]Division of Gastroenterology, Mayo Clinic, Rochester, MN, United States

This preliminary investigation provides evidence that MRE-assessed hepatic and renal stiffness in two controlled animal models has a dynamic component that can increase or decrease following a fluctuation in perfusion. The use of MRE to assess changes in tissue mechanics associated with the dynamic perfusion of tissue provides new insights into the natural history and pathophysiology of hepatic and renal diseases and may have significant diagnostic value. Diagnostic and longitudinal MRE studies should take into account potential dynamic perfusion effects as a potential cause of variability.

14:06 ***257***. **Automated T2* Estimation with Complex-Signal Based Weighted Least Squares Exponential Fitting**

Shreyas S. Vasanawala[1], Huanzhou Yu[2], Ann Shimakawa[2], Michael Jeng[3], Jean H. Brittain[4]
[1]Department of Radiology, Stanford University, Stanford, CA, United States; [2]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [3]Department of Pediatrics, Division of Hematology/Oncology, Stanford University, Stanford, CA, United States; [4]Applied Science Laboratory, GE Healthcare, Madison, WI, United States

Patients who receive chronic red blood cell transfusion therapy are at risk for iron overload if not receiving appropriate iron chelation. Quantification of iron deposition for therapeutic decision-making is vital. We aim to evaluate a method of automated T2* mapping with a weighted least squares algorithm in pediatric patients with suspected hepatic iron deposition and to compare it with a conventional T2* mapping method. Twenty three patients ages 5 to 17 years were recruited. Good correlation was obtained between the methods with R2 of 0.97. It is noted that the simple exponential fitting technique likely over-estimates T2* at short T2*.

14:18 ***258***. **MRI of Liver Fibrosis by Fibrin-Fibronectin Targeted Contrast Agent**

Darwin S. Gao[1,2], Mingqian Tan[3], Jerry S. Cheung[1,2], April M. Chow[1,2], Shu Juan Fan[1,2], Kannie W.Y. Chan[1,2], Kwan Man[4], Zheng-Rong Lu[3], Ed X. Wu[1,2]
[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [3]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, United States; [4]Department of Surgery, The University of Hong Kong, Pokfulam, Hong Kong SAR, China

Liver fibrosis, associated with chronic liver injury, including hepatitis and alcohol intoxication, can progress to cirrhosis and hepatocellular carcinoma. It is characterized by an increased amount of extracellular matrix consisting of fibril-forming collagens and matrix glycoconjugates such as fibronectin The fibrin-fibronectin complexes in fibrotic liver, resulted from cross-linkage between fibrin/fibrinogen and fibronectin, may serve as a specific molecular target for contrast-enhanced MRI. Our preliminary results demonstrated that a fibrin-fibronectin targeted Gd contrast agent provided distinct contrast enhancement in fibrotic liver, as compared with a non-targeted Gd contrast agent, in an experimental model.

14:30 ***259***. **T2 Relaxation Time as a Surrogate Marker of Liver Fibrosis**

Luiz Siqueira[1], Michael Chew[1], Peter F. Hahn[1], Giles Boland[1], Lawrence T. White[2], Deborah Gervais[1], Peter R. Mueller[1], Alexander R. Guimaraes[2,3]
[1]Radiology, Massachusetts General Hospital/Division of Abdominal Imaging, Boston, MA, United States; [2]Radiology, Massachusetts General Hospital/Martinos Center for Biomedical Imaging, Charlestown, MA, United States; [3]Radiology, Division of Abdominal Imaging and Interventional Radiology, Boston, MA, United States

83 patients who underwent both liver MRI and liver biopsy for fibrosis staging within a 6 month period, between January 2004 and December 2008 were enrolled in this IRB approved retrospective study. All biopsies were staged histologically (Ishak classification system (0-6)) and grouped into mild (stage (1-2) n=20), moderate (stage (3-4), n=17), severe (stage (5-6), n=46). T2 relaxation time of liver parenchyma in patients was calculated by 2 point fit (mild 66.7 +/- 1.9msec; moderate 71.6 +/- 1.7msec; severe 72.4 +/- 1.4msec) with low standard error (~1.9msec), demonstrating statistically significant difference between degrees of mild vs. severe fibrosis ($p<0.05$).

14:42 ***260***. **Assessment of Liver Fibrosis: Comparison of Magnetic Resonance Elastography (MRE) and Diffusion-Weighted Imaging (DWI)**

Frank H. Miller[1], Yi Wang[2], Robert McCarthy, Zongming Chen, Andrew Larson[2], Laura Sternick, Daniel Ganger, Richard Ehman[3], Josh Levitsky, Reed Omary[2], Laura Merrick[2], Bradley D. Bolster, Jr[4], Sven Zuehlsdorff[4], Saurabh Shah[4], Paul Nikolaidis[2], Vahid Yaghmai[2]

[1]Radiology , Northwestern University Feinberg School of Medicine, Chicago, IL, United States; [2]Radiology, Northwestern University Feinberg School of Medicine, Chicago, IL, United States; [3]Radiology, Mayo Clinic; [4]Siemens Healthcare

We prospectively compared and assessed the discriminatory capabilities of MRE and DWI in detecting and staging hepatic fibrosis in patients with suspected chronic liver diseases using histopathologic analysis as the reference standard. Our study demonstrated that the stiffness values on MRE had a positive linear correlation with degree of liver fibrosis and had greater capability for discriminating stages of fibrosis compared to ADCs on DWI. Furthermore, the absence of fibrosis, mild fibrosis, moderate fibrosis, and late-stage fibrosis (F3-4) can be distinguished from one to another by stiffness values; however, the individual stages of fibrosis could not be differentiated by ADCs.

14:54 ***261***. **Non-Invasive Imaging of Diffuse Liver Disease Using Water T2 and Fat Fractions Obtained from a Breath Hold Radial GRASE Method**

Maria I. Altbach[1], Christian Graff[2], Chuang Huang[3], V Abraham[1], Scott W. Squire[1], Denise Bruck[4], K Ray[4], T Boyer[4]

[1]Radiology, University of Arizona, Tucson, AZ, United States; [2]Division of Imaging and Applied Math, U.S. Food and Drug Administration, Silver Spring, MD, United States; [3]Mathematics, University of Arizona, United States; [4]Medicine, University of Arizona, United States

The diagnosis of inflammation, fibrosis, and steatosis is important in the characterization of diffuse liver disease such as Hepatitis C, non-alcoholic steatosis (NASH), and cirrhosis. Currently the diagnosis of these pathologies requires a liver biopsy which is an invasive procedure with associated morbidity and cost. Recently our group developed a novel radial gradient and spin-echo (GRASE) method which provides T2 and fat-water mapping with the advantage that the T2 estimation is independent of the presence of fat. The method is fast (data for T2 and fat-water mapping are acquired in a breath hold) and it provides high spatial resolution and motion insensitivity. In this work we provide the first results in patients with various liver conditions and compare T2 and fat-water information to biopsy results.

15:06 ***262***. **Field Strength Reproducibility of Hepatic Proton Density Fat Fraction Estimation by a Complex-Data, T1-Independent, T2*-Corrected, Spectrum-Modeled MRI Technique**

Benjamin Johnson[1], Michael Schroeder[1], Katie Hansen[1], Geraldine HyeWon Kang[1], Tanya Wolfson[1], Anthony Gamst[1], Scott B. Reeder[2], Claude B. Sirlin[1], Mark Bydder[1]

[1]University of California-San Diego, San Diego, CA, United States; [2]University of Wisconsin, Madison, WI, United States

With over ten million Americans affected by non-alcoholic fatty liver disease (NAFLD), there is a need for a non-invasive biomarker of liver fat content. Because confounders lead to inaccurate estimates of liver fat when using conventional MRI, advanced MRI techniques are being developed and refined to address these problems and accurately and precisely predict hepatic fat content. We demonstrate the reproducibility across field strength of an advanced complex-based MRI technique that corrects for confounders such as T1 bias, T2*, spectral complexity of liver fat, eddy currents and noise bias.

15:18 ***263***. **T1 Independent, T2* Corrected Chemical Shift Based Fat-Water Separation with Accurate Spectral Modeling Is an Accurate and Precise Measure of Liver Fat**

Catherine D. G. Hines[1], Alex P. Frydrychowicz[2,3], Dana L. Tudorascu[4], Gavin Hamilton[5], Karl K. Vigen[2], Huanzhou Yu[6], Charles A. McKenzie[7], Claude B. Sirlin[5], Jean H. Brittain[8], Scott B. Reeder[1,2]

[1]Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States; [2]Radiology, University of Wisconsin-Madison, Madison, WI, United States; [3]Diagnostic Radiology and Medical Physics, University Hospital Freiburg, Freiburg, Germany; [4]Waisman Laboratory for Brain Imaging and Behavior, University of Wisconsin-Madison, Madison, WI, United States; [5]Radiology, University of California-San Diego, San Diego, CA, United States; [6]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [7]Medical Biophysics, University of Western Ontario, London, Ontario, Canada; [8]Applied Science Laboratory, GE Healthcare, Madison, WI, United States

Accurate quantification of hepatic steatosis is essential for early detection of non-alcoholic fatty liver disease, which is increasingly common in Western societies. Quantitative IDEAL provides a means to measure hepatic steatosis in vivo, although its precision and accuracy are unknown. 40 patients were scanned twice using both quantitative IDEAL and MRS to assess accuracy and precision. Analysis of Bland-Altman plots, concordance correlation coefficients, linear regression and confidence intervals indicate that quantitative IDEAL provides both highly accurate and precise fat-fractions using MRS as a reference and is a reliable method of in vivo fat quantification.

CLINICAL INTENSIVE COURSE
MR Physics & Techniques for Clinicians

Room K1 16:00-18:00 *Organizers & Moderators:* Marcus T. Alley and Michael Markl

EDUCATIONAL OBJECTIVES
Upon completion of this session, participants should be able to:

- Define and describe the fundamental principles of MR imaging, including the definition of spin magnetization, the Larmor relationship, relaxation phenomena, and the process of using the spin magnetization to produce an image;

- Explain imaging pulse sequences based upon spin and gradient echoes, including fast spin-echo and echo planar techniques;
- Design MR imaging protocols for diagnostic applications considering image contrast, spatial resolution, acquisition time, signal-to-noise ratio, and artifacts; and
- Describe the principles of parallel imaging, high-field imaging, perfusion imaging, diffusion imaging, and functional MR imaging.

16:00 **Spin Echo Imaging**
Bernd A. Jung, Ph.D.

16:40 **Gradient Echo Imaging**
Brian A. Hargreaves, Ph.D.

17:20 **Fast Spin Echo Imaging**
Frank R. Korosec, Ph.D.

CLINICAL INTENSIVE COURSE
Multimodality Imaging of Angiogenesis

Room K2 16:00-18:00 *Organizers:* Anwar R. Padhani and Bachir Taouli

EDUCATIONAL OBJECTIVES
Upon completion of this session, participants should be able to:

- Describe basics of tumor angiogenesis;
- Explain non-MRI methods to diagnose and quantify tumor angiogenesis; and
- Explain MRI methods used to diagnose and quantify tumor angiogenesis.

Moderators: **Anwar R. Padhani and Bernard E. Van Beers**

16:00 **CE-US**
Nathalie Lassau, M.D., Ph.D.

16:30 **Perfusion CT**
Dushyant V. Sahani, M.D.

17:00 **Perfusion Modeling for Tumor Angiogenesis**
David L. Buckley, Ph.D.

17:30 **Perfusion MRI**
Anwar R. Padhani, M.R.C.P., F.R.C.R.

fMRI: Limits & Techniques

Room A1 16:00-18:00 *Moderators:* Markus Barth and Ravi Menon

16:00 ***264***. **Echo Time Dependence of Laminar BOLD Activation at 7 Tesla**
Peter Jan Koopmans[1], Markus Barth[1,2], David Gordon Norris[1,2]
[1]Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands; [2]Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, Germany

We present a multi-echo fMRI study at 7 T with 0.75 mm isotropic voxels and TEs ranging from 4.8 to 56 ms. Layer dependent T2* values are reported for human V1 showing a gradient from lower T2* near white matter and higher near the cortical surface with a superimposed dip in the granular layer. We show that the intravascular contribution to GE-BOLD at 7 T is dominated by the pial compartment and that laminar activation profiles are TE dependent. The optimal TE to detect BOLD changes in parenchyma is ~28 ms considerably longer than previously thought as previous estimates have included venous blood.

16:12 ***265***. **Retinotopically Organized Left to Right Hemisphere Functional Connectivity in Human V1 Using High-Resolution FMRI at 7T**

Jonathan Rizzo Polimeni[1], Kyoko Fujimoto[1], Bruce Fischl[1,2], Douglas N. Greve[1], Lawrence L. Wald[1,3]
[1]Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Harvard Medical School, Massachusetts General Hospital, Charlestown, MA, United States; [2]Computer Science and AI Lab (CSAIL), Massachusetts Institute of Technology, Cambridge, MA, United States; [3]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

Functional connectivity analysis of resting-state fMRI data has been used to investigate large-scale networks of brain activity. Here investigate whether functional connectivity analysis exhibits sufficient spatial specificity to detect retinotopic organization of the cross-hemispheric correlations detected in cortical area V1. The observed pattern of functional connectivity follows the retinotopic layout—presumably due to the retinotopically-organized common drive from the retina via the LGN. This indicates that despite the indirect nature of these inter-hemispheric connections, an orderly topographic pattern is present and functional connectivity analysis possesses the specificity to detect small-scale organization of the connections within a single cortical area.

16:24 ***266***. **Detailed Topographic and Functional Mapping of Areas Within the Posterior Lateral-Occipital and HMT/V5 Complex at 3T Using Functional Grid Analysis**

Hauke Kolster[1], Ron Peeters[2], Guy A. Orban[1]
[1]Lab. for Neuro- and Psychophysiology, KU Leuven, Leuven, Belgium; [2]Radiology, UZ Leuven, Leuven, Belgium

We functionally mapped areas within the human posterior lateral-occipital (LOC) and hMT/V5 complex. Using a topographical alignment and correlating retinotopic with unsmoothed functional data we developed a fMRI group analysis, which is specific to within fractions of the individual areas. We demonstrate that the human MT/V5 complex includes the homologue of the macaque MT/V5 field-map cluster, consisting of areas V4t, MT/V5, MSTv, and FST. We further show that these areas can be sharply distinguished from neighboring areas in LOC based on functional characteristics and that a previously reported overlap of motion and shape responses coincides with areas V4t and FST.

16:36 ***267***. **Mapping the Early Spatiotemporal BOLD FMRI Response in the Barrel Cortex of Rats**

Xin Yu[1], Stephen Dodd[1], Yoshiyuki Hirano[1], Daniel Glen[2], Ziad S. Saad[2], Richard C. Reynolds[2], Afonso C. Silva[1], Alan P. Koretsky[1]
[1]NINDS, NIH, Bethesda, MD, United States; [2]NIMH, NIH, Bethesda, MD, United States

BOLD-fMRI signals increase in the rat somatosensory cortex faster than the transit time of blood moving from arteries to veins, which enables us to measure the evolution of BOLD responses at early times after stimulation. Here, the rat barrel cortex activity was mapped at 0.2s temporal resolution in 2D GE-EPI images at 150μmx150μmx500μm using an 11.7T MRI. Activity-evoked BOLD signals were first observed at 0.8s, and shifted to adjacent penetrating venules at 1-1.2s, later propagating to the superficial draining veins. This indicates that BOLD-fMRI maps made prior to about 1 s will have minimal contribution from penetrating cortical venules.

16:48 ***268***. **Relative Timing of Brain Activations Revealed by Ultra-Fast MR Inverse Imaging (InI)**

Fa-Hsuan Lin[1], Thomas Witzel[1], Tommi Raij, Jyrki Ahveninen, John Bellveau
[1]A. A. Martinos Center, Charlestown, MA, United States

We use the ultra fast MR inverse imaging (InI) to interrogate the feasibility to detect hemodynamic timing difference across the brain areas using a two-choice reaction time task. We hypothesize that the vascular response variability can be reduced in the group-level analysis such that neuronally related timing information can become distinct. The MRI and behavior results supported this hypothesize by showing statistically significant timing first at visual and then at motor cortices in our group data (N=23).

17:00 ***269***. **Investigation of Seizure Propagation Using EEG-FMRI and Dynamic Causal Modelling**

Patricia Figueiredo[1], Alberto Leal[2]
[1]Instituto Superior Técnico, Lisbon, Portugal; [2]Department of Neurophysiology, Hospital Júlio de Matos, Lisbon, Portugal

One of the challenges of EEG-fMRI techniques in epilepsy is the investigation of the spatio-temporal dynamics of seizure-related BOLD signals. Here, we have employed Dynamic Causal Modelling (DCM) to test a number of competing models of discharge propagation within a network of functionally connected brain areas identified from EEG-fMRI data of ictal activity, in a patient with epilepsy associated with a hypothalamic hamartoma. Our results demonstrated the feasibility and utility of DCM in the study of the origin and propagation pathway of seizure activity, which may be of critical importance when deciding the surgical approach for epilepsy treatment.

17:12 ***270***. **Support Vector Machine Classification of FMRI Data in Image and K-Space Domains**

Scott Peltier[1], Jonathan Lisinski[2], Douglas Noll, Stephen LaConte[2]
[1]Functional MRI Laboratory, University of Michigan, Ann Arbor, MI, United States; [2]Computational Psychiatry Unit, Baylor College of Medicine, Houston, TX, United States

This work examines support vector machine (SVM) classification of complex fMRI data, both in the image domain and in the acquired k-space data. We achieve high classification accuracy using image magnitude, image phase, and k-space magnitude data. Additionally, we maintain high classification accuracy even when using only partial k-space data.

17:24 ***271***. **A Rapid Whole-Brain Classifier for Real-Time Functional MRI Feedback**

Jeremy F. Magland[1], Ze Wang[2], Daniel Willard[2], Anna Rose Childress[2,3]
[1]Department of Radiology, University of Pennsylvania Medical Center, Philadelphia, PA, United States; [2]Department of Psychiatry, University of Pennsylvania Medical Center, Philadelphia, PA, United States; [3]VA VISN 4 MIRECC, Philadelphia, PA, United States

Recent studies demonstrate that functional MRI subjects can learn to control activity in localized areas of the brain through the use of real-time fMRI feedback. Potential implications of this technology include a variety of therapies, such as pain management for patients suffering from chronic pain, and craving suppression in individuals with addictions. Whereas much is known about which specific brain regions to target in the case of pain management, less is known about which regions impact craving in addicted individuals. To address this challenge, we have implemented a real-time feedback system based on whole-brain classification.

17:36 ***272***. **Hadamard-Encoded FMRI for Reduced Susceptibility Dropout**

Gary H. Glover[1], Catherine E. Chang[1]
[1]Radiology, Stanford University, Stanford, CA, United States

The susceptibility difference between air and tissue induces intravoxel dephasing that causes signal dropout in BOLD fMRI. Thin slices can mitigate some of this loss but at a severe SNR efficiency penalty that is only partially offset by summing adjacent slices together. We propose a method that uses Hadamard encoding of two thin subslices per slice subsequently combined incoherently with UNFOLD to recover signal at no loss of SNR in uniform regions. Results using 2 2mm subslices and a hypercapnic challenge demonstrate a 10% increase in activation volume in frontal-orbital regions when compared with conventional 4 mm slice acquisitions.

17:48 ***273***. **Rapid Multiecho 3D Radial FMRI**

Gregory R. Lee[1], Jean Tkach[1], Mark Griswold[1,2]
[1]Department of Radiology, Case Western Reserve University, Cleveland, OH, United States; [2]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States

A method to perform multi-echo BOLD functional MRI using an undersampled, multishot 3D radial trajectory is demonstrated. The proposed view-ordering scheme is a 3D analog of bit-reversed view ordering and allows reconstruction at power of 2 undersampling factors (2,4,8,16). Aliasing artifacts are periodic in time and can be removed via UNFOLD. Whole brain images were reconstructed at five echo times (TE=7.3, 16.1, 24.9, 33.6 and 42.4 ms) while maintaining a temporal resolution of 798 ms / volume. The multiple echoes can used to create dynamic T2* maps and may be combined via weighted summation (optimizing sensitivity over multiple T2* values).

DTI Brain: Clinical Applications

Victoria Hall 16:00-18:00 *Moderators:* Hao Huang and Harald E. Moller

16:00 ***274***. **Atlas-Based Approach to Study White Matter Disruption in Alzheimer's Disease**

Xin Fan[1], Guanghua Xiao[2], Kristin Martin-Cook[3], Roger Rosenberg[3], Myron Weiner[4], Hao Huang[1]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Department of Clinical Sciences, University of Texas Southwestern Medical Center, Dallas, TX, United States; [3]Department of Neurology, University of Texas Southwestern Medical Center, Dallas, TX, United States; [4]Department of Psychiatry, University of Texas Southwestern Medical Center, Dallas, TX, United States

Conventional VBM (voxel-based-morphometry) approaches delineate the abnormality at the voxel level. However, it is the information reflected from whole white matter tracts that have clinical importance. In this study, with no a priori information, this novel atlas-based approach has been used to examine fractional anisotropy (FA) of DTI of all 50 major white matter tracts at the tract level to detect white matter disruption in Alzheimer disease (AD). The proposed method is highly efficient, accurate, makes comprehensive examination of all major tracts and allows comparison of disruption level of these tracts.

16:12 ***275***. **Converging Microstructural Evidence in Prodromal and Early Alzheimer's Disease: Alteration of Commissural and Association Pathways, Sparing of Motor Pathways**

Gwenaelle Douaud[1], Saad Jbabdi[1], Timothy Edward Behrens[1], Ricarda Menke[1], Achim Gass[2], Andreas Monsch[3], Anil Rao[4], Brandon Whitcher[4], Gordon Kindlmann[5], Paul M. Matthews[4], Stephen Smith[1]
[1]FMRIB Centre, University of Oxford, Oxford, Oxfordshire, United Kingdom; [2]Departments of Neurology and Neuroradiology, University Hospital, Basel, Switzerland; [3]Memory Clinic, Basel, Switzerland; [4]GSK, CIC Hammersmith Hospital, London, United Kingdom; [5]Department of Computer Science and Computation Institute, University of Chicago, Chicago, IL, United States

Using TBSS, we investigated white matter abnormalities in the largest diffusion study including healthy elderly, mild cognitive impairment and Alzheimer's disease. We also used the 'mode' of anisotropy which specifies the *shape* of anisotropy. All diffusion tensor indices converged to show that the uncinate fasciculus, cingulum bundle, corpus callosum, anterior commissure and superior longitudinal fasciculus were affected. We found a regional *increase* of mode and fractional anisotropy, often considered atypical for a degenerative disorder. Using tractography, we *directly* and *quantitatively* showed that these local increases were related to the neuropathological sparing of the motor-related pathways compared with the superior longitudinal fasciculus.

16:24 ***276***. **Gender Differences in the Dependence of Body Weight and Brain Connectivity Revealed by Diffusion Tensor Imaging**

Karsten Mueller[1], Alfred Anwander[1], Annette Horstmann[1], Franziska Busse[2], Burkhard Pleger[1], Joeran Lepsien[1], Michael Stumvoll[2], Arno Villringer[1], Harald E. Möller[1]
[1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; [2]Department of Medicine, University Hospital Leipzig, Germany

We revealed gender differences in the dependence between body weight and brain structure using diffusion tensor imaging. For the female volunteers, we observed a significant negative correlation between the body mass index (BMI) and fractional anisotropy (FA) in all parts of the corpus callosum. This correlation could not be found for male subjects. A negative correlation between BMI and axial diffusivity was significant for both women and men. An additional effect was found for the female participants only: A positive correlation between BMI and radial diffusivity. The underlying physiological reasons are still unclear and need to be further investigated.

16:36 ***277***. **Diffusion Tensor Imaging of Time-Dependent Axonal and Myelin Degradation After Carbon Monoxide Intoxication: White Matter Tract-Specific Quantification by Tract Probabilistic Map**

Chun-Yi Lo[1], Wei-Che Lin[1,2], Chih-Hsueh Wang[1], Ai-Ling Hsu[3], Ching-Po Lin[1,3]
[1]Institute of Biomedical Imaging and Radiological Sciences, National Yang Ming University, Taipei, Taiwan; [2]Departments of Diagnostic Radiology, Chang Gung Memorial Hospital-Kaohsiung Medical Center, Kaohsiung, Taiwan; [3]Institute of Brain Science, National Yang Ming University, Taipei, Taiwan

Patients with acute carbon monoxide (CO) intoxication may develop progressive white matter (WM) demyelination. We created WM parcellation atlas-based probabilistic maps of 5 major WM tracts. Automated tract-specific quantification of DTI parameters were performed to evaluation WM tract damage and the chronologic change in 17 patients with CO intoxication. The results revealed that decreasing fractional anisotropy were primarily driven by increasing radial diffusivity, which appeared to be more strongly correlated with demyelination in the initial presentation. Our finding supplements previous MRI studies by adding a level of anatomic detail to the relationship between white matter damage and cognitive dysfunction.

16:48 ***278***. **2D Distribution Analysis of DTI in Two Phenotypes of Dystonia Patients**

An Vo[1], Miklos Argyelan[1], David Eidelberg[1], Aziz M. Ulug[1]
[1]The Feinstein Institute for Medical Research, Manhasset, NY, United States

Hereditary dystonia is a neurological movement disorder where the subjects have abnormal motions due to muscle contractions. We used a 2D distribution analysis with a physical brain model, which can automatically determine the different tissue types according the inherent diffusional characteristics. Seven dystonia patients with DYT1 genotype, four non-manifesting DYT1 mutation carriers and eight normal were studied. The results show that the brain tissue can be characterized using diffusion parameters using distribution analysis in 2D. There are considerable differences among three groups studied in terms of the parameters measured. Our model stained the putamen a DYT1 subject suggestive of disease involvement in that area.

17:00 ***279***. **Bimanual Coordination and Corpus Callosum Microstructure in Young Adults with Traumatic Brain Injury**

Karen Caeyenberghs[1], Alexander Leemans[2]
[1]KULeuven, Leuven, Heverlee, Belgium; [2]University Medical Center Utrecht, Netherlands

Deterioration of motor function is one of several clinical manifestations following traumatic brain injury (TBI). The aim of this study was to investigate the relationship between white matter (WM) integrity using diffusion tensor imaging (DTI) and bimanual motor performance in young TBI patients. A group suffering from moderate to severe TBI (N=25) and a control group (N=18) were scanned using DTI along with standard anatomical scans. Using ExploreDTI software, three corpus callosum subregions were evaluated. Bimanual performance was assessed using a motor switching task. This study provides evidence for a structural alteration of corpus callosum subregions in young adults with TBI that are correlated with motor functioning, inspiring new avenues for therapy.

17:12 ***280***. **DTI in Leukoencephalopathy with Brainstem and Spinal Cord Involvement and Elevated Lactate (LBSL): Local Strongly Increased FA and Reduced Diffusivity as Well as Globally Reduced FA and Increased Diffusivity.**

Marjan Steenweg[1], Marjo van der Knaap, Frederik Barkhof[2], Petra Pouwels[3]
[1]Child Neurology, VU University Medical Center, Amsterdam, Netherlands; [2]Radiology, VU University Medical Center, Amsterdam, Netherlands; [3]Physics & Medical Technology, VU University Medical Center, Amsterdam, Netherlands

LBSL is an inherited white matter (WM) disorder without known pathological basis. To gain insight into tissue microstructure, this study used high-resolution DTI (1.45x1.45x2mm) at 1.5T. Performing TBSS, a general increase in MD and decrease in FA was seen in the central cerebral WM, not always coinciding with signal abnormalities on conventional images. Strikingly, ROI-analysis showed small areas with an extremely low MD, together with low axial and radial diffusivity, and very high FA. Restricted diffusion has been described in leukoencephalopathies caused by myelin vacuolation, raising the question whether this also plays a role in LBSL.

17:24 ***281***. **7T DTI in Mild Chronic Traumatic Brain Injury: Assessment of the Superior Longitudinal Fasciculus and Cingulum Bundle**

Dustin Cunningham[1], Seongjin Choi[1], John Corrigan[2], Jennifer Bogner[2], W Mysiw[2], Cherian Renil Zachariah[1], Michael V. Knopp[1], Petra Schmalbrock[1]
[1]Radiology, The Ohio State University, Columbus, OH, United States; [2]Physical Medicine and Rehab, The Ohio State University, Columbus, OH, United States

In order to differentiate mild chronic traumatic brain injury (TBI) patients from age matched healthy controls we explored the use of 7T diffusion tensor imaging (DTI) of the cingulum bundle (CB) and the superior longitudinal fasciculus (SLF). We observed qualitative and quantitative differences between the two groups that included statistically different fractional anisotropy (FA) values for a ROI placed in the CB and visually different fibers for the SLF in the right hemisphere of TBI patients. Our results are encouraging because they support the idea that DTI may be useful as a tool to diagnose and characterize mild chronic TBI.

17:36 ***282***. **Functional and Structural Connectivity of Default Mode Network in Patients with Schizophrenia: A Combined Resting-State FMRI and Diffusion Spectrum Imaging Study**

Su-Chun Huang[1], Fang-Chen Yeh[2,3], Hai-Go Hwu[4], Chih-Min Liu[4], Chen-Chung Liu[4], Fa-Hsuan Lin[5], Wen-Yih Isaac Tseng,[2,5]
[1]Institution of Medical Engineering, Taipei, Taiwan; [2]National Taiwan University College of Medicine, Center for Optoelectronic Biomedicine, Taipei, Taiwan; [3]Carnegie Mellon University , Department of Biomedical Engineering, Pittsburgh, PA, United States; [4]National Taiwan University Hospital, Department of Psychiatry, Taipei, Taiwan; [5]National Taiwan University, Institute of Biomedical Engineering, Taipei, Taiwan

With the combination of resting-state fMRI and DSI, the relationships between FC, SC and clinical PNASS scores were investigated in patients with schizophrenia. Significant correlations between FC and PNASS scores were found in three pairs of DMN, namely the IPL-IPR, the IPL-PCCR, and the IPR-PCCL pairs. However, the SC showed no significant correlation with PNASS score. Our results suggest that FC of DMN associates with the severity of the

clinical symptoms more strongly than SC. Moreover, after ignoring three drug-naïve patients, the SC between IPR and PCCL was negatively correlated with FC, implying that alteration of FC might down regulate SC. To clarify this, a longitudinal study is warranted to study the interactions between FC and SC, and their effects on clinical symptoms during the disease course.

17:48 ***283***. **Automated Tract-Specific Quantification Using Probabilistic Atlas Based on Large Deformation Diffeomorphic Metric Mapping and Its Application to Alzheimer's Disease**

Kegang Hua[1], Kenichi Oishi[1], Hangyi Jiang[1], Xin Li[1], Jiangyang Zhang[1], Kazi Dilruba Akhter[1,2], Michael I. Miller[3,4], Van Zijl C.M. Peter[1,5], Marilyn Albert[6], Constantine G. Lyketsos[7], Michelle M. Mielke[7], Susumu Mori[1,2]

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Tractography is widely used to define locations of specific tracts in the white matter and perform tract-specific quantification of various MR parameters such as FA and MD. However, tractography requires placements of ROIs to extract tracts of interest, which involves subjective and expert judgment. In this presentation, an automated tract-specific quantification approach is demonstrated based on pre-defined population-averaged tract information and a highly non-linear image transformation technique. This tool was applied to an Alzheimer's disease population and age-matched control. The results show accurate tract identification and consistent diffusivity abnormality of the forceps major.

Cardiovascular Interventions & Catheter Tracking

Room A4 16:00-18:00 *Moderators:* Michael Bock and Reza Razavi

16:00 ***284***. **Preclinical Evaluation of an MR-EP Suite Including an MR-EP Navigator and Dedicated MR-EP Catheters**

Sascha Krueger[1], Ronald Holthuizen[2], Jouke Smink[2], Steffen Weiss[1], Oliver Lips[1], Bernd David[1], Daniel Wirtz[1], Steen Fjord Pedersen[3], Dennis Caulfield[4], Julian Bostock[4], Gang Gao[4], Phani Chinchapatnam[4], Tobias Schaeffter[4], Reza Razavi[4]

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Cardiac arrhythmias, e.g. atrial fibrillation and ventricular tachycardia, are increasingly treated by electrophysiological (EP) interventions. Applying MR for guiding these interventions offers advantages like 3D visualization of the cardiac soft tissue in relation to the catheter, visualization of the treatment effect and absence of ionizing radiation. Making the step towards clinical MR-guided EP interventions requires a focus on RF safety of the devices, localization accuracy of the catheters, guidance of the procedure, intra-cardiac signal quality and procedure workflow. Here, an MR-EP suite based on an MR-EP Navigator application with a real-time interface to the MR system and therapy equipment is demonstrated along with specialized MR-EP catheters. These catheters are based on RF-safe concepts for both, MR- and EP functionality. RF-safety, localization accuracy and EP signal quality of these devices, and the operation of the MR-EP suite and the workflow of the MR-EP Navigator are demonstrated in a series of pre-clinical MR-guided EP experiments.

16:12 ***285***. **Visualizing RF Ablation Lesions Real-Time at 3Tesla**

Sathya Vijayakumar[1,2], Eugene G. Kholmovski[1], Gene Payne[1], Joshua Blauer[3], Christopher Gloschat[3], Jayne H. Davis[4], Rob MacLeod,[3,4], Kimberly Lilbok[5], Gaston Vergara[5], Mike Guttman[6], Kamal Vij[6], Chris J. McGann,[27], Dennis L. Parker[1], Nassir F. Marrouche[5]

[1]UCAIR, Department of Radiology, University of Utah, Salt Lake City, UT, United States; [2]CARMA Center, University of Utah, Salt Lake City, UT, United States; [3]Dept. of Biomedical Engineering, University of Utah, Salt Lake City, UT, United States; [4]CVRTI, University of Utah, Salt Lake City, UT, United States; [5]Dept. of Cardiology, University of Utah, Salt Lake City, UT, United States; [6]Surgivision Inc,, Irvine, CA, United States; [7]Drpt. of Cardiology, University of Utah, Salt Lake City, UT, United States

In this work, we present the real-time imaging of lesions as they form on a porcine model.

16:24 ***286***. **MRI-Compatible 12-Lead ECGs with MHD Separation: Application to Cardiac MRI Gating, Physiological Monitoring and Non-Invasive Cardiac-Output Estimation**

Zion Tsz Ho Tse[1], Charles L. Dumoulin[2], Gari Clifford[3], Michael Jerosch-Herold[1], Daniel Kacher[1], Raymond Kwong[4], William Gregory Stevenson[4], Ehud Jeruham Schmidt[1]

[1]Radiology, Brigham and Women's Hospital, Boston, MA, United States; [2]University of Cincinnati College of Medicine, Cincinnati, OH, United States; [3]Health Sciences and Technology, Massachusetts Institute of Technology, Boston, MA, United States; [4]Cardiology, Brigham and Women's Hospital, Boston, MA, United States

An adaptive filtering procedure, based on a set of ECG measurements performed outside and inside the MRI, is presented in order to separate between the real ECG and Magneto-HydroDynamic (MHD) signals in 12-lead ECGs acquired within a 1.5T MRI. The cleaned ECG improves cardiac gating and preserves S-T segment fidelity for physiological monitoring. The integrated MHD magneto-hydrodynamic signals provide non-invasive beat-to-beat cardiac output estimations. The proposed method was validated in five normal healthy subjects, including an athlete exercising inside the magnet, and a patient with frequent Premature Ventricle Contractions.

16:36 ***287***. **RF-Safe, Multi-Polar, Diagnostic MR-EP Catheter Employing Resistive Leads and a Transformer-Based Transmission Line**

Daniel Wirtz[1], Bernd David[1], Steffen Weiss[1], Sascha Krueger[1], Oliver Lips[1]
[1]Imaging Systems & Intervention, Philips Research Europe - Hamburg, Hamburg, Germany

RF heating of a diagnostic multi-polar EP mapping-catheter equipped with resistive leads for ECG signal transmission was investigated by electromagnetic simulations and subsequent measurements. The influence of wire resistance and number of wires in the catheter has been adressed. The simulations were validated by fiberoptic temperature measurements on a prototype catheter employing resistive leads.
Furthermore, the effect of a transformer-based transmission line connected to a tracking coil on RF heating at the catheter tip, the ring electrodes and near the tracking coil was analyzed. Favourable distributions of the transformers along the safe transmission line resulting in minimum SAR were derived.

16:48 ***288***. **Roadmaps Incorporating Respiratory and Cardiac Motion for X-Ray Fused with MRI**

Anthony Zahi Faranesh[1], Peter Kellman[1], Robert J. Lederman[1]
[1]Division of Intramural Research, National Heart Lung and Blood Institute, National Institutes of Health, Bethesda, MD, United States

X-ray fused with MRI provides 3D roadmaps for x-ray cardiovascular interventional procedures. This work incorporates respiratory and cardiac motion into the roadmaps to enhance image guidance. Cardiac and respiratory motion is measured from real-time MRI images and then fit to an affine model. Separate models are used for individual anatomic structures, to accommodate complex regional motion. The 3D roadmaps are then deformed based on cardiac and respiratory phase to better reflect physiological motion during the procedure.

17:00 ***289***. **Feasibility of MR-Thermometry with Blood Suppression on the Human Heart at 3T**

Silke Hey[1], Alexandru Cernicanu[2], Baudouin Denis de Senneville[1], Sebastien Roujol[1], Mario Ries[1], Chrit T. W. Moonen[1], Bruno Quesson[1]
[1]Laboratory for Molecular and Functional Imaging, Bordeaux, France; [2]Philips Healthcare, France

Ventricular tachycardia and atrial fibrillation can be treated by catheter radio-frequency ablation where PRFS-based MR thermometry is a candidate to provide intra-procedural feedback. However, MR thermometry of the heart is challenging. As blood suppression is preferable to avoid artifacts in the myocardium, we explore three different options, namely double inversion recovery (DIR), motion-sensitized driven equilibrium (MSDE), and inflow saturation (IS). The effectiveness of the blood suppression and its effect on the temperature stability in the septum is evaluated in eight healthy volunteers for 50s of free-breathing using VCG cardiac triggering and navigator respiratory compensation.

17:12 ***290***. **Direct MRI-Guided Needle Access to the Heart and Blood Vessels**

Christina E. Saikus[1], Kanishka Ratnayaka[1,2], Israel M. Barbash[1], Ozgur Kocaturk[1], Anthony Z. Faranesh[1], Robert J. Lederman[1]
[1]Translational Medicine Branch, Division of Intramural Research, National Heart Lung and Blood Institute, National Institutes of Health, Bethesda, MD, United States; [2]Cardiology Division , Children's National Medical Center, Washington DC , United States

Inherent soft-tissue contrast and multi-planar imaging of MRI without ionizing radiation makes it appealing for guidance of traditional and complex cardiovascular access. In this work, we have utilized real-time MRI to guide peripheral vascular access in addition to more precise targeting of direct cardiac access to the right ventricle in swine. MR imaging with compatible devices provides valuable anatomical information to the operator and enables trajectory planning and procedure monitoring to ensure a safe and efficient entry to the heart and vasculature.

17:24 ***291***. **Catheter Tracking Using Transmit Array System**

Haydar Celik[1,2], Ibrahim Davut Mahcicek[2], Ergin Atalar,[2,3]
[1]Electrical and Electronics Engineering, Bilkent University , Ankara, Turkey; [2]National Magnetic Resonance Research Center (UMRAM), Ankara, Turkey; [3]Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey

Although, soft tissue contrast of MRI is effectively high, visualization of the internal devices, such as guidewires and catheters, is not straight forward. In order to achieve better identification of these devices, various tracking techniques have been developed. Passive tracking methods are easy to implement, but they are not sufficiently reliable. The main problem of active tracking techniques is uneasy device handlings. They need to be connected to imager with cables. In addition, these cables create safety problems. There are also hybrid methods, using inductively coupled RF (ICRF) and receive coupled RF (RCRF) coils. In our study, we propose a new method using ICRF coils and transmit array system. Presented method enables simultaneous acquisition of anatomy and catheter images.

17:36 ***292***. **Excite by Light: A Novel MR-Safe Method of Catheter Tip Tracking**

Reiner Umathum[1], Axel Joachim Krafft[1], Michael Bock[1]
[1]German Cancer Research Center, Heidelberg, Germany

A novel method for MR-safe catheter tip tracking was investigated. RF-modulated light is converted into a current at the tip of an interventional catheter driving a small resonant circuit tuned to the 1H resonance frequency and exciting a small liquid reservoir locally. The generated MR signal is read out with conventional MR imaging coils so that the catheter tip can be effectively visualized against a dark signal background.

17:48 ***293***. **Prospective Motion Correction Using an MR-Tracking Tetrahedron for Intra-Cavitary MRI**

Lei Qin[1], Ehud J. Schmidt[1], W. Scott Hoge[1], Juan Santos[2], Clare Tempany-Afdhal[1], Kim Butts-Pauly[3], Charles L. Dumoulin[4]
[1]Radiology, Harvard Medical School, Boston, MA, United States; [2]Electrical Engineering, Stanford University, Stanford, CA, United States; [3]Radiology, Stanford University, Stanford, CA, United States; [4]Radiology, Cincinnati Children's Hospita, Cincinnati, OH, United States

Intra-cavitary imaging coils have been developed to achieve higher spatial resolution. However, they suffer more severely from motion artifacts since both the anatomy and the coil are moving while image acquisition occurs. We propose integrating a Tetrahedron-shaped active MR-tracking coil into an intra-cavitary imaging coil for motion detection, and to perform prospective motion (rotation and translation) corrections in real-time, so that the entire image can

be acquired in a "static" frame of reference. Experiments show significant image quality improvements for both in-plane and through-plane motion correction.

Diffusion, Biophysics & Modeling

Room A5 16:00-18:00 *Moderators:* Klaas Nicolay and Markus Nilsson

16:00 ***294***. **Variation of ADC with Cell Cycle Phases: A Study Using Synchronized HL-60 Cells**

Junzhong Xu[1], Jingping Xie[1], Jerome Jourquin[2], Daniel C. Colvin[1], Mark D. Does[1], Vito Quaranta[2], John C. Gore[1]
[1]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States; [2]Cancer Biology, Vanderbilt University, Nashville, TN, United States

Proliferating tumors usually contain a much higher fraction of cells in active cell division phases, so for a full understanding of the diffusion properties of tumors it is necessary to understand the changes that occur in cells in different phases. Here we report how oscillating gradient spin echo (OGSE) methods detect intracellular changes of synchronized HL-60 cells at different phases, while conventional pulsed gradient spin echo (PGSE) methods cannot distinguish changes at sub-cellular dimensions due to relatively long diffusion times. This feature means OGSE methods may provide extra contrast for detecting cancer.

16:12 ***295***. **Determining the Biophysical Mechanisms of Intracellular Water Diffusion and Its Response to Ischemia in Perfused Cell Cultures**

Kevin D. Harkins[1,2], Jean-Phillipe Galons[3], Joseph L. Divijak[1], Theodore P. Trouard[1,3]
[1]Biomedical Engineering, University of Arizona, Tucson, AZ, United States; [2]Vanderbilt University Institute of Image Science, Vanderbilt University, Nashville, TN, United States; [3]Radiology, University of Arizona, Tucson, AZ, United States

It was initially discovered nearly two decades ago that the apparent diffusion coefficient (ADC) drops 30-50% after the onset of ischemic stroke. Despite its clinical utility, there is still no consensus on the biophysical cause of the drop in the ADC. In this work, oscillating gradient and pulsed gradient diffusion experiments were performed on perfused cell cultures to measure the ADC of intracellular water over a wide range of diffusion times. Results indicate that the biophysical mechanisms that influence ADC are diffusion time dependent, where diffusion measured at short diffusion times is highly sensitive to the intrinsic diffusion of intracellular water and the diffusion measured at longer diffusion times is more sensitive to cell size.

16:24 ***296***. **Acute Diffusion MRI Measurements Predict Chronic Axonal Function Assessed Using Electrophysiology**

Joong Hee Kim[1], David S. K. Magnuson[2], Sheng-Kwei Song[1]
[1]Radiology, Washington University , St. Louis, MO, United States; [2]Neurological Surgery and Anatomical Sciences & Neurobiology, University of Louisville, Louisville, KY, United States

Diffusion tensor imaging (DTI) has been widely employed to assess central nervous system white matter integrity in animal models and patients. Herein, we demonstrate for the first time that the axonal injury marker derived by DTI as early as 3 hours post-spinal cord contusion, a time point when no existing modality is capable of assessing underlying axonal injury or the neurological disability, reflects injury severity and accurately predicts long-term neurological function.

16:36 ***297***. **Early Detection of Tumor Treatment Response with Temporal Diffusion Spectroscopy**

Daniel C. Colvin[1], Mary E. Loveless[1], Mark D. Does[1], Zou Yue[1], Thomas E. Yankeelov[1], John C. Gore[1]
[1]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States

Temporal diffusion spectroscopy methods, which employ rapid oscillations of the motion sensitizing diffusion gradient, are capable of probing diffusion times orders of magnitude shorter than those typically achieved with conventional pulsed gradient methods. Consequently, the apparent diffusion coefficient (ADC) measured with these methods may provide a more accurate assessment of tumor response to therapy due to their ability to detect structural variations over much shorter length scales. Results in a 9L tumor model in rats in vivo demonstrate that these methods can detect variations in ADC within 24 hours of chemotherapeutic treatment, when conventional methods showed no such change.

16:48 ***298***. **Apparent Exchange Rate of Water in Human Brain Matter Revealed by a Novel Pulse Sequence**

Markus Nilsson[1], Daniel Topgaard[2], Sara Brockstedt, Freddy Ståhlberg[1,3], Jimmy Lätt[1,4]
[1]Department of Medical Radiation Physics, Lund University, Lund, Sweden; [2]Physical Chemistry, Lund University, Lund, Sweden; [3]Department of Diagnostic Radiology, Lund University, Lund, Sweden; [4]Center for Medical Imaging and Physiology, Lund University Hospital, Lund, Sweden

Results using a novel diffusion sensitive imaging sequence generating a potentially useful contrast mechanism: the apparent exchange rate of water, related to the and cell membrane permeability. Diagnostics and prediction of treatment outcome of various pathologies might benefit from the additional information gained by knowledge of the water exchange rate. The sequence was evaluated in phantom as well as in vivo.

17:00 ***299***. **Neurite Beading Is Sufficient to Decrease the Apparent Diffusion Coefficient Following Ischemic Stroke**

Matthew D. Budde[1], Joseph A. Frank[1]
[1]Radiology and Imaging Sciences, National Institutes of Health, Bethesda, MD, United States

Within minutes of an ischemic stroke, the apparent diffusion coefficient (ADC) dramatically decreases in the infarcted brain tissue. Although the ADC change is likely related to cell swelling, the precise biophysical mechanism remains elusive. In this report, it is demonstrated that swelling of axons and dendrites, collectively known as neurites, causes the cell membrane to exhibit a beaded morphology. A simulation of diffusion in beaded neurites was

performed and validated in an ex vivo model of beading in sciatic nerves. The results demonstrate that beading of the cell membrane is sufficient to decrease ADC following acute ischemic stroke.

17:12 ***300***. **Accounting for Free and Restricted Diffusion Processes in Single- And Double-PFG Experiments Using a Novel Bi-Compartmental Phantom**

Noam Shemesh[1], Evren Özarslan[2], Amnon Bar-Shir[3], Peter J. Basser[2], Yoram Cohen[1]
[1]School of Chemistry, Tel Aviv University, Tel Aviv, Israel; [2]Section on Tissue Biophysics and Biomimetics, NICHD, National Institutes of Health, Bethesda, MD, United States; [3]Chemistry Department, Tel Aviv University, Tel Aviv, Israel

White-matter voxels which are contaminated with CSF or water diffusing in perpendicular crossing fibers constitute systems in which free and restricted diffusion are superimposed. To study the microstructural information that can be obtained in such settings, we prepared a bi-compartmental phantom in which free water (Gaussian diffusion) are superimposed with water in microcapillaries (restricted diffusion). Both single- and double-PFG experiments were conducted. We find that at low q-values, the signal arising from free water masks that of restricted diffusion and that microstructural information can only be obtained at higher q-values. We also applied these findings to a crossing fibers phantom.

17:24 ***301***. **Feasibility of Measuring Microstructural Features of Systems with Intermediate Exchange and Sub-Cellular Compartmentalization Using Diffusion MRI**

Irina Kezele[1], Philip Batchelor[2], Cyril Poupon[1], Jean-François Mangin[1], Denis Le Bihan[1], Daniel C. Alexander[3]
[1]NeuroSpin, CEA, Gif-sur-Yvette, France; [2]King's College , London, United Kingdom; [3]University College , London, United Kingdom

We propose an analytic three-compartment diffusion model where the intra-cellular architecture and exchange between the compartments are considered. This model can explain cell characteristic sizes and cell-membrane permeability, the features that are suggested to be related to different soft tissue pathologies (e.g., malignancy). Using the proposed model, we deliver an optimized imaging protocol to measure the relevant model parameters. The simulation results demonstrate the accuracy of estimating the parameters with both negligible and moderate membrane permeability, assuming pulsed-gradient spin-echo sequence and scanner parameters suitable for small animal imaging. The potential for new biomarker definition at the micro-scale is thus suggested.

17:36 ***302***. **Monte Carlo Study of a Two-Compartment Exchange Model of Diffusion**

Els Fieremans[1], Dmitry S. Novikov[1], Jens H. Jensen[1], Joseph A. Helpern[1,2]
[1]Radiology, New York University School of Medicine, New York, United States; [2]Center for Advanced Brain Imaging, Nathan S. Kline Institute, Orangeburg, NY, United States

Chemical exchange models have been frequently applied to quantify diffusion measurement in living tissues. Here we investigate numerically a two-compartment exchange (Kärger) model as applied to diffusion in a system of parallel cylinders with permeable walls, which serves as a model for axons in white matter. We show that the Kärger model accurately predicts the diffusivity and the diffusional kurtosis when the membranes are sufficiently impermeable. The exchange time can then be derived from the time-dependence of the diffusional kurtosis. For larger permeabilities, the Kärger model overestimates the actual exchange time.

17:48 ***303***. **A Joint PDF for the Eigenvalues and Eigenvectors of a Diffusion Tensor**

Sinisa Pajevic[1], Peter J. Basser[2]
[1]CIT, NIH, Bethesda, MD, United States; [2]NICHD, NIH, Bethesda, MD, United States

We propose a joint probability density function (pdf) of the eigensystem of a 2nd-order estimated diffusion tensor, which we show decouples into a product of pdfs of its eigenvalues and eigenvectors for a well-designed MR experiment and moderate SNR. This finding provides the foundation for the development of a rigorous and general statistical hypothesis-testing framework valid for measured DTI data.

Manganese-Enhanced MRI

Room A6 16:00-18:00 *Moderators:* Ichio Aoki and Alan P. Koretsky

16:00 ***304***. **Mapping of Cellular Layers in Mouse Brain and Spinal Cord Using Magnetization Transfer and Manganese**

Takashi Watanabe[1], Jens Frahm[1], Thomas Michaelis[1]
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This work demonstrates the complementary and combined use of magnetization transfer and manganese administration in T1-weighted MRI of the brain and spinal cord of living mice. The off-resonance irradiation effectively suppresses the signal intensity of the white matter, while the bright signals of dense cellular assemblies are much less affected. This differential effect well complements the contrast induced by manganese administration. Thus, magnetization transfer may distinguish neuron-rich tissue from adjacent myelin-rich tissue. Furthermore, quantitative evaluations indicate a higher sensitivity for manganese when combined with magnetization transfer.

16:12 ***305***. **In Vivo Manganese-Enhanced MRI of Retinotopic Mapping in Superior Colliculus**

Kevin C. Chan[1,2], Jiang Li[3], Iris Y. Zhou[1,2], Kwok-fai So[3], Ed X. Wu[1,2]
[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong SAR, China; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR, China; [3]Department of Anatomy, The University of Hong Kong, Hong Kong SAR, China

This study explores the capability of high-resolution 3D Mn-enhanced MRI (MEMRI) for in vivo retinotopic mapping of the rat superior colliculus (SC) upon partial transection of the intraorbital optic nerve. Upon intravitreal Mn2+ injection into both eyes, all animals in Group 1 (n=8) exhibited significantly lower signal intensity in the lateral side of the left SC compared to the left medial SC and right control SC 1 week after superior optic nerve transection in

the right eye. Partial transection at other regions of the optic nerve in Group 2 (n=7) led to hypointensity in other regions of the left SC. The results of this study demonstrated the feasibility of high-resolution MEMRI for in vivo, 3D mapping of retinotopic projections in the SC upon reduced anterograde axonal transport of Mn2+ ions at sites of partial transections in the anterior visual pathways. Future MEMRI studies are envisioned that measure the retinotopic changes in normal development, disease, plasticity and therapy in longitudinal studies.

16:24 ***306***. **In Vivo Evidence of Axonal Transport Perturbation in a Mouse Model of Tauopathy : A Track-Tracing Memri Study**

Anne Bertrand[1,2], Minh D. Hoang[2], Dmitry Novikov[2], Susan Pun[2], Pavan Krishnamurthy[1], Hameetha Banu[1], Benjamin Winthrop Little[2], Einar M. Sigurdsson[1], Youssef Zaim Wadghiri[2]
[1]Physiology and Neuroscience, NYU Medical Center, New York, NY, United States; [2]Radiology, NYU Medical Center, New York, NY, United States

We report a track-tracing MEMRI in a mouse model of tauopathy (P301L line). We compared transgenic and wild-type animals at an early stage (6 month-old), using a long timeframe protocol (9 consecutive MR examinations for each mice) and a mathematical modelization of axonal transport using a drift-diffusion model. We show that P301L mice display significant differences in 2 parameters of axonal transport : the value of the peak of Mn, and the time of the peak of Mn. We also observed trends in drift velocity V, leakage rate λ and apparent speed of Mn transport that were smaller in TG mice that in WT. This provides the first in vivo evidence of axonal transport impairment assessed by MRI in a model of tauopathy.

16:36 ***307***. **Logan Graphical Analysis for Quantitative Evaluation of Calcium Channel Activity in the Pituitary Gland Using Manganese-Enhanced MRI (MEMRI)**

Christoph Leuze[1,2], Ichio Aoki[1], Yuichi Kimura[1]
[1]National Institute of Radiological Sciences, Chiba, Japan; [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Sachsen, Germany

Logan graphical analysis (LGA), common in PET for the quantitative analysis of neuroreceptors, was performed with MRI to investigate the influence of stimulants and inhibitors on the Calcium channel activity in animal brain tissue. In this study LGA is applied to data which was acquired by measuring the concentrations of Manganese (Mn) in tissue and blood over a certain period of time after Mn-injection. The Mn uptake between experiments was varied by the excitatory neurotransmitter Glutamate and the Calcium channel blocker Verapamil. The analysis successfully delivers information about the varying in- and outflow of Mn from blood to tissue.

16:48 ***308***. **MEMRI Monitoring of Manganese Release and Transport in the Rat Brain Following Convection-Enhanced Delivery (CED) of Manganese (III)-Transferrin**

Christopher H. Sotak[1,2], Alan P. Koretsky[3]
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Convection-enhanced delivery (CED) of manganese(III)-transferrin (Mn(III)-Tf) into the rat brain was used to investigate its properties as an in vivo MRI contrast agent. The spatio-temporal evolution of MEMRI signal enhancement and calculated T1 relaxation times following Mn(III)-Tf infusion was comparable to that observed following CED of Mn2+ alone. Furthermore, Mn2+ released following intrastriatal Mn(III)-Tf infusion was transported along the striatonigral pathway and the temporal dynamics were in excellent agreement with the neuronal tract tracing studies that employ Mn2+ alone. The results of this study are consistent with the release and subsequent transport of Mn2+ following receptor-mediated endocytosis of Mn(III)-Tf.

17:00 ***309***. **Quantitative Multi-Parametric Assessment of a Radiation-Induced Encepholodysplasia CNS Model Using Magnetic Resonance Imaging**

Shigeyoshi Saito[1,2], Kazuhiko Sawada[3], Xue-Zhi Sun, Kai-Hsiang Chuang[4], Tetsuya Suhara, Iwao Kanno, Ichio Aoki
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In vivo evaluation of radiation damage in the CNS is important for the assessment and treatment. In this study, we non-invasively assessed neonatal brain of development disorder induced by prenatal x-ray exposure with quantitative MRI. Changes in T1 induced by intracellular Mn2+ contrast agents were observed in the CNS of normal and radiation irradiated rats. Diffusion and transverse relaxation time (T2) were assessed. For the assessment of acquired images, the rats were killed humanely for a histological study with Hematoxylin-Eosin (cell density and necrotic changing), Activated Caspase-3 (apoptotic changing), and Glial fibrillary acidic protein (astrogliosis).

17:12 ***310***. **Induced T_1, T_2^* and Phase Changes Following Manganese Systemic Administration at 14.1T**

Rajika Maddage[1], José P. Marques[2,3], Rolf Gruetter[2,4]
[1]Laboratory of Functional and Metabolic Imaging, Ecole Polytechnique Fédérale de Lausanne , Lausanne, Switzerland; [2]Laboratory of Functional and Metabolic Imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [3]Department of Radiology , University of Lausanne, Lausanne, Switzerland; [4]Department of Radiology, University of Lausanne and Geneva, Switzerland

Manganese enhanced MRI studies have been increasingly used in animal neuroimaging thanks to its T_1 shortening properties and enhancement specificity. The aim of this study was to quantitatively evaluate at 14.1T the dynamic evolution of T_1, T_2^* in different regions of the rat brain during manganese systemic administration and to access its impact on phase imaging. Preliminary results show enhancement in the hippocampus and cortex in phase imaging making it a potential tool to trace Mn^{2+} enrichment.

17:24 ***311***. **Dynamics of Mn Transport in the Mesolimbic System Reveal Neural Projections from the Nucleus Accumbens in Vivo**

Jessica A. M. Bastiaansen[1,2], Xiaowei Zhang[1], Davit Janvelyan[1], Scott E. Fraser[1], Russell E. Jacobs[1]
[1]Biological Imaging Center, California Institute of Technology, Pasadena, CA, United States; [2]CIBM, EPFL, Lausanne, Switzerland

The Nucleus Accumbens (NAc) plays a fundamental role in the neural reward circuit. Herein, we investigated the feasibility of MEMRI to map neural circuitry, activation and anatomy in the rodent reward system in vivo. Using MEMRI and SPM, we monitored Mn dynamics along the afferent and efferent projections from the NAc after a stereotaxic injection of MnCl. Spatiotemporal connectivity in the mesolimbic system was visualized in vivo, providing a paradigm for future studies on the neurophysiological basis of addiction using MEMRI.

17:36 ***312***. **Repeated T1 Mapping in Brain Following Clinical Dosage of Teslascan**

Pål Erik Goa[1], Christian Brekken[2], Anders Thorstensen[2], Brage Høyem Amundsen[2], Asta Kristine Håberg[3]
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Whole-brain T1-mapping was performed before and 1 day, 4 days and 7 days after administration of clinical dosage of Teslascan in 8 healthy male volunteers. ROI was defined in Hippocampus, Caudate Nucleus and Corpus Callosum, and the T1 relaxation time at different timepoints after injection was compared to baseline values. Only in hippocampus at day 1 after injection was a statistically significant reduction in T1 observed. At later timepoints for the hippocampus, and for caudate nucleus in general only a trend towards reduced T1 was observed. For Corpus Callosum no T1 changes were observed.

17:48 ***313***. **The Dose Makes the Poison - Studying Toxicity in MEMRI Applications**

Barbara Gruenecker[1], Sebastian Frank Kaltwasser[1], Yorick H. Peterse[1], Philipp G. Saemann[1], Mathias Schmidt[1], Carsten T. Wotjak[1], Michael Czisch[1]
[1]Max Planck Institute for Psychiatry, Munich, Germany

Different fractionated manganese injections schemes for MEMRI applications have been applied to study their influence on the animals' health and stress response and MRI signal intensity in the brain of the often used mouse strain C57BL/6N. 8 applications of 30 mg/kg MnCl2 injected at an interval of 24 hours (8x30/24) were found to produce least toxic side effects while simultaneously producing highest MRI intensity and contrast compared to 6 injections of 30 mg/kg (6x30/48) and 3 injections of 60 mg/kg applied injected with 48 hours intervals. This method may allow functional MRI in freely behaving animals exposed to prolonged paradigms.

Spectroscopic Quantification Methodology

Room A7 16:00-18:00 *Moderators:* Robin A. de Graaf and Roland Kreis

16:00 ***314***. **In Vivo Simultaneous Measurement of Glutamine Synthetase and Glutamate Dehydrogenase Activity in the Hyperammonemic Rat Brain Using Localized ^{1}H and ^{15}N MRS**

Cristina Cudalbu[1], Bernard Lanz[2], Paul R. Vasos[3], Yves Pilloud[2], Vladimír Mlynárik[2], Rolf Gruetter[2,4]
[1]Laboratory for Functional and Metabolic Imaging (LIFMET), Ecole Polytechnique Fédérale de Lausanne (EPFL) , Lausanne, Switzerland; [2]Laboratory for Functional and Metabolic Imaging (LIFMET), Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland; [3]Laboratory for Biomolecular Magnetic Resonance, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland; [4]2Departments of Radiology, Universities of Lausanne and Geneva, Switzerland

15N MRS is an alternative approach to 13C MRS in studying glutamate-glutamine metabolism and can provide a more straightforward interpretation. For this study we developed a new pulse sequence in order to simultaneously measure [5-15N]Gln and [2-15N]Gln+Glu for a direct measurement of the net glutamine synthesis rate (Vsyn-Vnt), Vsyn and VGDH under 15N-labeled ammonia infusion in the rat brain, using in vivo localized 15N MRS interleaved with 1H MRS. We obtained from the 1H data a net synthesis flux (Vsyn-Vnt)=0.035±0.001µmol/min/g. By fitting the in vivo 5-15N Gln and 2-15N Glu+Gln time courses, Vsyn=0.24±0.03µmol/min/g, VGDH=0.030±0.001µmol/min/g. Finally, the apparent neurotransmission rate, Vnt=0.21±0.03µmol/min/g.

16:12 ***315***. **GABA Concentration in Frontal Eye Field Predicts Oculomotor Distractibility**

Richard AE Edden[1,2], Petroc Sumner[3], Aline Bompas[3], Krish D. Singh[3]
[1]Russell H Morgan Department of Radiology and Radiological Sciences, The Johns Hopkins University, Baltimore, MD, United States; [2]FM Kirby Research Center for Functional MRI, Kennedy Krieger Institute, Baltimore, MD, United States; [3]CUBRIC, School of Psychology, Cardiff University, Cardiff, United Kingdom

Recent developments in the quantitation of GABA through edited MRS allow the behavioural consequences of individual differences in local GABA concentration to be studied. Such studies provide an important window into the workings of the healthy brain and a multimodal probe to investigate pathology. Eye movements, known to be altered in many pathologies, are thought to be planned in frontal eye fields (FEF). In this study we measure GABA concentration in a functionally-localised FEF region and show that GABA predicts saccade distractibility in healthy controls; this novel approach suggests further studies into the biochemical origins of neuropathologic behavioural deficits.

16:24 ***316***. **MR Spectroscopy Without Water Suppression for the Determination of Proton Exchange Rates in the Human Brain**

Erin Leigh MacMillan[1], Daniel Guo Quae Chong[1], Wolfgang Dreher[2], Anke Henning[3], Chris Boesch[1], Roland Kreis[1]
[1]Department of Clinical Research, University of Bern, Bern, Switzerland; [2]Dept. Chemistry, University of Bremen, Bremen, Germany; [3]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

MRS without water suppression can detect exchangeable proton resonances, particularly downfield of water. Employing a two-acquisition scheme with alternating up- or down-field metabolite inversion prior to PRESS, both the metabolite and water spectra were obtained from the human brain in-vivo. The experiment was performed with and without a water inversion prepulse with varying inversion times (TI). The magnetization transfer curves were fit with a Bloch-McConnell two-site exchange model to determine exchange rates, with initial estimates yeilding lifetimes (1/Km ¨w) ranging from 90ms to >2s, which offer information about pH and chemical microenvironments, and may aid in the understanding of CEST effects.

16:36 ***317***. **Modeling of ^{13}C MRS Data of Cerebral Glucose Metabolism Comparing Mild Hypoglycemia with Euglycemia in Humans**

Kim C.C. van de Ven[1], Marinette van der Graaf[1,2], Alexander A. Shestov[3], Bastiaan E. de Galan[4], Cees J.J. Tack[4], Pierre-Gilles Henry[3], Arend Heerschap[1]
[1]Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; [2]Clinical Physics Laboratory, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; [3]Center for Magnetic Resonance Research, University of Minneapolis, Minneapolis, MN, United States; [4]General Internal Medicine, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands

During hypoglycemia the supply of the brain with glucose is reduced. The aim of this study was to examine the direct effects of hypoglycemia on cerebral glucose metabolism by ^{13}C MRS with infusion of [1-^{13}C]glucose. ^{13}C-label from glucose gets incorporated into isotopic positions in downstream amino acids. To estimate metabolic kinetics the time dependent uptake curves were modeled with a one-compartment model of cerebral glucose metabolism. Assuming similar labeling in plasma [3-^{13}C]lactate, the flux through the TCA cycle, given by V_{TCA} , were comparable for both groups indicating that brain metabolism is maintained during mild hypoglycemia.

16:48 ***318***. **Quantification and Differentiation of CK and ATPase Fluxes Between Human GM and WM Using 3D ^{31}P CSI and Saturation Transfer**

Xiao-Hong Zhu[1], Fei Du[1], Qiang Xiong[1], Hongyan Qiao[1], Xiao Liu[1], Jianyi Zhang[2], Xiaoliang Zhang[3], Kamil Ugurbil[1], Wei Chen[1]
[1]Center for Magnetic Resonance Research, Department of Radiology,, Minneapolis, MN, United States; [2]Department of Medicine, University of Minnesota, Minneapolis, MN, United States; [3]University of California San Francisco, San Francisco, CA, United States

In vivo ^{31}P MRS in combine with saturation transfer provides a useful tool for noninvasively measuring the cerebral metabolic fluxes of creatine kinase (CK) and ATPase reactions. However, 3D imaging of these metabolic fluxes in human brain is challenging owing to limited sensitivity and complicated quantification model when a short (desired) repetition time is used. In this study, we demonstrate that with advanced ^{31}P MRS imaging approach and a newly developed quantification method, it is possible to image the CK and ATPase reaction rate constants and fluxes in human brain at 7T. We found that these fluxes were several folds higher in the grey matter than white matter. This study demonstrates not only the superior sensitivity achievable at high/ultrahigh field, but also the great potential of ^{31}P approach for studying cerebral HEP metabolism and neuroenergetics associated with brain function and dysfunction.

17:00 ***319***. **Improved Quantification of Mitochondrial Exchange, TCA Cycle Rate and Neurotransmission Flux Using ^{1}H{^{13}C} MRS Measurements of C4 and C3 of Glutamate and Glutamine**

Bernard Lanz[1], Lijing Xin[1], Rolf Gruetter[1,2]
[1]Laboratory for functional and metabolic imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Departments of Radiology, Universities of Lausanne and Geneva, Lausanne and Geneva, Switzerland

[2-^{13}C]acetate infusion coupled with ^{13}C MRS enables the separated assessment of glial and neuronal Krebs cycle fluxes with higher accuracy than ^{13}C labeled glucose, due to the asymetric metabolism of acetate in the brain. However, the faster neuronal Krebs cycle induces a strong dilution of the ^{13}C labeled glutamate on the neuronal side, resulting in lower ^{13}C MRS signal than with glucose. In this study, we analyzed with Monte-Carlo simulations the precision of the fitted metabolic fluxes with separated GluC3/GlnC3 curves obtained with ^{1}H{^{13}C} MRS as well as the impact of the neuroglial partition of glutamate on the fluxes.

17:12 ***320***. **Composition of Fatty Acids in Adipose Tissue by *In Vivo* ^{13}C MRS at 7T**

Ivan Dimitrov[1], Jimin Ren[2], Deborah Douglas[2], Jeannie Davis[2], A Dean Sherry[2], Craig R. Malloy[2]
[1]Philips Medical Systems, Cleveland, OH, United States; [2]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States

The risk of many chronic diseases may be influenced by the composition of fatty acids in adipose tissue, particularly the ratio of saturated to unsaturated fats and the ratio of omega-6 to omega-3 fats. However, the chemical shift dispersion of ^{1}H MRS is not sufficient for full analysis of chemical composition. Broadband proton-decoupled ^{13}C NMR spectra of subcutaneous adipose tissue were obtained in healthy subjects. After corrections for T_1 and nuclear Overhauser effects, the poly-, mono-, and saturated fat composition was 18%, 49%, and 32%, respectively. ^{13}C NMR is a rich source of information about adipose composition in humans.

17:24 ***321***. **Influence of Regional Macromolecule Baseline on the Quantification of Neurochemical Profile in Rat Brain**

Lijing Xin[1], Vladimir Mlynárik[1], Hongxia Lei[2], Rolf Gruetter,[12]
[1]Laboratory of Functional and Metabolic Imaging (LIFMET), Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Department of Radiology, University of Lausanne, Lausanne, Switzerland

The aim of present study was to measure the macromolecule baselines from four different volumes of interest including cortex, hippocampus, striatum and a mixture of brain structures, and then to assess their influence on the quantification of metabolites. Minor differences were found between the macromolecules acquired from specific regions and a large volume containing various cerebral structures. A slight variability in the shape of the

macromolecule baseline introduced by data processing can affect calculated concentrations of less well characterized metabolites. The use of a generic experimental macromolecule baseline provides a sufficiently accurate measurement of the neurochemical profile in rat brain.

17:36 ***322***. **Short Echo Time H^1 Chemical Shift Imaging Data Quantification in the Mouse Brain at 11.7T Using a Constrained Parametric Macromolecular Model**

Hélène Ratiney[1], Yann Le Fur[2], Michaël Sdika[2], Sophie Cavassila[3]
[1]Université de Lyon, CREATIS-LRMN; CNRS UMR 5220; Inserm U630; INSA-Lyon; Université Lyon 1, Villeurbanne, France; [2]Université Aix-Marseille II, CRMBM, CNRS UMR 6612, Marseille, France; [3]Université de Lyon,, CREATIS-LRMN; CNRS UMR 5220; Inserm U630; INSA-Lyon; Université Lyon 1, Villeurbanne, France

Short echo time chemical shift imaging (SE-CSI) data quantification at 11.7T in the mouse brain is challenging because the magnetic field inhomogeneity impact the quality of both water suppression and spectral resolution and macromolecular contamination can vary from voxel to voxel. We propose to derive from macromolecular CSI acquisition a constrained parametric macromolecular model to incorporate strong prior knowledge into the fitting of the SE-CSI. Evaluation of this approach on in vivo data acquisition is proposed and discussed.

17:48 ***323***. **Spectroscopy of the Human Prostate at 3 Tesla Using Surface Coil: Age-Related Changes**

Jan Weis[1], Antonina Bergman[1], Francisco Ortiz-Nieto[1], Mikael Häggman[2], Håkan Ahlström[1]
[1]Dept. of Radiology, Uppsala University Hospital, Uppsala, Sweden; [2]Dept. of Urology, Uppsala University Hospital, Uppsala, Sweden

Single-voxel spectroscopy and 2D spectroscopic imaging of the prostate at 3 T was performed using standard surface coil. Spectra of 53 healthy volunteers were processed using customized LCModel. It was found that metabolite-to-citrate spectral intensity ratios were significantly lower in older individuals than in younger. Our results demonstrate that the prostate spectroscopy at 3 T is feasible using surface coil. LCModel provides a high level of accuracy for analysis of prostate spectra. Our results indicate that each 1H MRS study of the human prostate should include age-matched controls.

Functional MRI of Kidneys

Room A8 16:00-18:00 *Moderators:* Hersh Chandarana and Harriett C. Thoeny

16:00 **Introduction**
Vivian S. Lee

16:24 ***324***. **Intravoxel Incoherent Motion (IVIM) and Diffusion Tensor Imaging (DTI) in Healthy Kidney: Influence of Renal Flow Challenge**

Eric Edward Sigmund[1], Pierre Hughes Vivier[1], Nicole Lamparello[1], Dabang Sui[1], Artem Mikheev[1], Henry Rusinek[1], Vivian S. Lee[1], Lei Zhang[1], Hersh Chandarana[1]
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Renal fluid transport is a superposition of flow, resorption, and diffusion, and diffusion-weighted imaging (DWI) in the kidney is correspondingly complex. Advanced DWI protocols have emerged, such as intravoxel incoherent motion (IVIM) for flow/diffusion separation, and diffusion tensor imaging (DTI) for measurement of flow or structural anisotropy. We employed these two approaches in a cohort of normal volunteers undergoing MRI at baseline and following two flow challenges (hydration and furosemide). Six diffusion metrics (apparent diffusion coefficient ADC, tissue diffusivity Dt, perfusion fraction fp, pseudodiffusivity Dp, mean diffusivity MD, fractional anisotropy FA) were evaluated for reproducibility, tissue contrast, and challenge response.

16:36 ***325***. **Determination of Glomerular Filtration Rate in Cirrhotic Patients by MR Renography: Pilot Study**

Pierre-Hugues Vivier[1,2], Pippa Storey[1], Jeff L. Zhang[1], Akira Yamamoto[1], Kristopher Tantillo[1], Ruth P. Lim[1], James S. Babb[1], Henry Rusinek[1], Devon John[3], Lewis W. Teperman[3], Kent Friedman[4], Judith Benstein[5], Edward Skolnik[5], Vivian S. Lee[1]
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Glomerular filtration rate (GFR) assessment based on creatinine formulas is highly inaccurate in cirrhotic patients, despite its utmost importance. We prospectively investigated the feasibility, accuracy, precision and reproducibility of MR-GFR measurements in 20 cirrhotic patients undergoing routine liver MRI, using a protocol that added less than 10 additional minutes and 3 mL gadoteridol. Urinary clearance of 99mTc-DTPA served as reference GFR. MR-GFR values were more accurate and precise than creatinine-based GFR values. Reproducibility was comparable to the reference method.

16:48 ***326***. **Accurate and Precise Measurement of Renal Filtration and Vascular Parameters Using DCE-MRI and a 3-Compartment Model.**

Paul S. Tofts[1], Marica Cutajar[1,2], Iosif Mendichovszky[3], Isky Gordon[2]
[1]Imaging Physics, Brighton & Sussex Medical School, Brighton, East Sussex, United Kingdom; [2]Radiology and Physics, UCL Institute of Child Health, London, United Kingdom; [3]University of Manchester, Manchester, United Kingdom

The precision and accuracy of a recent compartmental model of renal DCE-MRI is investigated. Precision is assessed by repeated examination of 15 normal volunteers; accuracy is assessed by comparison with published values (where available). Local filtration (Ktrans) is reproducible (instrumental sd 15%) and accurate (0.25 min-1), giving GFR 115 mL min-1. Mean Transit Time (5.9 s) is reproducible (sd 6%) and a candidate biomarker. Blood flow is reproducible to 12%, although absolute values are high. Filtration fraction is more reproducible (8%) although lower than published values. Normal kidney volume was measured as 214 mL/1.73m2.

17:00 ***327***. **Multiphase True-FISP ASL in the Kidney**

Caroline L. Hoad[1], Eleanor F. Cox[1], Alexander G. Gardener[1], Devasuda Anblagan[1], Susan T. Francis[1]
[1]School of Physics and Astronomy, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

Multiphase True-FISP ASL is implemented in the kidney. This technique provides a robust method to map the transit time, perfusion rate and longitudinal relaxation time of the kidney in a total acquisition time of less than 5 minutes. Maps of these parameters are shown, with transit time maps depicting a clear increase in transit time from feeder vessels to the outer edge of the renal cortex, and perfusion maps displaying significant differences between renal cortex, medulla, and feeder vessels. The mean transit time to the renal cortex was 368±52 ms, mean perfusion rate 246±21 ml/100g/min and mean T_1 1132±63 ms.

17:12 ***328***. **Effect of Iodixanol, a Iso-Osmolar Radio-Contrast Agent on Intra-Renal Oxygenation by BOLD MRI**

Lu-Ping Li[1], JoAnn Carbray[1], Maria Papadopulou-Rosenzweig[2], Richard Solomon[3], Pottumarthi V. Prasad[1]
[1]Radiology, Northshore University Healthsystem, Evanston, IL, United States; [2]Radiation Medicine, Northshore University Healthsystem, Evanston, IL, United States; [3]Nephrology, University of Vermont, Burlington, Burlington, VT, United States

Radiocontrast nephropathy (RCN) is the 3rd common cause of in-hospital mortality in patients with pre-existing kidney insufficiency. Although low- and iso-osmolal radiocontrast are in general believed to be safer than older ionic and high-osmolal agents, the issue remains controversial. Renal hypoxia plays a role in the pathophysiology of RCN and BOLD MRI was previously shown to be useful in monitoring the changes in intra-renal oxygenation with iothalamate, a 1st generation ionic high osmolality agent. Here, we report our preliminary findings using iodixanol, a 3rd generation nonionic iso-osmolality agent, that suggest similar trends as reported earlier with iothalamate.

17:24 ***329***. **Optimisation of Oxygen-Enhanced Imaging in the Kidney**

Katherine Frances Holliday[1,2], Josephine H. Naish[1,2], Jean Tessier[3], Geoffrey J M Parker[1,2]
[1]Imaging Sciences, The University of Manchester, Manchester, United Kingdom; [2]Biomedical Imaging Institute, Manchester, United Kingdom; [3]Early Clinical Development, AstraZeneca, Macclesfield, United Kingdom

In this work we have optimised two sequences commonly used in Oxygen-Enhanced MRI (OE-MRI), Inversion-prepared Half Fourier Turbo Spin Echo (IR-HASTE) and Spoiled Gradient Echo (SPGR), for use in the kidneys. We then compared their abilities in vivo in a single subject. Finally we carried out a dynamic OE-MRI study in the kidneys of a small group of healthy volunteers. We showed that through the parameterisation of the dynamic signal curve obtained during gas switch-over, it is possible to create maps which distinguish between regions in the kidney with differing oxygen delivery.

17:36 ***330***. **An Arterial Spin Labeling Approach to Kidney Perfusion: Assessing Reproducibility in Native and Transplanted Kidneys**

Nathan S. Artz[1], Elizabeth A. Sadowski[2], Andrew L. Wentland[1], Songwon Seo[3], Arjang Djamali[4], Sean B. Fain[1,2]
[1]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States; [2]Radiology, University of Wisconsin-Madison, Madison, WI, United States; [3]Biostatistics and Medical Informatics, University of Wisconsin-Madison, Madison, WI, United States; [4]Nephrology, University of Wisconsin-Madison, Madison, WI, United States

An ASL-FAIR approach was used to measure kidney perfusion in the cortex of 10 native kidneys and 15 transplanted kidneys in subjects with a wide range of kidney function. Exams were repeated within each visit and on two separate days and evaluated for reproducibility. The average within day Interclass Correlation Coefficient (ICC) was 0.93 with a Coefficient of Variation (CV) of 7.6% and the average between day ICC was 0.91 with a CV of 10.6%. This ASL method is reproducible in the cortex of the kidney. The data also provides guidelines for differentiating normal and abnormal perfusion variation during longitudinal assessment.

17:48 ***331***. **Early Detection of Transplant Rejection by *In Vivo* ^{19}F MRI**

Ulrich Flögel[1], Su Song[2], Inga Kreideweiß[1], Zhaoping Ding[1], Oliver Witzke[2], Jürgen Schrader[1]
[1]Institut für Herz- und Kreislaufphysiologie, Heinrich-Heine-Universität, Düsseldorf, NRW, Germany; [2]Klinik für Nephrologie, Universitätsklinikum Essen, Germany

This study was aimed at developing an approach for the early *in vivo* detection of organ rejection in a murine heterotopic abdominal heart transplantation model. As contrast agent emulsified perfluorocarbons (PFCs) were used, which are biochemically inert and are known to be phagocytized by monocytes/macrophages. ^{1}H/^{19}F MRI enabled us to detect the initial immune response not later than 3 days after surgery, when conventional parameters did not reveal any signs of rejection. The results show that intravenously applied PFCs accumulate in areas affected by rejection and can be sensitively detected by ^{1}H/^{19}F MRI at a field strength of 9.4 T.

Endogenous Contrast Imaging

Room A9 16:00-18:00 *Moderators:* Ravinder Reddy and David J. Tozer

16:00 ***332***. **Observation of Frequency Shifts Induced by Chemical Exchange in Brain Tissue**

Karin Shmueli[1], Steve Dodd[2], T-Q Li[3], Jeff H. Duyn[1]
[1]Advanced MRI Section, Laboratory of Functional and Molecular Imaging, National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD, United States; [2]Functional and Molecular Metabolism Section, Laboratory of Functional and Molecular Imaging, National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD, United States; [3]Department of Medical Physics, Karolinska Huddinge, Stockholm, Sweden

Water-macromolecular exchange has been proposed to explain brain gray and white matter frequency (phase) contrast. We extended previous observations of exchange-induced frequency shifts (f_{exch}) in protein solutions by performing chemical shift imaging experiments using reference chemicals (TSP and dioxane) to observe positive f_{exch} in fixed human and fresh pig brain tissue. Substantial negative GM-WM δf_{exch} was observed which was similar for all tissues and references but opposite to in-vivo GM-WM frequency contrast, implying that tissue magnetic susceptibility may have a greater contribution. Exchange should therefore be included in frequency contrast models but is insufficient to explain in-vivo GM-WM phase contrast.

16:12 ***333***. **Classical Interpretation of T1rho and T2rho Relaxation**

Michael Carl[1], Mark Bydder[2], Eric Han[1], Graeme Bydder[2]
[1]GE Healthcare, Waukesha, WI, United States; [2]University of California, San Diego, CA, United States

We present a simulation model based solely on classical equations to study spin-lattice relaxation in the rotating frame. Without the confound of a quantum mechanical treatment, this model allows for an intuitive understanding of spin locking such as T1rho dispersion, oscillations caused by residual dipolar interactions (RDI), and T2rho.

16:24 ***334***. **Quantitative T1rho Imaging Using Phase Cycling for B0 and B1 Field Inhomogeneity Compensation**

Weitian Chen[1], Atsushi Takahashi[1], Eric T. Han[1]
[1]MR Applied Science Lab, GE Healthcare, Menlo Park, CA, United States

T1rho imaging is promising in clinical applications such as early detection of osteoarthritis. T1rho imaging, however, is sensitive to B0 and B1 RF field inhomogeneities. In this work, we report on a phase cycling method to eliminate B1 RF inhomogeneity effects in T1rho imaging. The presences of B0 field inhomogeneity can compromise B1 RF inhomogeneity compensation approaches. We present a method which combines the phase cycling approach with a composite RF pulse scheme proposed by Dixon et al for simultaneous compensation of B0 and B1 RF field inhomogeneity in T1rho imaging. The proposed T1rho RF preparation methods can be combined with an SNR-efficient 3D T1rho imaging method MAPSS without compromising scan time.

16:36 ***335***. **Quantitative Magnetization Transfer Imaging of Human Brain at 3T Using Selective Inversion Recovery**

Richard D. Dortch[1,2], Ke Li[1,2], Ashish A. Tamhane[3], E B. Welch[2,4], Dan F. Gochberg[1,2], John C. Gore[1,2], Seth A. Smith[1,2]
[1]Department of Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States; [2]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States; [3]Department of Biomedical Engineering, Illinois Institute of Technology, Chicago, IL, United States; [4]MR Clinical Science, Philips Healthcare, Cleveland, OH, United States

Quantitative magnetization transfer (qMT) yields quantitative information about interactions between immobile macromolecular protons and free water protons. Because of its relatively short scan times, the pulsed, off-resonance saturation qMT approach is most commonly employed on clinical systems; however, it suffers from complicated data analysis and sensitivity to macromolecular proton lineshape assumptions. The selective inversion recovery (SIR) approach does not suffer from these shortcomings, but has not been widely implemented on clinical systems. In this study, the SIR approach was implemented on a clinical 3T system. The resultant qMT parameters in healthy brain were in good agreement with previously published values.

16:48 ***336***. **Magnetization Transfer Mapping of Myelinated Fiber Tracts in Living Mice at 9.4 T**

Susann Boretius[1], Peter Dechent[2], Jens Frahm[1], Gunther Helms[2]
[1]Biomedizinische NMR Forschungs GmbH, Max-Planck-Institut für biophysikalische Chemie, Göttingen, Germany; [2]MR-Research in Neurology and Psychiatry, University Medical Center, Göttingen, Germany

MRI of mouse models is an integral part of translational research on white matter diseases and myelin disorders. Thus, the delineation of myelinated fiber tracts in mice becomes of growing interest. Here we used in healthy adult mice a novel FLASH-based parameter for magnetization transfer that was recently established for human applications. In comparison to maps of MT ratio and T1, this parameter provides an improved gray-white matter contrast that allows for the visualization of small neuronal fiber bundles such as the mammilothalamic tract and fasciculus retroflexus.

17:00 ***337***. **Molecular Mechanisms of Magnetization Transfer**

Scott David Swanson[1]
[1]Department of Radiology, University of Michigan, Ann Arbor, MI, United States

We present a look at the molecular mechanisms of MT in agarose and gelatin samples. MT is found to be driven by whole water exchange in agarose and proton exchange in gelatin.

17:12 ***338***. **CEST-Dixon MRI for Sensitive and Accurate Measurement of Amide Proton Transfer in Humans at 3T**

Jochen Keupp[1], Holger Eggers[1]
[1]Philips Research Europe, Hamburg, Germany

CEST-MRI based measurement of endogenous proteins using the amide proton transfer (APT) signal could find important clinical applications in oncology (tumor metabolism) and in neurology (ischemic acidosis). As APT-MRI is very sensitive to B_0 inhomogeneity, we propose to apply multi gradient-echo sequences and derive a B_0 map by the Dixon technique, as opposed to previously described methods like full CEST-spectra interpolation or separate water resonance mapping. Furthermore, technical limits for pulse lengths on clinical scanners are addressed and a saturation of 1 second is achieved (human head). Feasibility of APT-MRI within 6 minutes (SENSE R=3) is demonstrated in volunteers at 3T.

17:24 ***339***. **Detection of Myo-Inositol In-Vivo Using MR Chemical Exchange Saturation Transfer Imaging (MICEST)**

Mohammad Haris[1], Kejia Cai[1], Anup Singh[1], Feliks Kogan[1], Walter Witschey[1], Hari Hariharan[1], Ravinder Reddy[1]
[1]CMROI, Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States

In the current study, we demonstrated the mapping of Myo-inositol (MI) in human brain at 7T by exploiting chemical exchange saturation transfer (CEST) of labile hydroxyl proton (-OH) on the MI. The Z-spectrum of MI showed an asymmetry around~0.625ppm downfield to the bulk water resonance. The CEST imaging on healthy human brain clearly shows the distribution of MICEST contrast in gray and white matter regions and negligible contrast from cerebrospinal fluid.

17:36 ***340***. **Differentiation Between Glioma and Radiation Necrosis Using Molecular Imaging of Endogenous Proteins and Peptides**

Jinyuan Zhou[1], Erik Tryggestad[2], Zhibo Wen[1], Bachchu Lal[3], Tingting Zhou[1], Rachely Grossman[4], Kun Yan[1], Silun Wang[1], De-Xue Fu[5], Eric Ford[2], John Laterra[3], Peter C.M. van Zijl[1]

[1]Department of Radiology, Johns Hopkins University, Baltimore, MD, United States; [2]Department of Radiation Oncology, Johns Hopkins University, Baltimore, MD, United States; [3]Department of Neurology, Kennedy Krieger Institute, Baltimore, MD, United States; [4]Department of Neurosurgery, Johns Hopkins University, Baltimore, MD, United States; [5]Department of Oncology, Johns Hopkins University, Baltimore, MD, United States

We show that it is possible to differentiate between glioma and radiation necrosis using the amide proton signals of endogenous cellular proteins and peptides as imaging biomarker. Using a radiation necrosis model (dose, 40 Gy; area, 10x10 mm2) and a SF188/V+ human glioma model in rats, tumors and radiation necrosis had similar conventional MRI features. However, gliomas were consistently hyperintense on amide proton transfer (APT) images, while radiation necrosis (observed about six months post-radiation) was hypointense to isointense. APT MRI as an imaging biomarker for tumor presence provides unique visual information for assessing active tumor versus treatment-related injury, such as radiation necrosis.

17:48 ***341***. **Fast T1 Mapping Using Modified Double-Inversion Recovery Pre-Pulse**

Marcelo E. Andia[1], Rene M. Botnar[1]

[1]Division of Imaging Sciences, Kings College London, London, United Kingdom

In this work we present a new technique for fast T1 estimation where the intensity of each pixel is linearly related to its T1 value. The technique is based on a modified Double Inversion Recovery pre-pulse and only requires the acquisition of a single 2D or 3D dataset. The technique was validated in a T1 phantom and in a pre-clinical study of renal perfusion using a gadolinium based contrast agent. Potential applications include fast T1 quantification in myocardial perfusion, infarct or fibrosis imaging.

Cardiac MR Study Group
Room K1 18:15 - 20:15

Agenda:

Discussion of Goals of Cardiac MR Study Group
Albert de Roos, M.D., University Hospital Leiden, Leiden, The Netherlands and
John Oshinski, Ph.D., Emory University, Atlanta, GA, USA

Presentation of Flow Visualization in the Left Ventricle
Tino Ebbers, Ph.D., Linköping University, Linköping, Sweden

20:15 Adjourn

Current Issues in Brain Function
Room K2 18:15 - 20:15

18:15 Business Meeting, and Introduction of New Committee Members

18:30 **GABA & fMRI**
Richard Edden, Ph.D., Johns Hopkins University, Baltimore, MD, USA

18:50 **Optogenetics & fMRI**
Mark Lythgoe, Ph.D., University College London, London, UK

19:10 **Real Time fMRI**
Nikolaus Weiskopf, Ph.D., University College London, London, UK
Stephen LaConte, Ph.D., Baylor College of Medicine, Houston, TX, USA
Stefan Posse, Ph.D., University of New Mexico, Albuquerque, NM, USA
Rainer Goebel, BIC- Maastricht, Maastricht, The Netherlands

20:15 Adjourn

Dynamic NMR Spectroscopy Study Group
Victoria Hall 18:15 - 20:15

18:15 Business Meeting

18:30 **Scientific Meeting – "*In vivo* MRS Challenges & New Solutions for Advancing Biomedical Applications"**

18:30 **Mitochondrial Dysfunction in Insulin Resistance: What Do We Actually Measure?**
Jeanine Prompers, Ph.D., Assistant Professor, Eindhoven University of Technology, Department of Biomedical Engineering, Eindhoven, The Netherlands

19:00 **1H Spectroscopy of Lipids in Human Skeletal Muscle at 7T**
Craig R. Malloy, M.D., Professor, Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, USA

19:30 **Regional Variations of Metabolite Concentrations in the Rat Brain by 1H NMR at 16.4 T**
Sung-Tak Hong, M.Sc., Max-Planck Institute for Biological Cybernetics Tuebingen, Baden-Wuerttemberg, Germany

19:42 **Can You Really Use the Creatine Kinase Equilibrium to Calculate Free ADP Concentrations?**
Christine Habuurs, Department of Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands

19:54 **The Role of Cardiac Carbonic Anhydrases In Vivo: A Hyperpolarized 13C NMR Study**
Marie Schroeder, Departments of Physiology, Anatomy & Genetics, University of Oxford, Oxford, UK

20:06 **Fast 31P Metabolic Imaging of Human Muscle**
Isabell Steinseifer, M.Sc., Department of Radiology, Radboud Unversity Nijmegen Medical Centre, Nijmegen, The Netherlands

20:18 Final Discussions

20:30 Adjourn

Hyperpolarized Media MR Study Group
Room A4 18:15 - 20:15

18:15 Study-Group Business

18:30 **Statement on the Availability and Price of 3He**

18:40 ***in-vivo* Detection of Rat Brain Metabolism Using Hyperpolarized Acetate**
Mor Mishkovsky, Ph.D., EPFL, Lausanne, Switzerland

19:00 **Structural Response of the Compliant Lung to Different Ventilation Volumes Assessed by Multiple Exchange Time Xenon Transfer Contrast (MXTC)**
Isabel Dregely, University of New Hampshire, Durham, NH, USA

19:20 **Experimental Investigation of the Limits of Validity of the Physical Basis of a Method for *in-vivo* Lung Morphometry with 3He Diffusion MRI**
Juan M. Parra-Robles, Ph.D., The University of Sheffield, Sheffield, UK

19:35 **Acinar Structural Changes in Mild COPD Detected by *in-vivo* Lung Morphometry with Hyperpolarized 3He MRI**
James D. Quirk, Ph.D., Washington University School of Medicine, St. Louis, MO, USA

19:50 Discussion

20:15 Adjourn

Interventional MR Study Group
Room A5 18:15 - 20:15

Overview:
This symposium has two principal aims: (1) to provide guidance for new or inexperienced sites on how to establish an effective IMR program and (2) to address controversies in the field. We will specifically tackle what the ideal field strength is for iMRI sites and openly discuss the necessity of real time MR guidance versus efficient use of previously acquired or iterative intra-procedure MR data. This discussion will focus on cardiac EP ablations.

Agenda:

18:15 Administrative Business

18:30 **Running an iMRI program: How We Do It** (15-minutes presentations)
Thermal – R. Jason Stafford, Ph.D., University of Texas M.D. Anderson Cancer Center, Houston, TX, USA
Neuro – Charles L. Truwit, M.D., University of Minnesota, Minneapolis, MN, USA

19:00 **Controversies in iMRI – Optimal Field Strength for IMR**
(3 10-minute "position statements", 15 min panel discussion)
1T Advocate – Ulf Teichgräber, M.D., Charité - Universitätsmedizin Berlin, Berlin, Germany
1.5T Advocate – Clifford R. Weiss, M.D., Johns Hopkins University, Baltimore, MD, USA
3T Advocate – Clare Tempany, M.D., /Kemal Tuncali, Brigham and Women's Hospital, Boston, MA, USA

19:45 **Controversies in iMRI – MR Guided versus MR Assisted for Cardiac EP**
(2 10-minute "position statements", 10 min panel discussion)
MR Guided Advocate – Graham A. Wright, Ph.D., University of Toronto, Toronto, ON, Canada
MR Assisted Advocate – Tobias R. Schaeffter, Ph.D., Kings College London, London, UK

20:15 Adjourn

MR Engineering Study Group
Room A6 18:15 - 20:15

18:15 MRI systems in 2020

Array Systems for All Field Strengths
Mark Griswold, Ph.D., Case Western Reserve University, Cleveland, OH, USA

Next Generation of Magnet Design
Rory Warner, Magnex Scientific Ltd., Oxford, UK

Engineering Problems Remaining to be Solved: A Clinical Perspective
Thomas Grist, M.D., University of Wisconsin, Madison, WI, USA

20:15 Adjourn

MR in Drug Research Study Group
Room A7 18:15 - 20:15

18:15 Business Meeting

18:30 **The Great Debates in MR in Drug Research**

18:30 **MRI for Body Composition Assessment Has Little Value for Drug Development Studies**
Moderator: Bradley Wyman, Ph.D.
Pro: Paul Hockings, Ph.D., TBD Con: Jeff Evelhoch, Ph.D., TBD

19:05 **MRI is a Superior Modality for Assessing Rheumatoid Arthritis or Osteoarthritis Disease Progression in Drug Related S tudies**
Moderator: TBD
Pro: Joshua Farber, M.D., Bradley Wyman, Ph.D. Con: Derek Hill, Ph.D., John Waterton, Ph.D.

19:40 **The Use of MRI for Oncology Drug Trials Should be Severely Limited**
Moderator: John Hazle, Ph.D.
Pro: Edward Ashton, Ph.D., TBD Con: Yanping Luo, Ph.D., TBD

20:15 Adjourn

Susceptibilty Weighted Imaging Study Group
Room A8 18:15 - 20:15

18:15 **Introduction**
Juergen Reichenbach, Ph.D., Professor, Universitätsklinikum Jena, Germany

18:30 **An Overview of the State of the Art Now in SWI**
Juergen Reichenbach, Ph.D., Professor, Universitätsklinikum Jena, Germany

18:45 **Iron Associated with MS Lesions, Thalamus & the Basal Ganglia with SWI**
Mark Haacke, Ph.D., Director, The MRI Institute for Biomedical Research, Detroit, MI, USA

19:00 **Correlating SWI Iron Measurements with MS Disease Progression & CCSVI**
Robert Zivadinov, M.D., Ph.D., Director, Buffalo Neuroimaging Analysis Center, Buffalo, NY, USA

19:15 **The Role of CCSVI in Multiple Sclerosis**
Paolo Zamboni, M.D., Director, Vascular Diseases Center, ITALY

19:30 **Phase Image and Iron Content - A Word of Caution**
Dmitriy A. Yablonsky, PhD, Professor, Mallinckrodt Institute of Radiology, USA

19:45 Panel Discussion

20:00 Closing Remarks

20:15 Adjourn

MR Safety Study Group
Room A9 18:15 - 20:15

WEDNESDAY

SUNRISE EDUCATIONAL COURSE
CLINICAL INTENSIVE COURSE
Hot Topics in Body MRI: Diffusion II

Room K1 7:00 – 08:00 *Organizers:* Talissa Altes, Elmar Max Merkle and Bachir Taouli

EDUCATIONAL OBJECTIVES
Upon completion of days 1 and 2 participants should be able to:

- Explain the physics of DWI methods in body imaging;
- Apply DWI technique in their practice;
- Design female pelvic and prostate MR protocols including DWI; and
- Describe current results of DWI in oncology

Advanced Body Diffusion 1
Moderators: **Dow-Mu Koh, M.D., M.R.C.P., and Harriet C. Thoeny, M.D.**

07:00 **Oncologic Applications of DWI (Including WBDWI)**
Ihab Kamel, M.D.

07:30 **DWI: Applications in the Pelvis**
Nandita M. de Souza, M.D., F.R.C.R.

SUNRISE EDUCATIONAL COURSE
CLINICAL INTENSIVE COURSE
Tissue Contrast in MSK MRI - From Physics to Physiology

Room K2 07:00 – 08:00 *Organizer & Moderator*: Bernard J. Dardzinski

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe contrast mechanisms in MSK imaging, most notably in imaging of articular cartilage;
- Describe the physics of advanced MR sequences;
- Identify the most suitable new MR sequences for four important indications;
- Implement current MR protocols for daily practice and be aware of the most useful indications for these techniques.

07:00 **Tissue Anisotropy in Tendons and Cartilage**
Gary D. Fullerton, Ph.D.

07:30 **Structural Organization of Cartilage and the Habituation Hypothesis**
Douglas W. Goodwin, M.D.

SUNRISE EDUCATIONAL COURSE

Image Reconstruction

Victoria Hall 07:00 – 08:00 *Organizer & Moderator*: Elfar Adalsteinsson

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the main steps involved in efficient non-Cartesian image reconstruction;
- Formulate a generalized signal model incorporating gradient encoding, coil sensitivity and Bo inhomogeneity;
- List the pro's and con's of Cartesian and non-Cartesian parallel MRI;
- Compare compressed sensing, HYPR, and k-t BLAST with respect to their use of prior knowledge;
- Describe the principles of separating water and fat signals; and
- Name three different approaches for motion correction and appraise their potential to become routine methods

Parallel Imaging

07:00 **Parallel Imaging Reconstruction I: Cartesian**
Michael Schacht Hansen, Ph.D.

07:30 **Parallel Imaging Reconstruction II: Non-Cartesian**
Chunlei Liu, Ph.D.

SUNRISE EDUCATIONAL COURSE

Imaging Biomarkers

Room A1 07:00 – 08:00 *Organizers & Moderators*: Jeffrey L. Evelhoch and Sabrina M. Ronen

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe what a biomarker is and how MR can be used as a biomarker;
- Explain how biomarkers are qualified to be fit for their intended purpose;
- List requirements for use of MR biomarkers in both preclinical studies and clinical trials; and
- Give examples of how imaging biomarkers are being used in at least two of the following areas: multiple sclerosis, oncology, cardiovascular diseases and neurodegenerative diseases.

07:00 **Preclinical Applications of Imaging Biomarkers**
Markus Von Kienlin, Ph.D.

07:30 **Quantitiative MR in Multi-Center Trials**
Edward Ashton, Ph.D.

SUNRISE EDUCATIONAL COURSE

Brain: An Absolute Beginner's Guide to Anatomical & Functional MRI

Room A4 07:00 – 08:00 *Organizer & Moderator*: Geoffrey J.M. Parker

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Identify the neuroanatomical and neurophysiological parameters which are accessible to MR measurement;
- Describe the underlying physics of MR neuroimaging techniques;
- Describe the data acquisition and analysis techniques most commonly used for anatomical and functional MRI of the brain;
- Recognize the potential value of advances such as parallel imaging, fast imaging techniques and high magnetic field strengths for imaging the brain; and
- Name typical clinical applications for which specific MRI techniques are suited.

07:00 **Absolute Beginners' Guide to Perfusion MRI**
Laura M. Parkes, Ph.D.

SUNRISE EDUCATIONAL COURSE

Potentials & Challenges of High-Field MRS

Room A5 07:00 – 08:00 *Organizers & Moderators*: Rolf Gruetter and Ivan Tkac

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe advantages and potentials of MRS at very high fields;
- Identify problems and challenges of high field MRS;
- Define the MRS detectable neurochemical profile of the brain;
- Describe principles of metabolite quantification;
- Assess spectral quality and identify main sources of spectral quality deterioration; and
- Explain the importance of B0 shimming at high fields.

B0 Shimming at High Fields

07:00 **Shimming and MRS**
Ivan Tkac, Ph.D.

07:30 **Shimming and MRSI**
Hoby P. Hetherington, Ph.D.

SUNRISE EDUCATIONAL COURSE

Modeling & Quantitative Analysis for Body DCE MRI

Room A6 07:00 – 08:00 *Organizers*: Henry Rusinek and Min-Ying Lydia Su

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe various DCE models used for different organs including kidney, liver, breast, and prostate;
- Describe analysis methods used to measure vascularity, permeability, and blood flow;
- Implement Monte Carlo noise simulation method to predict parameter bias and precision;
- Compare conventional compartmental kinetic models and distributed models;
- Apply procedures for converting MRI signal intensity to tracer concentration; and
- Explain current method for measuring vascular input function and analyzing its impact on obtained DCE parameters.

Moderators: **Steven P. Sourbron and Thomas E. Yankeelov**

07:00 **From Simple to Complex**
David L. Buckley, Ph.D.

07:30 **Renal Filtration Models**
Louisa Bokacheva, Ph.D.

SUNRISE EDUCATIONAL COURSE

From Bench to Bedside to Bench: Translation of Animal Models to Clinical Practice & From Clinical Practice to Animal Models

Room A7 07:00 – 08:00 *Organizers & Moderators*: Pia C. Maly Sundgren and Afonso C. Silva

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the main MRI methods used in experimental studies to understand the underlying disease mechanisms;
- Identify what is known about the underlying disease mechanisms, and which type of MRI investigations could be used for diagnosis and clinical investigation;
- Describe the main MRI methods used in the clinical setting to diagnose the condition, and the rationale behind this; and
- Make the translation from what is - and can be - done in experimental studies to what can be done clinically, and where animal models bring new insight to disease.

Polycystic Kidney Disease

Moderators: **Diana M. Gomez-Hassan, M.D., Ph.D. and Afonso C. Silva, Ph.D.**

07:00 **Mouse Models for Polycystic Kidney Disease**
Stéphane Burtey, Ph.D., Ph.D.

07:30 **Polycystic Kidney Disease and MRI**
Arlene B. Chapman, M.D.

SUNRISE EDUCATIONAL COURSE

Cardiovascular Imaging: Disease or Problem Based Teaching, Practical Protocols

Room A8 07:00 – 08:00 *Organizers & Moderators*: Victor A. Ferrari, Vivian S Lee, & Mitsue Miyazaki

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Recognize recent advancements and requirements in 3T cardiovascular MRI, as compared to present 1.5T MRI;
- Evaluate the strengths and limitations of current cardiovascular MRI techniques when applied to clinical diagnostic examinations;
- Describe current clinical techniques for assessment of ischemic heart disease and various cardiac diseases using new methods;
- Select the potential clinical applications of time-resolved techniques, and the technical challenges that will need to be resolved for wider applications; and
- Apply current approaches optimally to these diseases.

Time Resolved MRA

07:00 **Techniques Cartesian**
Stephen J. Riederer, Ph.D.

07:20 **Techniques Radial**
Walter F. Block, Ph.D.

07:40 **Applications**
J. Paul Finn, M.D., Ph.D.

SUNRISE EDUCATIONAL COURSE

Trials & Tribulations: Multicenter Trial Headaches & Their Cures

Room A9 07:00 – 08:00 *Organizers & Moderators*: Nicola de Stefano and Jeffrey Joseph Neil

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe multiple methods for setting up and maintaining site quality and certification for multicenter imaging trials;
- Explain the issues related to performing research involving INDs or IDEs;
- Evaluate the sensitivity, specificity and reliability of current imaging methods to detect relevant quantitative changes within the brain; and
- Describe the underlying principles for adopting and evaluating potential surrogate imaging markers for assessment of drug efficacy.

Trying Drugs & Devices: Safety & Liability

07:00 **Multicenter Drug Trials**
A. Gregory Sorensen, M.D.

07:30 **Trials Using Devices**
Christine H. Lorenz, Ph.D.

PLENARY SESSION

The Eye of the Beholder: An Image Reconstruction Challenge

Room A1 08:15-09:30 *Organizers & Moderators:* Margaret A. Hall-Craggs, Douglas C. Noll and James G. Pipe

08:15 ***342***. **If I Am So Good at This, Why Do I Miss So Much?**

Jeremy M. Wolfe[1]
[1]Brigham & Women's Hospital, Harvard Medical School, Cambridge, MA, United States

Humans are very good at visual search tasks, looking for targets in scenes filled with distractors. Trained humans are very good at applied search tasks like medical and security screening. However, people make errors and these can be associated with high costs like missed disease. This talk will illustrate three sources of error that are rooted in human cognitive function: Crowding effects: where neighboring items "hide" clearly visible targets. Change blindness: where the limits on visual processing make observers insensitive to substantial changes in an image. And prevalence effects: where rare targets are missed simply because they are rare.

08:40 **Reconstruction Challenge: So Many Algorithms, So Few Data**
Award presentations, panel discussion

CLINICAL INTENSIVE COURSE

(Admission to this session is limited to Clinical Intensive Course registrants only)

Advances in Multiple Sclerosis II

Room K1 08:15 – 09:15 *Oraganizers*: Walter Kucharczyk and Pia C. Maly Sundgren

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Explain brain plasticity;
- Describe cases when MRI could appropriately be used as a biomarker for MS; and
- Explain the rationale for using (or not) different dosages of contrast in MS patients.

Moderators: **Frederik Barkhof and Nicola de Stefano**

08:15 **MRI as a Biomarker**
Alex Rovira, M.D.

08:45 **Is There a Need for High Dosages of Contrast in MS Imaging**
Ruth C. Carlos, M.D.

CLINICAL INTENSIVE COURSE

(Admission to this session is limited to Clinical Intensive Course registrants only)

Body MR Angiography: An Update - Case-Based Teaching

Room K2 08:15 – 10:00 *Organizer*: Juerg Hodler

Moderators: **Thorsten Bley and Elmar Max Merkle**

08:15 Welcome

08:20 **Body MRA in the Era of CTA - Is It Still the Imaging Modality of Choice?**
Stefan G. Ruehm, M.D.

09:00 Questions

09:10 **Time Resolved MRA from Head to Toe - Nice Toy or Helpful Clinical Tool?**
Winfried A. Willinek, M.D.

09:50 Questions

CLINICAL INTENSIVE COURSE
Epilepsy: From Electrophysiology to Imaging & Back Again

Room K1 10:30 – 12:30 *Organizer*: Stefan Sunaert

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe current concepts regarding underlying neurophysiology of epilepsy;
- Explain application of MRI to the diagnosis, evaluation and therapy of patients with seizures; and
- Describe and compare utility of individual imaging techniques and their combined use for diagnosis and therapy in epilepsy.

Moderators: **Micheal D. Phillips and Stefan Sunaert**

10:30 **Neurophysiology of Epilepsy**
Imad Najm, M.D.

11:10 **MR Imaging of Seizures**
Diana M. Gomez-Hassan, M.D., Ph.D.

11:50 **Combining Electrophysiology and Imaging in Epilepsy: EEG-fMRI, Source Imaging, DTI**
Louis Lemieux, Ph.D.

CLINICAL INTENSIVE COURSE
Wrist Imaging

Room K2 10:30 – 12:30 *Organizers* & *Moderators*: Juerg Hodler and Hollis G. Potter

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the most relevant wrist-related diagnoses and their MR appearance;
- Identify the differential diagnosis of MR findings; and
- Implement optimized wrist imaging protocols in their practice.

10:30 **Triangular Fibrocartilage**
Hiroshi Yoshioka, M.D., Ph.D.

11:00 **Intrinsic Ligaments**
Kimberly K. Amrami, M.D.

11:45 **Bone and Cartilage Injury**
Hollis G. Potter, M.D.

CLINICAL INTENSIVE COURSE
Bowel Imaging

Room A9 10:30 – 12:30 *Organizer:* Juerg Hodler

Moderators: **Thomas C. Lauenstein and Elmar M. Merkle**

10:30 **CT Enterography: Why is it the Modality of Choice?**
Erik K. Paulson, M.D.

10:55 **MR Enterography: Why is it the Modality of Choice?**
Jeff L. Fidler, M.D.

11:20 Questions

11:30 **MR Colonography in the Era of CT Colonography: Is There Any Meaningful Role?,**
Thomas C. Lauenstein, M.D.

11:55 **MR Imaging of the Rectum: From Inflammatory Bowel Disease to Cancer Staging.**
Lennart Karl Olof Blomqvist, M.D., Ph.D.

12:20 Questions

Less is More: Compressed Sensing & Constrained Reconstruction

Room A1 10:30-12:30 *Moderators:* Nicole E. Seiberlich and Leslie Ying

10:30 ***343***. **Exploiting Sparsity in the Difference Images to Achieve Higher Acceleration Factors in Non-Contrast MRA**

Pippa Storey[1], Ricardo Otazo[1], Lazar Fleysher[1], Niels Oesingmann[2], Ruth P. Lim[1], Vivian S. Lee[1], Daniel K. Sodickson[1]
[1]Radiology Department, NYU School of Medicine, New York, NY, United States; [2]Siemens Medical Solutions USA

Non-contrast techniques for peripheral MRA exploit the pulsatility of arterial blood flow and involve subtraction of dark-blood images, acquired during fast flow, from bright-blood images, acquired during slow flow. The difference images, which depict the arteries, are sparse, although the source images are not. We show that higher acceleration factors can be achieved by performing subtraction on the raw data, before calculation of the GRAPPA weights, rather than on the final magnitude images. Depiction of large arteries is similar to that achieved with low acceleration factors and standard reconstruction, but depiction of small arteries and fine branch vessels is compromised.

10:42 ***344***. **Combination of Compressed Sensing and Parallel Imaging for Highly-Accelerated 3D First-Pass Cardiac Perfusion MRI**

Ricardo Otazo[1], Jian Xu[2,3], Daniel Kim[1], Leon Axel[1], Daniel K. Sodickson[1]
[1]Center for Biomedical Imaging, New York University School of Medicine, New York, NY, United States; [2]Siemens Medical Solutions USA, New York, NY, United States; [3]Polytechnic Institute of NYU, Brooklyn, NY, United States

Compressed sensing and parallel imaging are combined into a single joint acceleration approach for highly accelerated 3D first-pass cardiac perfusion MRI. 3D perfusion imaging is a natural candidate for this combined approach, due to increased sparsity and incoherence provided by the high dimensionality of the data, multi-dimensional acceleration capability and increased baseline SNR. We demonstrate the feasibility of high in vivo acceleration factors of 16 for 3D first-pass cardiac perfusion MRI studies with whole-heart coverage per heartbeat using a 32-element coil array

10:54 ***345***. **Efficient L1SPIRiT Reconstruction (ESPIRiT) for Highly Accelerated 3D Volumetric MRI with Parallel Imaging and Compressed Sensing**

Peng Lai[1], Michael Lustig[2,3], Anja CS. Brau[1], Shreyas Vasanawala[4], Philip J. Beatty[1], Marcus Alley[2]
[1]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [2]Electrical Engineering, Stanford University, Stanford, CA, United States; [3]Electrical Engineering and Computer Science, University of California, Berkeley, CA, United States; [4]Radiology, Stanford University, Stanford, CA, United States

Conventional L1SPIRiT reconstruction enables highly-accelerated MRI by combining parallel imaging and compressed sensing but suffers from impractically long reconstruction time. This work developed a new efficient L1SPIRiT algorithm (ESPIRiT) to address the computation challenge from three perspectives: 1. reducing the computation complexity based on Eigenvector calculations, 2. reducing the number of pixels to process based on pixel-specific convergence, 3. reducing the number of iterations using parallel imaging initialization. ESPIRiT was compared with L1SPIRiT on in-vivo datasets. Our results show that ESPIRiT can improve image quality and reconstruction accuracy with >10× faster computation compared to L1SPIRiT.

11:06 ***346***. **Accelerated 3D Phase-Contrast Imaging Using Adaptive Compressed Sensing with No Free Parameters**

Kedar Khare[1], Christopher J. Hardy[1], Kevin F. King[2], Patrick A. Turski[3], Luca Marinelli[1]
[1]GE Global Research Center, Niskayuna, NY, United States; [2]GE Healthcare, Waukesha, WI, United States; [3]School of Medicine & Public Health, University of Wisconsin, Madison, WI, United States

We present a robust method for compressed-sensing reconstruction using a data-driven, iterative soft-thresholding (ST) framework with no tuning of free parameters. The algorithm combines a Nesterov-type optimal gradient scheme for iterative update with adaptive wavelet denoising methods. Vascular 3D phase-contrast scans on healthy volunteers are used to show that image quality is comparable to that of empirically tuned, nonlinear conjugate-gradient (NLCG) reconstruction. Statistical analysis of image quality scores for five datasets indicates that the ST approach improves the robustness of the reconstruction and image quality as compared to NLCG with a single set of tuning parameters for all scans.

11:18 ***347***. **Nonconvex Compressive Sensing with Parallel Imaging for Highly Accelerated 4D CE-MRA**

Joshua D. Trzasko[1], Clifton R. Haider[1], Eric A. Borisch[1], Stephen J. Riederer[1], Armando Manduca[1]
[1]Mayo Clinic, Rochester, MN, United States

CAPR is a state-of-the-art Cartesian acquisition paradigm for time-resolved 3D contrast-enhanced MR angiography that typically employs Tikhonov and partial Fourier methods for image reconstruction. When operating at extreme acceleration rates, such reconstructions can exhibit significant noise amplification and Gibbs artifacts, potentially inhibiting diagnosis. In this work, an offline reconstruction framework for both view-shared and non-view-shared CAPR time-series acquisitions based on nonconvex Compressive Sensing is proposed and demonstrated to both suppress noise amplification and improve vessel conspicuity.

11:30 ***348***. **Fast MR Parameter Mapping from Highly Undersampled Data by Direct Reconstruction of Principal Component Coefficient Maps Using Compressed Sensing**

Chuan Huang[1], Christian Graff[2], Ali Bilgin[3], Maria I. Altbach[4]
[1]Mathematics, University of Arizona, Tucson, AZ, United States; [2]Program in Applied Mathematics, University of Arizona; [3]Biomedical Engineering, University of Arizona; [4]Radiology, University of Arizona

There has been an increased interest in quantitative MR parameter mapping techniques which enable direct comparison of tissue-related values between different subjects and scans. However the lengthy acquisition times needed by conventional parameter mapping methods limit their use in the clinic. In this work, we introduce a new model-based approach to reconstruct accurate T2 maps directly from highly undersampled FSE data. The proposed approach referred to as DIrect REconstruction of Principal COmponent coefficient Maps (DIREPCOM) removes non-linearity from the model and employs sparsity constraints in both the spatial and temporal dimensions to produces accurate T2 maps by using Principal Component Analysis. While this proposed technique has been illustrated for T2 estimation, the methodology can be adapted to the estimation of other MR parameters.

11:42 ***349***. **Compressed Sensing with Transform Domain Dependencies for Coronary MRI**

Mehmet Akçakaya[1,2], Seunghoon Nam[1,2], Peng Hu[2], Warren Manning[2], Vahid Tarokh[1], Reza Nezafat[2]
[1]Harvard University, Cambridge, MA, United States; [2]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States

Lengthy acquisition time is one of the main limitations of coronary MRI. Parallel imaging has been used to accelerate image acquisition but with limited success due to low signal-to-noise ratio. Compressed sensing (CS) has been recently utilized to accelerate image acquisition in MRI, but its use in cardiac MRI has been limited due to blurring artifacts. In this study, we develop an improved CS reconstruction method that uses the dependencies of transform domain coefficients to reduce the observed blurring and reconstruction artifacts in coronary MRI.

11:54 ***350***. **A Novel Approach for T1 Relaxometry Using Constrained Reconstruction in Parametric Dimension**

Julia Velikina[1], Andrew L. Alexander[1], Alexey A. Samsonov[1]
[1]University of Wisconsin - Madison, Madison, WI, United States

A novel method for T1 relaxometry is proposed using constrained reconstruction in the parametric (flip angle) dimension. Preliminary results indicate that the proposed method allows T1 estimation from undersampled data collected for multiple flip angles with better accuracy than from the data collected for two ideal angles acquired within the same scan time.

12:06 ***351***. **Accelerated Breath-Hold Multi-Echo FSE Pulse Sequence Using Compressed Sensing and Parallel Imaging for T2 Measurement in the Heart**

Li Feng[1], Ricardo Otazo[2], Jens Jensen[2], Daniel K. Sodickson[2], Daniel Kim[2]
[1]Sackler Institute of Graduate Biomedical Sciences, New York University School of Medicine, New York, NY, United States; [2]Radiology, New York University School of Medicine, New York, NY, United States

T2 Measurement can be used to detect pathological changes in tissue for a variety of clinical applications, including identification of edema and iron overload. Rapid T2 mapping in the heart is challenging because of the need to acquire adequate spatial resolution within clinically acceptable breath-hold duration of 20s or less. We propose to extend a recently developed breath-hold T2 mapping pulse sequence to achieve higher spatial resolution, by implementing a joint reconstruction algorithm that combines compressed sensing and parallel imaging. This accelerated T2 mapping pulse sequence with high spatial resolution was validated in vitro and in vivo.

12:18 ***352***. **Interleaved Variable Density Sampling with ARC Parallel Imaging and Cartesian HYPR for Dynamic MR Angiography**

Kang Wang[1], James Holmes[2], Reed Busse[2], Philip Beatty[3], Jean Brittain[2], Christopher Francois[4], Lauren Keith[1], Yijing Wu[1], Frank Korosec[1,4]

[1]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States; [2]Applied Science Laboratory, GE Healthcare, Madison, WI, United States; [3]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [4]Radiology, University of Wisconsin-Madison, Madison, WI, United States

Both high spatial and temporal resolution are desired for contrast-enhanced MR angiography (CE-MRA). In this work, we describe a technique that combines interleaved variable density (IVD) Cartesian sampling, ARC parallel imaging (PI), and Cartesian HYPR reconstruction. This technique is validated in multiple exams performed on healthy volunteers.

Functional Connectivity

Victoria Hall 10:30-12:30 *Moderators:* Mark J. Lowe and Scott J. Peltier

10:30 **Introduction**

Vesa J. Kiviniemi

10:42 ***353***. **Identifying Common-Source Driven Correlations in Resting-State FMRI Via Laminar-Specific Analysis in the Human Visual Cortex**

Jonathan Rizzo Polimeni[1], Thomas Witzel[1,2], Bruce Fischl[1,3], Douglas N. Greve[1], Lawrence L. Wald[1,2]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Harvard Medical School, Massachusetts General Hospital, Charlestown, MA, United States; [2]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States; [3]Computer Science and AI Lab (CSAIL), Massachusetts Institute of Technology, Cambridge, MA, United States

High-resolution 7T fMRI together with laminar surface-based analysis is utilized to assess the ability of laminar-specific comparisons to differentiate resting state correlations stemming from direct cortical-to-cortical connections from correlations arising from common-source input. We show that the Layer II/III "outputs" of human V1 are more highly correlated to the Layer IV "inputs" of area MT than to other layers, while each layer of V1 is maximally correlated with the same layer in the V1 of the opposite hemisphere. This suggests that laminar analysis of functional connectivity can help identify correlations that may be attributable to indirect connections through common inputs.

10:54 ***354***. **Demonstration of the Central Role of the Subcortex in the Developing Brain by Identifying "hubs" in the Network Organisation of Functional Connectivity**

Richard Andrew James Masterton[1], Graeme D. Jackson[1,2]

[1]Brain Research Institute, Florey Neuroscience Institutes, Melbourne, Victoria, Australia; [2]Department of Medicine, The University of Melbourne, Melbourne, Victoria, Australia

We describe a new voxel-based analysis technique for characterising the network organisation of functional connectivity in the brain. Results are presented showing that subcortical structures play a more central role in children compared with adults.

11:06 ***355***. **Do Neural Oscillations Underlie Haemodynamic Functional Connectivity Measurements?**

Joanne Rachel Hale[1], Matthew Brookes[1], Claire Stevenson[1], Johanna Zumer[1], Gareth Barnes[2], Julia Owen[3], Susan Francis[1], Srikantan Nagarajan[3], Peter Morris[1]

[1]SPMMRC, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]University College London, London, United Kingdom; [3]University of California, San Francisco, San Francisco, CA, United States

Recently, interest has increased in studying resting state fluctuations in BOLD fMRI and work has shown correlation between BOLD signals from spatially separate but functionally related brain regions. Unfortunately, fMRI signals are affected by non-neuronal physiological artifacts which can lead to spurious connectivity measurements. The ability to investigate the neuronal activity underlying BOLD connectivity is therefore important. Here we use MEG and 7T fMRI to measure independently resting state sensorimotor cortex connectivity. We show that beta-band fluctuations are implicated in sensorimotor network connectivity, adding weight to previous EEG/fMRI results implying a neural oscillatory basis to resting state BOLD signals.

11:18 ***356***. **The Modulation of 7.0T Spontaneous Blood-Oxygenation-Level-Dependent (BOLD) Signal by the Behavioral State**

Manus Joseph Donahue[1,2], Hans Hoogduin[3], Stephen M. Smith[1,4], Jeroen CW Siero[3], Natalia Petridou[3], Peter Jezzard[1,2], Peter Luijten[3], Jeroen Hendrikse[3]

[1]Clinical Neurology, Oxford University, Oxford, United Kingdom; [2]Physics Division, FMRIB Centre, Oxford, United Kingdom; [3]Radiology, University Medical Center Utrecht, Utrecht, Netherlands; [4]Analysis Division, FMRIB Centre, Oxford, United Kingdom

Although the use of spontaneous BOLD activity is being increasingly exploited for connectivity studies, there is limited information available on how spontaneous BOLD signal is influenced by different behavioural states. Here, we investigate the effect of different behavioural states (eyes closed, eyes open, constant-fist-clench, and finger tapping) on spontaneous BOLD signal in the motor cortex at high field strength (7.0T) and high spatial resolution (1.6x1.6x1.6 mm3). Results show that spontaneous signal coherence and, to a lesser degree, amplitude are both dependent ($P<0.05$) on behavioural state; implications of this phenomenon on evoked, spontaneous and 7.0T BOLD experiments are discussed.

11:30 ***357***. **Specific Versus Nonspecific Connectivity: A Transition of the Resting Network from Light to Deep Anesthesia**

Xiao Liu[1,2], Xiao-Hong Zhu[1], Yi Zhang[1], Wei Chen[1,2]
[1]CMRR, radiology, University of Minnesota, Minneapolis, MN, United States; [2]Biomedical Engineering, University of Minnesota, Minneapolis, MN, United States

In this study, we observed that the resting networks covering specific rat cortical regions under light anesthesia (~1.0% isoflurane) merged into a nonspecific network covering wider cortical regions with stronger connectivity under the deep anesthesia (~1.8% isoflurane). This observation is consistent with a previous electrophysiological study, which demonstrated that the deeply anesthetized brain showed global and nonselective responses to external stimuli. They support a new theory in regards to anesthesia: the deep anesthesia can disrupt the repertoire of neural activity patterns and thus reduce the information carried by them, even though the information may still be integrated globally.

11:42 ***358***. **Correlation Between Simultaneously Recorded Full-Band EEG and BOLD at Rest**

Ahmed Abou Elseoud[1], Tuija Hiltunen[1], Pasi Lepola[2], Kalervo Suominen[2], Tuomo Starck[1], Juha Nikkinen[1], Jukka Remes[1], Osmo Tervonen[1], Vesa Kiviniemi[1]
[1]Diagnostic Radiology, Oulu University Hospital, Oulu, Finland; [2]Clinical Neurophysiology, Oulu University Hospital, Oulu, Finland

Hypothesizing that low frequency FbEEG recordings correlate to the most active brain network at rest, i.e. default mode network (DMN). We investigated the correlation between the two signals, and we showed how the amplification of vasomotor waves by caffeine alters the resulted correlation. Correlations between FbEEG and resting state BOLD were located in the dorsomedial prefrontal cortex (dMPFC), left superior medial and precentral gyri. Caffeine administration augmented the correlations in dMPFC and more correlating areas were observed in; ventromedial prefrontal cortex (vMPFC), cuneus, lingual, middle occipital, middle temporal gyri and right anterior cingulate. These correlations were reduced after physiological corrections.

11:54 ***359***. **Identification of Anti-Correlated Resting-State Networks Using Simultaneous EEG-FMRI and Independent Components Analysis**

Chi Wah Wong[1], Valur Olafsson[2], Hongjian He[2], Tom Liu[2]
[1]Radiology, University of California - San Diego, La Jolla,, CA, United States; [2]Radiology, University of California - San Diego, La Jolla, CA, United States

It has been shown with resting-state fMRI that the Default Mode Network (DMN) is anti-correlated with the Task Positive Network (TPN). In this study, we used simultaneous EEG-fMRI to investigate the relationship of the EEG alpha power time course with the resting-state BOLD signals in these anti-correlated networks. We found that the relation between the EEG alpha power and BOLD fMRI signals in these networks is stronger when using independent components (as determined with Independent Components Analysis) as compared to the use of the global alpha power.

12:06 ***360***. **Within- And Between-Subject Reproducibility of Matrix-Based Analysis of Resting-State Functional Connectivity Network**

Ying-hui Chou[1], Lawrence P. Panych[2], Chandlee C. Dickey[3], Nan-kuei Chen[4]
[1]Fu-Jen Catholic University, Hsin-chung, Taipei, Taiwan; [2]Brigham and Women's Hospital and Harvard Medical School, Boston, MA, United States; [3]VA Boston Healthcare System and Harvard Medical School, Boston, MA, United States; [4]Duke University, Durham, NC, United States

In this study, we assessed the within- and between-subject reproducibility of resting-state functional connectivity measured by a matrix-based analysis (MBA) in six healthy volunteers. The MBA can quantify connectivity strength for the whole brain without a priori model, and can be applied to dissociate clinical populations. Each participant was scanned nine times for more than a one-year period. Our results show that 1) the functional networks measured by the MBA are highly reproducible across nine sessions; and 2) there exists measurable between-subject variance. The MBA-based connectivity mapping should prove useful for monitoring long-term changes in functional networks.

12:18 ***361***. **Contribution of Different Sources of Signal Variance to T_2* and S_0 Maps in the Human Brain at Rest: A 7T Study**

Marta Bianciardi[1], Masaki Fukunaga[1], Peter van Gelderen[1], Jacco A. de Zwart[1], Jeff H. Duyn[1]
[1]Advanced MRI Section, LFMI/NINDS/NIH, Bethesda, MD, United States

To exploit the increased BOLD-contrast available at 7T for fMRI-studies, it is crucial to identify the various noise-sources and their origin. We determined the contribution of non-thermal noise to fluctuations in BOLD-weighted-, T_2*- and S_0-signals in the visual cortex at 7T during rest. The following noise-sources were considered: low-frequency-drifts, effects related to the phase of physiological cycles and to changes in physiological rates, thermal-noise, and other sources, tentatively attributed to spontaneous-activity. Our findings show that low-frequency-drifts have a physiological-contribution, and that spontaneous-activity has an echo-time dependence. Effects related to physiological-cycles and their rates contributed both to T_2*- and to S_0-images.

Breast MR: Nodes, Ducts & Diffusion

Room A4 *Moderators:* Elizabeth A. Morris and Simone Schrading

10:30 ***362***. **A Novel MRI Method for Breast Cancer Detection Based on Diffusion Tensor Tracking of the Ductal Trees**

Erez Eyal[1], Myra Shapiro-Feinberg[2], Edna Furman Haran[1], Dov Grobgeld[1], Talia Golan[3], Yaakov Itzchak[3], Raphael Catane[3], Moshe Papa[4], Hadassa Degani[1]
[1]Weizmann Institute of Science, Rehovot, Israel; [2]Meir Medical Center, Kfar Saba, Israel; [3]Sheba Medical Center, Tel Hashomer, Israel; [4]Sheba Medical Center,, Tel Hashomer, Israel

Mammary malignancies typically develop from the ductal epithelial cells, and spread within the ducts. Consequently, the ductal structures are an important area of investigation of both normal breast development and malignant breast transformation. Our goal is to characterize the anisotropic water diffusion properties in the mammary ductal trees tissue using diffusion tensor MRI and to utilize this method to detect breast cancer. The results show that DTI based MRI reveals the diffusion anisotropy in the mammary ducts and can track changes in the diffusion tensor components due to cancer growth.

10:42 ***363***. **Gadofosveset as a Negative Contrast Agent for Detecting Metastatic Axillary Lymph Nodes in Breast Cancer Patients on Diffusion and T2* Weighted Images - A Proof of Principle**

Mies A. Korteweg[1], Fredy Visser[1,2], Daniel L. Polders[1], Taro Takahara[1], Willem P.Th.M. Mali[1], Wouter B. Veldhuis[1]
[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands; [2]Philips Healthcare, Best, Netherlands

This abstract describes the pathology-controlled, retrospective, gadofosveset-enhanced 3T MRI characterization of axillary lymph nodes in breast cancer patients. Gadofosveset was hypothesized to accumulate in a higher concentration in healthy than in metastatic nodes. It was shown that the mean absolute T2* relaxation time and the post contrast signal intensity of the lesion to spinal cord ratio on diffusion-weighted (DWI) scans were significantly higher in metastatic compared to non-metastatic nodes. The preliminary results suggest that gadofosveset increased the transverse relaxation rate in healthy nodes causing a negative contrast effect on DWI scans, selectively preserving the signal of metastatic lymph nodes.

10:54 ***364***. **Vascular and Cellular Biomarkers from Intravoxel Incoherent Motion (IVIM) MRI in Locally Advanced Breast Cancer Lesions**

Eric Edward Sigmund[1], Linda Moy[1], Gene Cho[1], Sungheon Kim[1], Myra Finn[1], Jens Hesselberg Jensen[1], Melanie Moccaldi[1], Daniel Sodickson[1], Robert Schneider[2], Silvia Formenti[3]
[1]Radiology, New York University Langone Medical Center, New York, NY, United States; [2]Microbiology, New York University Langone Medical Center, New York, NY, United States; [3]Radiation Oncology, New York University Langone Medical Center, New York, NY, United States

Diffusion-weighted imaging (DWI) is playing an increasing important role in breast cancer lesion characterization, most commonly marking restricted diffusion in tumor cellularity. Intravoxel incoherent motion (IVIM) MRI is a DWI variant ideally providing markers not only of cellularity, but also tumor vascularity and blood velocity. In this study we acquired IVIM data in N=25 breast cancer patients at 3 T and compared these markers with contrast-enhanced MRI and biopsy diagnosis. Robust quantification of the IVIM parameter set clearly differentiated lesions from the weakly perfused normal fibroglandular tissue and may be helpful for future quantitative lesion grading.

11:06 ***365***. **Identifying Breast Calcification by Using Susceptibility Weighted Imaging: Optimizing Parameters for Detection of Calcifications at 3T**

Ali Fatemi[1], Colm Boylan[2,3], Michael D. Noseworthy, [1,4]
[1]Medical Physics and Applied Radiation Sciences, McMaster University, Hamilton, Ontario, Canada; [2]Diagnostic Imaging, St. Joseph's Healthcare, Hamilton, Ontario, Canada; [3]Radiology, McMaster University, Hamilton, Ontario, Canada; [4]Electrical and Computer Engineering, School of Biomedical Engineering, McMaster University, Hamilton, Ontario, Canada

We have optimized corrected phase images acquired at 3T with a dedicated breast coil to detect breast microcalcification. Corrected phase images demonstrating calcifications correlate well with x-ray mammography.

11:18 ***366***. **High Resolution T2 Breast Imaging Using FADE**

Kristin L. Granlund[1,2], Ernesto Staroswiecki[1,2], Marcus T. Alley[1], Bruce L. Daniel[1], Brian A. Hargreaves[1]
[1]Radiology, Stanford University, Stanford, CA, United States; [2]Electrical Engineering, Stanford University, Stanford, CA, United States

High resolution breast MRI is useful for distinguishing benign and malignant tumors. The FADE sequence allows us to acquire two images during a single scan with different image contrasts, the first image having high SNR and the second image having T2 weighting. A second pair of images can then be acquired with different crusher areas to evaluate the diffusivity of different tissues. Phantom studies were performed to confirm sources of image contrast. The technique was then evaluated in two patients and it was found that the FADE sequence highlighted tumors with both high T2 and restricted diffusion.

11:30 ***367***. **Time Intensity Curve Analysis of Malignant Enhancing Breast Lesions: Atypical Findings More Frequent in Smaller Lesions**

Dorothee Barbara Engel[1], Winifred Dunbar[2], Fred Kelcz[2]
[1]Clinical Radiology and Nuclear Medicine, University Medical Center Mannheim, Mannheim, Germany; [2]Radiology, School of Medicine and Public Health, Madison, WI, United States

Dynamic contrast-enhanced (DCE) breast MRI has become the mainstay for assessing breast problems not resolved by mammography and ultrasound. A signal intensity vs. time curve showing rapid gadolinium contrast uptake and delayed washout is typically associated with malignancy, but our study of 81 malignant spanning a wide size range showed that the “typical pattern” was only in lesions > 1 cm. A delayed persistent pattern may be seen in up to 20% of sub-centimeter lesions. Radiologists should be aware of these exceptions and emphasize morphology over contrast enhancement for small lesions.

11:42 ***368***. **Approaching Complete Separation of Benign and Malignant Breast Lesions by DCE-MRI: Impact on Healthcare Costs**

Wei Huang[1], Patricia A. Carney[1], Luminita Alina Tudorica[1], Yiyi Chen[1], Xin Li[1], Elizabeth A. Morris[2], Ian J. Tagge[1], Sunitha Thakur[2], Maayan Korenblit[2], Jason A. Koutcher[2], Charles S. Springer[1]
[1]Oregon Health & Science University, Portland, OR, United States; [2]Memorial Sloan Kettering Cancer Center, New York, NY, United States

Shutter-Speed Model (SSM) analyses of breast DCE-MRI data from 98 suspicious lesions show significantly improved diagnostic accuracy compared to Standard Model (SM) analyses and clinical MRI protocols. The difference in Ktrans derived from the two models, ¦¤Ktrans [¡Ô Ktrans(SSM) ¨C Ktrans(SM)], has near perfect specificity at 100% sensitivity. The cost effectiveness of replacing unnecessary benign biopsies with SSM DCE-MRI is significant.

11:54 ***369***. **Can Proton MR Spectroscopy Provide Useful Information for Characterizing Estrogen Receptor Status in Breast Cancer?**

Hyeon-Man Baek[1], Jeon-Hor Chen[2,3], Orhan Nalcioglu[2], Min-Ying Su[2]
[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States; [2]Center for Function Onco-Imaging, University of California-Irvine, Irvine, CA, United States; [3]Radiology, China Medical University Hospital, Taichung 404, Taiwan

ER-negative cancer was more aggressive, with bigger tumor size, more prominent tumor infiltration showing non-mass-type enhancements on magnetic resonance imaging (MRI) features. The aim of our study was to determine whether in vivo 1H-MRS can provide useful information for characterizing ER status in breast cancer. On the basis of the criterion (i.e., CRB < 100%), tCho detection rate was higher in ER-negative group (16/20, 80%) than in ER-positive group (15/27, 56%), but not reaching significant level (P = 0.083). The ER-positive group had a lower mean tCho concentration than the ER-negative group, but no significant difference was observed (2.01 vs. 2.24 mmol/kg, P = 0.677). The reason why our finding was not significant might be due to the heterogeneity of the breast cancer tissue.

12:06 ***370***. **Predicting Long Term Survival for Breast Cancer Patients by HR MAS Metabolic Profiling During Neoadjuvant Chemotherapy**

Maria Dung Cao[1], Beathe Sitter[1], Tone Frost Bathen[1], Per Eystein Lønning[2,3], Steinar Lundgren[1,4], Ingrid Susanne Gribbestad[1]
[1]Department of Circulation and Medical Imaging, Norwegian University of Science and Technology (NTNU), Trondheim, Norway; [2]Department of Oncology, Haukeland University Hospital, Bergen, Norway; [3]University of Bergen, Bergen, Norway; [4]Department of Oncology, St.Olav University Hospital, Trondheim, Norway

HR MAS MR metabolic profiling was performed in paired samples from locally advanced breast cancer patients obtained pre (n=19) and post (n=19) doxorubicine treatment. PLSDA analysis of HR MAS spectra showed classification between patients with long time survival (≥5 years), and patients who died of cancer recurrence within 5 years. Our results suggest distinct metabolic profiles of these two patient groups. High tCho, most significant GPC, levels before treatment correlated to long time survival, while high glycine and lactate levels were associated with poorer outcome.

12:18 ***371***. **MRI Characterization of Dissected Sentinel Lymph Nodes of Breast Cancer Patients at 7T**

Mies A. Korteweg[1], Jaco J.M. Zwanenburg[1], Vincent O. Boer[1], Richard van Hillegersberg[2], Paul J. van Diest[3], Peter R. Luijten[1], Willem P.Th.M. Mali[1], Wouter B. Veldhuis[1]
[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands; [2]Surgery, University Medical Center Utrecht, Utrecht, Netherlands; [3]Pathology, University Medical Center Utrecht, Utrecht, Netherlands

We describe the pathology-correlated 7T MRI characterization of dissected sentinel lymph nodes of breast cancer patients. The mean absolute ADC and T1, T2, T2* relaxation times were determined. Nodal dimensions and the presence of a fatty hilus was scored. In 20 patients 83 nodes were excised and scanned, 17 contained metastases. Blood- and lymph vessels and an in-transit metastasis inside a lymph vessel were identified on MRI. While the location of intranodal metastases could not be delineated morphologically, there was a significant difference in T2 and T2* relaxation times between metastatic and non-metastatic nodes.

Spectroscopy Methodology for Improved Metabolite Detection

Room A5 10:30-12:30 *Moderators:* Malgorzata Marjanska and Douglas L. Rothman

10:30 ***372***. **GABA Editing at 3T with Macromolecule Suppression: MEGA-SPECIAL**

Jamie Near[1], Philip J. Cowen[1], Peter Jezzard[2]
[1]Department of Psychiatry, University of Oxford, Oxford, OXON, United Kingdom; [2]The Centre for Functional Magnetic Resonance Imaging of the Brain, John Radcliffe Hospital, Oxford, OXON, United Kingdom

GABA editing using the MEGA-PRESS technique at 3T results in signal contamination from macromolecules. We present a modified spectral editing technique called MEGA-SPECIAL, which enables the use of longer, more frequency-selective editing pulses. This, in turn, enables the use of previously described strategies for the removal of macromolecular contamination. In-vitro measurements indicate that the newly developed sequence provides improved editing efficiency over MEGA-PRESS, and experiments performed in-vivo confirm that macromolecular suppression is achieved.

10:42 ***373***. **^{13}C MRS of Frontal Lobe at 3 Tesla Using a Volume Coil for Stochastic Proton Decoupling**

Shizhe Steve Li[1], Yang Zhang[1], Shumin Wang[1], Maria Ferraris Araneta[1], Christopher S. Johnson[1], Yun Xiang[1], Robert B. Innis[1], Jun Shen[1]
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^{13}C spectra from the frontal lobe of human brain were acquired for the first time at 3 Tesla. After intravenous infusion of [2-^{13}C]glucose, glutamate, glutamine, and aspartate were detected in the carboxylic/amide carbons region. The RF power deposition was well below the safety guidelines, due to enhanced decoupling efficiency from the volume coil and weak J coupling between proton and carboxylic/amide carbons. The effect of the strong B_0 field

inhomogeneity in the frontal lobe region was reduced by RF coil arrangement and by a reference deconvolution technique that used the glutamate C5 peak as a lineshape reference.

10:54 ***374***. ***In Vivo* detection of *trans*-Fatty Acids by ^{13}C MRS at 7T**

Ivan Dimitrov[1,2], Jimin Ren[2], Deborah Douglas[2], A Dean Sherry[2], Craig R. Malloy[2]
[1]Philips Medical Systems, Cleveland, OH, United States; [2]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States

The severe health implications of *trans*-fats are well-known: their consumption leads to coronary heart disease, diabetes, cancer, liver dysfunction, and Alzheimer's. We report the first non-invasive detection of *trans*-fats in humans by ^{13}C MRS at 7T. WALTZ-16 decoupled FIDs with NOE were acquired from calves of healthy volunteers in 5 min. The allylic carbons (α to C=C) display substantially different chemical shifts (*cis* 27.18 vs. *trans* 32.59 ppm). A volunteer on a Western diet had a *trans* : *cis* ratio = 4.4 %, consistent with *ex vivo* reports, whereas no *trans*-fats were detected in a volunteer on a Mediterranean diet.

11:06 ***375***. **Stimulated-Echo Contrast with Hyperpolarized [1-^{13}C]-Pyruvate**

Peder E. Z. Larson[1], Ralph Hurd[2], Adam B. Kerr[3], Robert Bok[1], John Kurhanewicz[1], Daniel B. Vigneron[1]
[1]Radiology and Biomedical Imaging, University of California - San Francisco, San Francisco, CA, United States; [2]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [3]Electrical Engineering, Stanford University, Stanford, CA, United States

Stimulated-echoes can be used to provide high sensitivity to diffusion and flow, providing unique contrast. We have developed and applied stimulated-echo pulse sequences for hyperpolarized 13C metabolic imaging, studying both normal animals and the TRAMP prostate cancer mouse model to better distinguish the local metabolite environment. These experiments demonstrated a dramatic increase in CNR for tumors and present a new parameter for characterizing the metabolic state.

11:18 ***376***. **Rapid Volumetric Imaging of Cardiac Metabolism**

Angus Z. Lau[1,2], Albert P. Chen[3], Nilesh Ghugre[2], Venkat Ramanan[2], Wilfred W. Lam[2], Kim A. Connelly[4], Graham A. Wright[1,2], Charles H. Cunningham[1,2]
[1]Dept. of Medical Biophysics, University of Toronto, Toronto, ON, Canada; [2]Imaging Research, Sunnybrook Health Sciences Centre, Toronto, ON, Canada; [3]GE Healthcare, Toronto, ON, Canada; [4]Keenan Research Centre, Li Ka Shing Knowledge Institute, St. Michael's Hospital and University of Toronto, Toronto, ON, Canada

A rapid multi-slice cardiac-gated spiral ^{13}C imaging pulse sequence consisting of a large flip-angle spectral-spatial excitation RF pulse with a single-shot spiral k-space trajectory was implemented and demonstrated *in vivo*. This sequence allows for whole heart coverage (6 slices, 8.8 mm in-plane resolution) in any plane, with imaging of the metabolites of interest, [1-^{13}C] pyruvate, [1-^{13}C] lactate, and ^{13}C bicarbonate, within a single 20 s breathhold. The sequence is anticipated to be useful in the non-invasive monitoring of changes in spatial distribution of metabolites in disease.

11:30 ***377***. **High Resolution ^{31}P Magnetic Resonance Spectroscopic Imaging of the Human Brain at 7T.**

Jannie Petra Wijnen[1], Arend Heerschap[1], Tom W.J. Scheenen[1,2]
[1]Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Gelderland, Netherlands; [2]Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, Germany

We demonstrated the use of a surface ^{31}P quadrature coil in combination with a ^{1}H CP head coil for ^{31}P MRSI of the brain at 7T with high sensitivity and spatial resolution. ^{31}P MRS was run with a pulse acquire MRSI sequence with adiabatic excitation. With this method we detected phosphorylated signals from the energy metabolism in the brain as well as resonances from phosphomono and diester compounds and inorganic phosphate in the human brain within relatively short acquisition times (16 or 25minutes).

11:42 ***378***. **Diffusion-Weighted Spectroscopy in the Healthy and U87 Glioblastoma-Induced Mouse Brain**

Julien Valette[1,2], Boucif Djemai[2], Françoise Geffroy[2], Mohamed Ahmed Ghaly[2], Fawzi Boumezbeur[2], Denis Le Bihan[2], Franck Lethimonnier[2]
[1]CEA-MIRCen, Fontenay-aux-Roses, France; [2]CEA-NeuroSpin, Gif-sur-Yvette, France

Diffusion-weighted (DW) spectroscopy is a unique tool for probing the intracellular compartment in vivo. As far as we know, the apparent diffusion coefficient (ADC) of metabolites has never been reported in the mouse brain. In this preliminary work, the ADC of six metabolites is measured in a mouse brain for the first time, using an original DW-LASER sequence. In addition, measurements are performed in a Human U87-MG glioblastoma induced in the same animal, showing a dramatic increase in the ADC of choline compounds, which might be ascribed to lactacidosis-induced cell swelling.

11:54 ***379***. **Real Time Measurement and Correction of Motion-Induced Changes in B0 Field for Neuro Spectroscopic Imaging**

Aaron Timothy Hess[1], Ovidiu C. Andronesi[2,3], Matthew Dylan Tisdall[2,3], Ernesta M. Meintjes[1,4], Andre J. van der Kouwe[2,3]
[1]University of Cape Town, Cape Town, South Africa; [2]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, MA; [3]Department of Radiology, Harvard Medical School, MA; [4]MRC/UCT Medical Imaging Research Unit

Real time measurement of the B0 field using an EPI navigator is presented, its use in real time first order shim correction for LASER spectroscopic imaging is demonstrated. Homogeneity of the B0 field is important in spectroscopy and spectroscopic imaging and thus, by measuring the B0 field in real time, changes to the linear shim gradients and frequency offset are corrected on the fly. This technique is shown to minimise line broadening due to motion induced B0 changes.

12:06 ***380***. **Accelerated ^{1}H Chemical Shift Imaging of the Brain Using Compressive Sensing**

Sairam Geethanath[1], Hyeonman Baek[2], Vikram D. Kodibagkar[1,2]
[1]Biomedical Engineering, UT Southwestern Medical Center at Dallas, Dallas, TX, United States; [2]Dept of Radiology, UT Southwestern Medical Center at Dallas, United States

Application of compressed sensing to 1H Chemical Shift Imaging (CSI) of in vivo human brain data has been performed for the first time. The CSI data is sparse in the wavelet domain along the spatial and temporal dimensions and hence can be reconstructed with high SNR from significantly undersampled k-

space. This provides a significant reduction in acquisition time which is highly desired for CSI. The metabolite maps generated for 3 major metabolites of N-acetylaspartate, Creatine and Choline from 20% of the original k-space data match closely with the corresponding metabolite maps generated for the original k-space.

12:18 ***381***. **In Vivo L-COSY MR Distinguishes Glutamate from Glutamine and Shows Neuropathic Pain to Cause a Buildup of Glutamine in the Brain**

Alexander Peter Lin[1], Saadallah Ramadan[1], Peter Stanwell[1], Tuan Luu[1], James Celestin[2], Zahid Bajwa[2], Carolyn Mountford[1]
[1]Center for Clinical Spectroscopy, Brigham and Women's Hospital, Boston, MA, United States; [2]Pain Management Center, Beth Israel Deaconess Medical Center, Boston, MA, United States

This study utilizes two-dimensional (2D) COrrelated SpectroscopY (COSY) to allow, in a clinically accepted time, detailed chemical information to be collected in situ from the brain. 2D COSY can in theory separate the glutamate and glutamine resonances by measuring distinct scalar coupling. These metabolites are neurotransmitters and affected by a number of diseases. For the first time we successfully distinguished between glutamine and glutamate using 2D COSY and show that glutamine is present in higher quantities in subjects with neuropathic pain.

Multiple Sclerosis

Room A6 10:30-12:30 *Moderators:* Frederick Barkhof and Massimo Filippi

10:30 ***382***. **mcDESPOT-Derived Demyelination Volume in Multiple Sclerosis Patients Correlates with Clinical Disability and Senses Early Myelin Loss**

Hagen H. Kitzler[1], Jason Su[2], Michael Zeineh[2], Sean C. Deoni[3], Cyndi Harper-Little[4], Andrew Leung[5], Marcelo Kremenchutzky[6], Brian K. Rutt[2]
[1]Dept. of Neuroradiology, Technische Universitaet Dresden, Dresden, SN, Germany; [2]Department of Radiology, Stanford University, Palo Alto, CA, United States; [3]Department of Engineering, Brown University, Providence, RI, United States; [4]Imaging Laboratories, Robarts Research Institute, London, ON, Canada; [5]Department of Diagnostic Radiology and Nuclear Medicine, University of Western Ontario, London, ON; [6]Department of Clinical Neurological Sciences, University of Western Ontario, London, ON

We applied the multi-component Driven Equilibrium Single Pulse Observation of T1 and T2 (mcDESPOT) method to a population of Multiple Sclerosis patients and normal controls, to assess its ability to characterize brain tissue demyelination across a spectrum of MS disease severity. We found strong correlations between Demyelinated Volume and EDSS (clinical disability score), as well as with Normalized Brain Volume (measure of total brain atrophy). We also found a significant difference between Demyelinated Volume in normal controls vs the subset of Clinical Isolated Syndrome patients, demonstrating the ability of mcDESPOT to sensitively detect early pre-MS changes.

10:42 ***383***. **Decrease of Brain Stiffness Compared to Loss of Brain Volume in Multiple Sclerosis Patients**

Kaspar Josche Streitberger[1], Friedemann Paul[2], Dagmar Krefting[3], Dieter Klatt[1], Sebastian Papazoglou[1], Sebastian Hirsch[1], Jürgen Braun[3], Ingolf Sack[1]
[1]Institute of Radiology, Charité - University Medicine Berlin, Berlin, Germany; [2]Neurocure, Charité - University Medicine Berlin, Berlin, Germany; [3]Institute of Medical Informatics, Charité - University Medicine Berlin, Berlin, Germany

Chronic inflammatory diseases of the CNS such as Multiple Sclerosis (MS) lead to demyelinization and to widespread degradation of neurons and axons – processes which alter the mechanical consistency of the brain. In this study MR elastography and MRI volumetry is used to investigate the alteration of brain mechanics and brain geometry due to MS. A decrease in brain stiffness of 17% accompanied by a loss of brain volume of 5% was measured in 17 MS patients and 42 healthy volunteers.

10:54 ***384***. **Surface-Based Techniques Reveal Regions of Reduced Cortical Magnetization Transfer Ratio in Patients with MS**

Mishkin Derakhshan[1], Zografos Caramanos[1], Sridar Narayanan[1], Douglas L. Arnold[1], D Louis Collins[1]
[1]Montreal Neurological Institute and Hospital, McGill University, Montreal, QC, Canada

Novel imaging methods are essential to accurately detect and quantify the GM pathology that is increasingly being recognized in multiple sclerosis (MS). In this study, we measured the extent of subpial decreases in magnetization transfer ratios using a novel surface-based method. When comparing individual MS patients to a group of normal controls, we detected regions of significant MTR differences, which may include regions of cortical demyelination. Group-wise analysis revealed significant differences between the group with secondary progressive MS and normal controls, but not between the relapsing-remitting patients and normal controls. We assessed the sensitivity of our method using simulations.

11:06 ***385***. **Altered Structural Architecture of the Striatum Is Associated with Impaired Motor Learning in Multiple Sclerosis**

Valentina Tomassini[1,2], Rose Gelineau-Kattner[1,3], Mark Jenkinson[1], Jacqueline Palace[1], Carlo Pozzilli[2], Heidi Johansen-Berg[1], Paul M. Matthews[1,4]
[1]FMRIB Centre, Dept of Clinical Neurology, The University of Oxford, Oxford, United Kingdom; [2]Dept of Neurological Sciences, "La Sapienza" University, Rome, Italy; [3]Baylor College of Medicine, Houston, TX, United States; [4]GSK Clinical Imaging Centre, GlaxoSmithKline, London, United Kingdom

The behavioural evidence for altered motor skill learning in Multiple Sclerosis (MS) suggests that MS pathology may impair mechanisms of adaptive plasticity required for learning. The striatum is functionally relevant for both higher motor control and learning. The evidence for localized MS-related pathology within the striatum and disease-related disruption of its neocortical connections suggests a role of the striatum in impairing motor learning in MS. Here we tested whether impaired learning performance in MS was associated with localized changes in the striatal structural architecture and assessed the functional consequences of these behaviourally relevant structural changes.

11:18 ***386***. **Contribution of Subpial Pathology to Cortical Thinning in Multiple Sclerosis: A Combined 7T - 3T MRI Study.**

Caterina Mainero[1], Thomas Benner[1], Amy Radding[1], Andre van der Kouwe[1], R Philip Kinkel[2], Bruce R. Rosen[1]
[1]A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States; [2]Neurology, Beth Israel Deaconess Medical Center, Boston, MA, United States

In multiple sclerosis (MS) it is unclear whether cortical atrophy is secondary to white matter (WM) damage, or underlies a primary neuronal process. Here, we investigate the contribution of different cortical lesions types at 7T and WM lesion load (WMLL) to cortical thinning in 14 MS patients. The higher the number of all cortical lesions, and of type III/IV lesions (subpial lesions extending partly or completely through the cortical width) the thinner the cortex was. There was only a trend to significance for WMLL. Thinning in frontal cortical areas showed the highest correlation with type III/IV lesions. Subpial pathology is a major determinant of cortical atrophy in MS.

11:30 ***387***. **Grey Matter Perfusion Is Inversely Correlated to T2 Lesion Load in MS Patients - A 3D GRASE Arterial Spin Labeling Study at 1.5T**

Michael Amann[1], Jochen Gunther Hirsch[1], Lutz Achtnichts[2], Yvonne Naegelin[2], Johannes Gregori[3], Martin Schaellebaum[2], Katrin Weier[2], Alain Thöni, Ernst Wilhelm Radue, Matthias Günther[3], Ludwig Kappos[2], Achim Gass[1]
[1]Neurology/Neuroradiology, University Hospital, Basel, BS, Switzerland; [2]Neurology, University Hospital, Basel, BS, Switzerland; [3]MR Research Neurology, University Hospital, Mannheim, BW, Germany

We investigated the influence of different clinical and MRI factors onto grey matter (GM) perfusion in MS patients (123 RRMS, 42 SPMS, 7 PPMS, and 5 CIS). To assess cerebral blood flow (CBF), we applied a pulsed arterial spin labeling technique combined with single-shot 3D-GRASE readout. The mean GM-CBF in each patient was calculated for 10 supratentorial slices. Multiple linear regression models were calculated to investigate the relationship between different factor sets and mean GM-CBF. Post-hoc Spearman rank correlation revealed significant correlation of GM-CBF with T2 lesion load ($p=2*10^{-6}$) and with age ($p=0.002$), but neither with GM-atrophy nor disease onset.

11:42 ***388***. **Early Adaptation in Resting State Networks in Multiple Sclerosis Is Found Using Independent Component Analysis and Dual Regression**

Stefan D. Roosendaal[1], Menno M. Schoonheim[1], Hanneke E. Hulst[1], Ernesto Sanz-Arigita[1], Stephen M. Smith[2], Jeroen J.G. Geurts[1], Frederik Barkhof[1]
[1]Radiology, VU University Medical Center, Amsterdam, Noord-Holland, Netherlands; [2]FMRIB, John Radcliffe Hospital, Oxford, United Kingdom

We questioned whether functional changes can be found in rest in the early phase of MS. Resting state fMRI networks were compared between 14 patients with symptoms suggestive of MS (clinically isolated syndrome; CIS), 31 relapsing remitting (RR) MS patients and 41 healthy controls using independent component analysis and dual regression. CIS patients showed increased co activation in six of the eight networks found. No significant resting state network differences were found between RR patients and controls. Network-specific resting state changes can be already found in CIS, and are lost in MS patients with increasing brain damage and advancing disability.

11:54 ***389***. **T_2^*-Weighted Images Discriminate Multiple Sclerosis from Ischaemic Lesions**

Jennifer Elizabeth Dixon[1], Emma C. Tallantyre[2], Ian Donaldson[2], Trudy Owens[3], Nikos Evangelou[2], Peter G. Morris[1]
[1]Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Department of Clinical Neurology, Nottingham University Hospital NHS Trust, Nottingham, Nottinghamshire, United Kingdom; [3]Department of Economics, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

The detection of demyelinating lesions using MRI plays an important role in the diagnosis of MS. However, demyelinating brain lesions can be difficult to distinguish from small foci of cerebral ischaemia on MR images. Here we show that using ultra-high-field MRI we can reliably demonstrate the perivenous orientation of MS lesions and in doing so distinguish them from ischaemic brain lesions. The observation that T2* image contrast can be employed to differentiate between ischaemic and demyelinating lesions at ultra-high field offers hope that similar techniques could be adapted for application on clinically available systems.

12:06 ***390***. **Impaired Motor Performance in MS Is Associated with Increased GABA Level in Sensorimotor Cortex**

Pallab Bhattacharyya[1], Micheal Phillips[1], Robert Bermel[1], Lael Stone[1], Mark Lowe[1]
[1]Cleveland Clinic, Cleveland, OH, United States

In vivo GABA level is measured at sensorimotor cortex in healthy controls and MS patients using ^{1}H spectroscopy. The measured GABA level was correlated with clinical measure of MS as determined by Multiple Sclerosis Functional Composite (MSFC) scores. A strong inverse correlation was observed between the GABA level and motor performance (as measured by the 9 hole peg component of MSFC) in patients, while no such correlation was observed in the controls. No other component of MSFC showed any correlation with the GABA level in either patients or controls. The findings indicate motor impairment with increased GABA level in MS.

12:18 ***391***. **Assessing Neuronal Metabolism in MS by Modelling Imaging Measures**

Olga Ciccarelli[1], Ahmed Toosy[1], Nicola De Stefano[2], Claudia Angela Michela Wheeler-Kingshott[3], David H. Miller[3], Alan J. Thompson[1]
[1]NMR Unit, Department of Brain Repair and Rehabilitation, UCL Institute of Neurology, London, United Kingdom; [2]Department of Neurological and Behavioural Sciences, University of Siena, Siena, Italy; [3]NMR Unit, Department of Neuroinflammation, UCL Institute of Neurology, London, United Kingdom

Mitochondrial dysfunction is central to the pathogenesis of many neurological diseases, including MS. We propose a methodology to estimate in-vivo neuronal mitochondrial metabolism and its relatice contribution to disability. We modelled N-acetyl-aspartate (NAA), measured by spinal cord 1H-MR spectroscopy, which reflects axonal integrity and mitochondrial metabolism, together with measures of axonal integrity, such as axial diffusivity and cord area, in patients with MS studied six months after a spinal cord relapse. The residual variance in NAA concentration after accounting for the structural

measures should reflect mitochondrial metabolism. A lower mitochondrial metabolism was associated with greater disability indipendent of structural damage.

Cancer Animal Models

Room A7 10:30-12:30 *Moderators:* Hagit Dafni and Simon P. Robinson

10:30 ***392***. **An MRI Investigation of the Effect of Active Site Mutant DDAH1 in C6 Glioma Xenografts in Vivo**

Jessica Katherine Rowena Boult[1], Simon Walker-Samuel[1], Yann Jamin[1], James M. Leiper[2], Guy St.John Whitley[3], Simon P. Robinson[1]
[1]CRUK and EPSRC Cancer Imaging Centre, The Institute of Cancer Research and Royal Marsden NHS Trust, Sutton, Surrey, United Kingdom; [2]MRC Clinical Sciences Centre, Faculty of Medicine, Imperial College London, London, United Kingdom; [3]Department of Basic Medical Sciences, St. Georges, University of London, London, United Kingdom

Dimethylarginine dimethylaminohydrolase (DDAH) metabolizes the endogenous inhibitor of nitric oxide synthesis, asymmetric dimethylarginine (ADMA), indirectly leading to an increase in nitric oxide. Diffusion-weighted and dynamic contract enhanced MRI were used to evaluate the vascular phenotypes of C6 glioma xenografts overexpressing either wildtype DDAH1 or an active site mutant DDAH1 incapable of metabolizing ADMA. Tumours expressing mDDAH1 demonstrated an intermediate phenotype between control and wtDDAH1 expressing tumours. Differences in ADC and native T1 and T2 times were consistent with higher cellularity/lower necrosis in the DDAH1 expressing tumours. Despite differences in VEGF expression and perfusion, no significant alterations in Ktrans or ve were observed between the 3 tumour groups.

10:42 ***393***. **Microscopic Morphology of Brain and Bone Metastases in a Rat Breast Cancer Model by Diffusion MRI**

Matthew D. Budde[1], Molly Resnick[1], Eric Gold[1], E Kay Jordan[1], Joseph A. Frank[1]
[1]Radiology and Imaging Sciences, National Institutes of Health, Bethesda, MD, United States

The apparent diffusion coefficient (ADC) measured with diffusion MRI has shown promise as an early marker of therapeutic response in malignant gliomas. However, metastatic tumors are the primary cause of intracranial tumors, and it is unknown whether brain metastases exhibit similar diffusion characteristics as the preclinical implanted brain tumor model. A rat model of metastatic breast cancer was used to examine the diffusion properties of brain and bone metastases. The results demonstrate that ADC is sensitive to the microscopic growth patterns of brain and bone metastases that result from their differing microenvironments.

10:54 ***394***. **Vessel Size Index (VSI) MRI in Solid Tumours - Validation with Microvascular Corrosion Casts**

Jake Samuel Burrell[1], Jane Halliday[2], Simon Walker-Samuel[3], John C. Waterton[2], Philip J. Withers[4], Robert S. Bradley[4], Jessica Boult[1], Yann Jamin[1], Lauren C. Baker[1], Simon P. Robinson[1]
[1]The Institute of Cancer Research, Sutton, Surrey, United Kingdom; [2]AstraZeneca, Manchester, United Kingdom; [3]UCL, London, United Kingdom; [4]School of Materials, University of Manchester, Manchester, United Kingdom

Susceptibility contrast MRI vessel size index (VSI) derived vessel diameters were compared with vessel diameters measured from vascular corrosion casts of the same SW1222 colorectal tumours. Good agreement was found between the MRI and vascular corrosion cast derived vessel sizes, reported as 38 ± 6μm and 39 ± 2μm respectively. This work helps to qualify non-invasive MRI vessel size measurements with appropriate histology.

11:06 ***395***. **Gas Challenge-Blood Oxygen Level Dependent (BOLD) MRI in Monitoring Tumor Angiogenesis of a Rodent Novikoff Hepatoma Model**

Yang Guo[1], Ning Jin[1,2], Rachel Klein[1], Guang-Yu Yang[3], Reed Omary[1,2], Andrew Larson[1,2]
[1]Department of Radiology, Northwestern University, Chicago, IL, United States; [2]Department of Biomedical Engineering , Northwestern University, Chicago, IL, United States; [3]Department of Pathology, Northwestern University, Chicago, IL, United States

Angiogenesis is fundamental for tumor growth, invasion and metastasis. Non-invasive methods to monitor tumor neo-vascular changes during tumor progression and/or in response to anti-angiogenic therapy may be critical. The purpose of our study was to investigate the relationship between gas-challenge (GC)-BOLD response and degree of tumor angiogenesis during tumor progression in rodent hepatoma model. A positive correlation was found between GC-BOLD response and tumor microvessel density and a negative correlation was between GC-BOLD response and tumor size. GC-BOLD MRI may offer the potential to serve as a non-invasive method for evaluating angiogenesis and monitoring anti-angiogenic therapy response in hepatic tumors.

11:18 ***396***. **Hypoxia Detected with Phase Contrast MRI Is an Early Event in Micrometastatic Breast Cancer Development in the Rat Brain**

Matthew D. Budde[1], Eric Gold[1], E Kay Jordan[1], Melissa Smith-Brown[1], Joseph A. Frank[1]
[1]Radiology and Imaging Sciences, National Institutes of Health, Bethesda, MD, United States

Hypoxia is an important prognostic factor in tumor growth and therapeutic response and is a driving force in the angiogenic cascade. Blood oxygen level dependent (BOLD) MRI contrast is related to the oxygenation status of tumors, but brain tumors can have significant edema that can complicate measurements of magnetic field inhomogeneities caused by deoxygenated hemoglobin. The purpose of this study was to determine if phase contrast MRI was more sensitive to vascular abnormalities than BOLD MRI in a rat model of breast cancer metastases to the brain and whether these changes were indicative of hypoxic changes that precede angiogenesis.

11:30 ***397***. **Hypoxic Environments Disrupt Collagen I Fibers and Macromolecular Transport**

Samata Kakkad[1], Marie-France Penet[1], Meiyappan Solaiyappan[1], Arvind Pathak[1], Venu Raman[1], Kristine Glunde[1], Zaver M. Bhujwalla[1]
[1]JHU ICMIC Program, The Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States

Solid tumors are characterized by hypoxic environments. Hypoxia stimulates the gene expression of a cluster of hydroxylases used for collagen fiber formation. Hypoxic environments in tumors may lead to abnormal collagen deposits either by cancer cells or by fibroblasts within the tumor stroma. In normal tissue collagen fibers direct interstitial fluid into lymphatic channels. In tumors these fibers may not be structured for efficient flow of fluid, especially in hypoxic areas. Our purpose was to understand the role of hypoxia in modifying macromolecular fluid transport using MRI, and collagen fiber distribution using second harmonic generation microscopy.

11:42 ***398***. **High-Resolution Imaging of Non-Small Cell Lung Cancer in a Mouse Model of Brain Metastasis**

Hye-Won Kang[1], Geun-Ho Im[2], Jung Hee Lee[2], Alexei A. Bogdanov[1]
[1]Radiology, University of Massachusetts Medical School, Worcester, MA, United States; [2]Radiology, Samsung Medical Center, Seoul, Korea, Republic of

A combination of anti-human EGFR antibody-enzyme conjugates and a paramagnetic substrate has been designed for EGFR MR imaging for detecting NSCLC in vivo. The specificity of conjugate to the tumors and the sensitivity to EGFR expression in vivo were examined. The experimental group of mice after the injection of pretargeting conjugates followed by the injection of the paramagnetic substrate showed a strong enhancement of the tumor. The increase of MR signal was higher and the peak of enhancement was reached earlier than in the control group. The higher signal around the tumor periphery was retained for up to 24 h.

11:54 ***399***. **Theranostic Imaging of Metastatic Disease**

Zhihang Chen[1], Marie-France Penet[1], Sridhar Nimmagadda[1], Cong Li[1], Sangeeta Ray[1], Paul Winnard[1], Dmitri Artemov[1], Kristine Glunde[1], Martin G. Pomper[1], Zaver M. Bhujwalla[1]
[1]JHU ICMIC Program, Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States

There is a compelling need to find effective treatments for metastatic disease, as it typically becomes refractory to treatment. We are developing targeted nanoplexes carrying multimodality imaging reporters together with small interfering RNA (siRNA) and a prodrug enzyme for theranostic imaging of metastatic prostate cancer. Down-regulation of specific pathways using siRNA provides unique opportunities to target cancer cells selectively while sparing normal tissue. The targeted nanoplexes we develop will allow us to deliver siRNA together with a prodrug enzyme, under image guidance for developing theranostic imaging of metastatic prostate cancer.

12:06 ***400***. ***In Vivo*** **Detection of PI3K Pathway Inhibition by Hyperpolarized ^{13}C MRSI at 14 Tesla**

Myriam Marianne Chaumeil[1], Subramanian Sukumar[1], Humsa Venkatesh[1], Christopher Ward[1], Kristen R. Scott[1], Tomoko Ozawa[2], C David James[2], John Kurhanewicz[1], Daniel B. Vigneron[1], Sarah J. Nelson[1], Sabrina M. Ronen[1]
[1]Radiology, UCSF, San Francisco, CA, United States; [2]Brain tumor Research Center, UCSF, San Francisco, CA, United States

In vivo inhibition of the PI3K pathway by Everolimus was evaluated using hyperpolarized (HP) ^{13}C MRSI in subcutaneous tumors in mice at 14 Tesla. Whereas lactate-to-pyruvate ratio was increased in control animals, this ratio was decreased by 78% and 35% in treated animals relative to controls after 2 and 7 days, respectively. The drop in lactate-to-pyruvate ratio following Everolimus treatment is in line with the findings in treated cells and likely indicates a decrease in LDH activity in treated tumors. This preliminary *in vivo* study demonstrates the likely value of HP ^{13}C studies of pyruvate for noninvasive monitoring PI3K inhibition.

12:18 ***401***. **In Vivo P31 NMR Demonstrates Reduced ATP Synthesis Rate in Skeletal Muscle in a Murine Cancer Cachexia Model**

Dionyssios Mintzopoulos[1,2], Cibely Cristine Fontes de Oliveira[3], Jianxin He[4], Caterina Constantinou[4], Michael N. Mindrinos[5], Laurence G. Rahme[4], Josep M. Argiles[3], A Aria Tzika[1,2]
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We employed in vivo P31 NMR on intact mice, in a mouse cancer (Lewis lung carcinoma) cachexia model. We examined ATP synthesis rate and the gene expression of key regulatory genes, involved in regulation of skeletal muscle metabolism. Our in vivo NMR results that showed significantly reduced rate of ATP synthesis rate were cross-validated with genomic analysis, showing aberrant expression levels in key regulatory genes. Our findings implicate that reduction in ATP synthesis rate is linked to mitochondrial dysfunction leading to wasting of skeletal muscle in cancer cachexia.

MRA: The Brighter the Better

Room A8 10:30-12:30 *Moderators:* Ruth P. Lim and Mitsue Miyazaki

10:30 ***402***. **Non-Contrast-Enhanced 4D Intracranial MR Angiography: Optimizations Using a Variable Flip Angle Approach**

Peter Schmitt[1], Peter Speier[1], Xiaoming Bi[2], Peter Weale[2], Edgar Mueller[1]
[1]MR Application & Workflow Development, Siemens AG, Healthcare Sector, Erlangen, Germany; [2]Cardiovascular MR R&D, Siemens Healthcare, Chicago, IL, United States

A novel concept is presented to optimize a FAIR-type spin-labeling technique for non-contrast-enhanced 4D intracranial MR angiography, which is based on an ECG-triggered CINE-like b-SSFP acquisition of multiple 3D phases after selective and non-selective inversion, respectively. Based on numerical Bloch simulations and a volunteer study, it is shown that a variable flip angle scheme, with the flip angle continuously increasing from lower to higher values, results in a significantly longer persistence of the spin labeling. This in turn leads to an improved visualization of late-filling vasculature if compared to the standard approach with constant flip angle.

10:42 ***403***. **Initial Experience with Non-Contrast Enhanced Renal Angiography at 7.0 Tesla**

Gregory John Metzger[1], Josh Simonson[2], Xiaoming Bi[3], Peter Weale[3], Sven Zuehlsdorff[3], Eddie J. Auerbach[1], Kamil Ugurbil[1], Pierre-Francois Van de Moortele[1]
[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States; [2]Radiology, University of Minnesota, Minneapolis, MN, United States; [3]Siemens Medical Solutions, Chicago, IL, United States

The potential of non-contrast enhanced renal angiography at 7T was explored. In order to obtain consistent bilateral visualization of the renal arteries transmit B1 homogeneity was optimized using a subject dependent, three slice, small flip angle calibration scan acquired in a single breathold. High quality visulizaiton of proximal and distal renal arteries was obtained despite system limits on achievable transmit B1.

10:54 ***404***. **Comparison of Different Techniques for Non-Contrast –enhanced and Contrast-Enhanced Magnetic Resonance Angiography of the Carotid Arteries**

Harald Kramer[1], Val M. Runge[2], Kenneth D. Williams[2], L Gill Naul[2], Konstantin Nikolaou[1], Maximilian F. Reiser[1], Bend J. Wintersperger[1]
[1]Department of Clinical Radiology, University Hospital Munich, Munich, Germany; [2]Scott and White Memorial Hospital, Temple, TX, United States

For imaging of the carotid arteries several non contrast enhanced (non CE) and contrast enhanced (CE) techniques for MRA exist. Since the discovery nephrogenic systemic fibrosis possibly caused by Gd-contrast agents non CE techniques for MRA experience a renaissance. This study compares established and newly developed non CE and CE techniques for imaging of the carotid arteries including TOF, T2w darkblood, TrueFISP, dynamic CE MRA and high resolution CE MRA in an intraindividual setting. Image quality (IQ) as well as accuracy is evaluated. Standard CE MRA exhibits best IQ and accuracy directly followed by ECG gated non CE TrueFISP MRA.

11:06 ***405***. **Non-Contrast-Enhanced Hand MRA Using Multi-Directional Flow-Sensitive Dephasing**

Zhaoyang Fan[1,2], Philip Hodnett[1], John Sheehan[1], Xiaoming Bi[3], Sven Zuehlsdorff[3], James Carr[1], Debiao Li[1,2]
[1]Radiology, Northwestern University, Chicago, IL, United States; [2]Biomedical Engineering, Northwestern University, Evanston, IL, United States; [3]Cardiac MR R&D, Siemens Healthcare, Chicago, IL, United States

Noncontrast hand MRA using ECG-triggered 3D bSSFP with flow-sensitive dephasing (FSD) preparation has recently been demonstrated in patients with Raynauds disease. However, a conventional FSD module with flow-sensitizing gradient pulses applied in both readout and phase-encoding direction simultaneously is only sensitive to one-direction flow. We proposed a new FSD preparative module with two FSD sub-modules combined in series. In each submodule, gradient pulses are applied in one direction only. Its effectiveness was verified on a flow phantom and healthy volunteer hands. Additionally, a volunteer study was performed to investigate the MRA quality with FSD bSSFP using contrast-enhance MRA as reference.

11:18 ***406***. **Initial Evaluation of a New NCE Angiography Method in Patients and Comparison with TRICKS**

Andrew Nicholas Priest[1], Ilse Joubert[1], Andrew P. Winterbottom[1], Teik Choon See[1], Martin John Graves[1], David John Lomas[1]
[1]Radiology, Addenbrookes Hospital and University of Cambridge, Cambridge, United Kingdom

A recently demonstrated non-contrast-enhanced MRA technique (VANESSA) uses a controllable, modified MSDE preparation module to obtain bright- and dark-blood images, which are subtracted to give an image showing only flowing blood. In this study, the method is evaluated for the first time in patients: the peripheral vasculature is assessed and compared to standard contrast-enhanced imaging using TRICKS. The new sequence has lower artefact levels, and most vessels are fully visualised. However the popliteal arteries are often poorly seen, possibly because the distorted flow profiles in patients were not adequately accounted for in the determination of the sequence timing.

11:30 ***407***. **Max CAPR: Preliminary Clinical Studies with 5 Sec Acquisition Times**

Clifton R. Haider[1], Eric A. Borisch[1], James F. Glockner[1], Petrice M. Mostardi[1], Stephen J. Riederer[1]
[1]Radiology, Mayo Clinic, Rochester, MN, United States

In this work a previously described Cartesian Acquisition with Projection Reconstruction-like sampling method (CAPR) is undersampled to provide a net acceleration approaching 40 by eliminating all view sharing, termed Max CAPR, to provide 5 sec acquisition times for bilateral 3D CE-MRA of the calves with 1 mm isotropic spatial resolution. Max CAPR is shown to have improved temporal fidelity as compared to the reference view-shared sequence. Results with the new method from nine volunteer studies and 17 patients with suspected peripheral vascular disease are shown to provide images of improved temporal fidelity and comparable diagnostic quality to the view-shared reference.

11:42 ***408***. **MR Angiography in Pre-Operative Evaluation for Fibula Free-Flap Transfer Operation: Application, Branching Pattern Analysis and Septocutaneous Perforator Identification**

Gurpreet Singh Sandhu[1,2], Rod P. Rezaee[3], Katherine Wright[4], John A. Jesberger[2], Mark A. Griswold[1,4], Vikas Gulani[1,2]
[1]Radiology, University Hospitals of Cleveland, Case Western Reserve University, Cleveland, OH, United States; [2]Case Center for Imaging Research, Case Western Reserve University, Cleveland, OH, United States; [3]Case Center for Imaging Research, University Hospitals of Cleveland, Case Western Reserve University, Cleveland, OH, United States; [4]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States

Lower leg magnetic resonance angiography (MRA) images of fibula free-flap transfer operation (FFFTO) candidates are commonly reported only in terms of branching patterns and pathological lesions in the lower leg arterial tree. Recent technical developments have enabled the acquisition of lower leg MRA images with a sub-millimeter spatial resolution that can also be employed to locate peroneal artery septocutaneous perforators (SCPs). Here, we describe an extension of application of MRA for visualization of the SCPs in these patients and compare bolus-chase and time-resolved MRA techniques for identification of the branching patterns and SCPs.

11:54 ***409***. **Arterial Flow Characteristics in the Presence of Vascular Disease, and Implications for Non-Contrast MRA**

Pippa Storey[1], Ruth P. Lim[1], Manjil Chatterji[1], Jian Xu[2], Hua Guo[1], David R. Stoffel[1], Vivian S. Lee[1]
[1]Radiology Department, NYU School of Medicine, New York, NY, United States; [2]Siemens Medical Solutions USA

Non-contrast techniques for peripheral MRA exploit differences in arterial flow velocity between diastole and systole, and produce exquisite bright-blood arterial images in healthy subjects. We studied the performance of ECG-gated 3D FSE-based MRA in 26 patients with vascular disease, and correlated the results with the patients' arterial flow characteristics. Notable findings included the observation in 2 patients of reduced pulsatility and increased diastolic flow distal to a stenosis or occlusion. The presence of this 'tardus parvus' waveform correlated with poor depiction of the distal segments. Techniques with reduced flow sensitivity in diastole may perform better in such conditions.

12:06 ***410***. **Visualization of Acute Atrial Injury by 3 Tesla MRI**

Eugene G. Kholmovski[1,2], Sathya Vijayakumar[1,2], Chris McGann, [2,3], Nassir F. Marrouche, [2,3]
[1]UCAIR, Department of Radiology, University of Utah, Salt Lake City, UT, United States; [2]CARMA Center, University of Utah, Salt Lake City, UT, United States; [3]Department of Cardiology, University of Utah, Salt Lake City, UT, United States

Imaging protocol has been developed for assessment of acute atrial injury caused by RF ablation by 3T MRI. The protocol has been optimized and applied to study 50 immediately post-ablation cases. The main observations are the following: 1. Significant edema was detected not only in the regions subjected to RF energy (pulmonary veins ostia, posterior wall, septum) but also in distant regions (anterior wall). 2. LGE images demonstrate heterogeneous appearance of LA wall in the regions subjected to RF energy. Significant areas of these regions has minimal enhancement.

12:18 ***411***. **Magnetic Resonance Imaging of Pulmonary Embolism: Diagnostic Accuracy of Contrast-Enhanced 3D MRA, Contrast-Enhanced Low Flip Angle 3D Gradient Echo and Noncontrast Steady-State Free Precession Sequences**

Bobby Kalb[1], Puneet Sharma[1], Gaye Ray[1], Daniel Karolyi[1], Hiroumi Kitajima[1], Khalil Salman[1], Diego R. Martin[1]
[1]Radiology, Emory University, Atlanta, GA, United States

Magnetic resonance angiography (MRA) has a potential role for PE diagnosis, shown in multiple studies. Alternative MRA-like methods that further improve diagnostic accuracy and simplify the acquisition techniques remain an area of clinically important development. MRA-like alternatives that produce enhancing signal from the vessel wall provide high contrast without need for bolus timing, and/or provide motion-insensitivity to respiration, with sequences including low flip angle (FA) 3D gradient echo (3D GRE), or steady state free precession (SSFP) sequences. Our study demonstrates the utility of low FA 3D GRE and SSFP sequences in conjunction with MRA for the diagnosis of PE.

GOLD CORPORATE MEMBER LUNCHTIME SYMPOSIUM
Siemens

Victoria Hall 12:30-13:30

CLINICAL INTENSIVE COURSE
Stroke Imaging: Case-Based Teaching

Room K1 13:30 – 15:30 *Organizer*s: Walter Kucharczyk and Pia C. Maly Sundgren

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the basic work-up for patients with suspected stroke;
- Compare the advantages and pitfalls of CT vs MRI perfusion;
- Explain relevance of small vessel disease to stroke;
- Describe common lesions that may masquerade stroke in imaging findings.

Moderators: R. Gilberto Gonzalez & Elna-Marie Larsson

13:30 **The MRI Work-Up In Acute Stroke (Arterial/Venous)**
Ramon Gilberto Gonzalez, M.D., Ph.D.

13:55 **Comparing CT to MRI in Acute Stroke: Large Vessels And Perfusion**
Roland Bruening, M.D.

14:20 **Small Vessel Disease**
Mark A. Van Buchem, M.D., Ph.D.

14:55 **Lesions Masquerading Acute Stroke**
Sven E. Ekholm, M.D., Ph.D.

CLINICAL INTENSIVE COURSE
Summits in Clinical Cardiovascular Applications: Non-Contrast MRA

Room K2 13:30 – 15:30 *Moderator*s: Georg M. Bongartz and Elizabeth M. Hecht

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Explain the basics of non-contrast MRA;
- Compare standard applications (time-of-flight / phase-contrast) and recent FSE/SSFP based non-contrast MRA techniques;
- Recognize the potential and the pitfalls in FSE/SSFP based non-contrast MRA methods; and
- Design appropriate scanning protocols for MRA.

Moderators: **Georg M. Bongartz and Elizabeth M. Hecht**

13:30 **Why Non-Contrast & NSF?**
Thomas M. Grist, M.D.

13:50 **Established Techniques**
Mitsue Miyazaki, Ph.D.

14:10 **True FISP**
Debiao Li, Ph.D.

14:30 **Ghost Imaging and Flow-Insensitive Unenhanced MRA**
Robert R. Edelman, M.D.

14:50 **Fast Spin Echo/SPACE-Based Techniques**
Ruth P. Lim, M.B.B.S.,M.Med.

15:10 Panel Discussion

Hot Topic Debate: Can 7T Go Clinical?

Room A4 13:30 – 15:30 *Moderator:* Mark E. Ladd

Proponent Mark A. van Buchem, M.D., Ph.D.

Opponent Peter A. Rinck, M.D., Ph.D.

Muscle Architecture & Metabolism

Room A5 13:30-15:30 *Moderators:* Bruce M. Damon and Xiaojuan Li

13:30 ***412***. **Ultra-High Field Measurements of Glycogen, IMCL and Perfusion in Skeletal Muscle in Post-Exercise Recovery: A ^{13}C and ^{1}H MRS Study**

Mary Charlotte Stephenson[1], Frances Gunner[2], Elizabeth J. Simpson[2], Paul Greenhaff[2], Susan T. Francis[1], Ian A. MacDonald[2], Peter G. Morris[1]
[1]SPMMRC, School of Physics and Astronomy, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]School of Biomedical Sciences, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

This study assesses the feasibility of sequentially monitoring muscle glycogen and IMCL levels, and perfusion, in exercising and non-exercising thigh muscles, prior to and following exercise at 7T. Levels of glycogen in exercising muscles decreased significantly during exercise, with larger decreases following higher intensity exercise. Carbohydrate re-feeding increased glycogen levels with levels returning towards baseline. Levels of glycogen in the non-exercising muscles showed no change following exercise and re-feeding. No significant changes in IMCL were measured. Perfusion data indicates an increase in muscle perfusion during exercise, however further analysis will be carried out to further improve results.

13:42 ***413***. **Longitudinal Evaluation of Intramyocellular Lipid (IMCL) in Tibialis Anterior (TA) Muscle of Ob/ob and Ob/- Control Mice Using a Cryogenic Surface Coil at 9.4 T and Correlation with Insulin Levels**

Qiong Ye[1,2], Carsten Friedrich Danzer[3], Alexander Fuchs[1], Wilhelm Krek[3], Markus Rudin[1,2]
[1]Institute for Biomedical Engineering, Zürich, Switzerland; [2]Institute for Pharmacology and Toxicology, Zürich, Switzerland; [3]Institute of Cell Biology, Zürich, Switzerland

Progress of intramyocellular lipid (IMCL) levels in tibialis anterior (TA) was investigated with 1H MRS on mouse of obesity model and correlated with insulin levels. In this work, reproducibility of single voxel 1H MRS, spatial heterogeneity of IMCL and influence of T2 relaxation were evaluated using a cryogenic transceiver RF coil. From the results, the ratios of IMCL/tCr in TA were significantly higher in ob/ob mice than in their age-matched ob/-lean controls at all ages studied while in ob/ob mice IMCL levels increased from weeks 11 to 16, and then decreased from weeks 17 to 25, while their age-matched lean controls show stable IMCL. A close correlation between IMCL/tCr and plasma insulin levels has been observed in ob/ob mice at the ages studied.

13:54 ***414***. **Diffusion Tensor Imaging to Track Changes in Skeletal Muscle Architecture of Sarcopenic Rats**

Ihssan S. Masad[1,2], Jacob M. Wilson[3], S-R Lee[3], Y-M Park[3], Paul C. Henning[3], Bahram H. Arjmandi[3], J-S Kim[3], Samuel Colles Grant[1,2]
[1]Department of Chemical & Biomedical Engineering, The Florida State University, Tallahassee, FL, United States; [2]National High Magnetic field Laboratory, Tallahassee, FL, United States; [3]Department of Nutrition, Food & Exercise Sciences, The Florida State University, Tallahassee, FL, United States

Diffusion tensor imaging (DTI) has demonstrated remarkable capability to assess cross-sectional areas (CSA) and myofiber architecture in muscle. However, DTI has not been applied to the study of age-related muscle wasting, known as sacropenia, in rodents. In this work, the effects of age on CSA and anisotropy of water diffusion in muscle are studied under the influence of advanced aging in rats. Results demonstrate that the soleus CSA and ADC decrease with age

until reaching a plateau at advanced time points. FA increases with age until it also plateaus. These findings indicate that DTI is sensitive to sacropenic alterations.

14:06 ***415***. ***In Vivo* Human Skeletal Muscle Glycogen Measured by Chemical Exchange Saturation Transfer (GlycoCEST) and ^{13}C MRS at 7T**

Theodore Towse[1,2], Adienne Dula[1,2], Samuel Bearden[3], Edward Welch[1], James Joers[1,2], Seth Smith[1,2], Bruce Damon[1,2]
[1]Vanderbilt University Institute of Imaging Science, Nashville, TN, United States; [2]Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States; [3]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States

CEST is a molecular imaging technique that allows indirect detection of protons associated with mobile proteins. GlycoCEST is a variant of CEST for imaging tissue glycogen, the storage form of glucose. With glycoCEST, the ¬-OH protons of glycogen are saturated, transfer the saturation to bulk water by way of chemical exchange which reduces the bulk water signal in proportion to the glycogen content. the purpose of this study was to determine the feasibility of glycoCEST imaging in human skeletal muscle at 7T. Our findings, although preliminary, suggest that glycoCEST imaging at 7T can be used to image muscle glycogen.

14:18 ***416***. **Comparison of *in Vivo* Post-Exercise PCr Recovery and Basal ATP Synthesis Flux for the Assessment of Skeletal Muscle Mitochondrial Function**

Nicole Martina Adriana van den Broek[1], Jolita Ciapaite[1], Klaas Nicolay[1], Jeanine J. Prompers[1]
[1]Biomedical NMR, Department of Biomedical Engineering , Eindhoven University of Technology, Eindhoven, Netherlands

The interpretation of basal ATP synthesis flux (V_{ATP}) measured by ^{31}P saturation transfer (ST) is not straightforward. In this study, post-exercise PCr recovery and ST-based V_{ATP} were compared in a rat model of mitochondrial dysfunction. Treatment with complex 1 inhibitor DPI induced mitochondrial dysfunction, as evidenced by a decreased oxygen consumption rate in isolated mitochondria and a decreased in vivo post-exercise PCr recovery. Interestingly, no significant difference in V_{ATP} was observed between DPI-treated rats and controls. This shows that ST measurements in rest do not necessarily reflect intrinsic mitochondrial function, but more likely the ATP demand of the cell.

14:30 ***417***. **The Effect of Two β-Alanine Dosing Protocols on Muscle Carnosine Synthesis and Washout Measured by ^{1}H-MR Spectroscopy**

Tania Buehler[1], Trent Stellingwerff[2], Helen Anwander[1], Andrea Egger[3], Roland Kreis[1], Chris Boesch[1]
[1]Dept. of Clinical Research, University of Bern, Bern, Switzerland; [2]Nestlé Research Center, Lausanne, Switzerland; [3]Division of Endocrinology, Diabetes & Clinical Nutrition, University of Bern, Bern, Switzerland

Carnosine (ß-alanyl-L-histidine) occurs in high concentrations in skeletal muscle and contributes to the intracellular muscle buffering capacity. Chronic (~4 weeks) ß-alanine supplementation has been shown to increase muscle carnosine contents; however, the optimal ß-alanine dosing regime remains to be clarified. The time-course of muscle carnosine changes in both tibialis anterior (TA) and gastrocnemius (GA) muscles was evaluated in 31 healthy subjects by means of non-invasive ^{1}H-MRS over 16 weeks (8 weeks ß-alanine supplementation with two different, placebo-controlled dosage schemes, followed by 8 weeks wash-out). A clear dose-response was found, with type I fibers (TA) being more responsive [%] to loading.

14:42 ***418***. **T_1 Corrected Multipeak T_2*-IDEAL Gradient-Echo Imaging for the Quantification of Intermuscular Adipose Tissue**

Dimitrios C. Karampinos[1], Huanzhou Yu[2], Ann Shimakawa[2], Richard B. Souza[1], Thomas M. Link[1], Xiaojuan Li[1], Sharmila Majumdar[1]
[1]Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States; [2]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States

IDEAL gradient-echo imaging has been proposed for mapping the spatial distribution and quantifying the amount of intermuscular adipose tissue (IMAT). However, the large difference in T_1 of muscle and fat can cause significant overestimation in IDEAL fat fraction. In the present work, the use of a precalibrated T_1-corrected fat spectrum is proposed in order to remove T_1 bias in dual flip angle multi-peak T_2* muscle IDEAL. The noise performance of the technique is compared to the single small flip angle approach. The technique is validated in a phantom and preliminary *in vivo* results are shown in the calf muscle.

14:54 ***419***. **Perfusion, BOLD and Bioenergetics Changes After Plasmid Electrotransfer in Mouse Leg Skeletal Muscle Assessed by Multiparametric Functional (Mpf-) NMR in Vivo**

Celine Baligand[1,2], Claire Wary[1,2], Olivier Schakman[3], Helene Gilson[3], Jacques C. Menard[1,2], Jean-Paul Thissen[3], Pierre Georges Carlier[1,2]
[1]NMR Laboratory, Institute of Myology, F-75651 Paris, France; [2]CEA, I²BM, MIRCen, IdM NMR Laboratory, F-75651 Paris, France; [3]Unite de Diabetologie et Nutrition, Universite Catholique de louvain, B-1200 Brussels, Belgium

In vivo gene eletcrotransfer is frequently used in muscle preclinical research. Procedures have been optimized to achieve high transgene expression level and minimize damage. However, consequences on muscle function have rarely been explored. We used multiparametric functional (mpf-)NMR imaging and spectroscopy to investigate perfusion, BOLD, and bioenergetics simultaneously in response to exercise after electroporation of an empty plasmid in mouse leg muscle. Important changes were found in all parameters and potential interference with therapy might have to be considered. Mpf-NMR constitutes a powerful tool for the optimization of electrotransfer protocols and the longitudinal assessment of preclinical gene therapy.

15:06 ***420***. **Mechanical Properties of Thigh Muscle from Childhood to Adulthood with Magnetic Resonance Elastography (MRE) Technique**

Laëtitia Debernard[1], Ludovic Robert[2], Fabrice Charleux[2], Sabine Fanny Bensamoun[1]
[1]Biomécanique et Bioingénierie, UMR CNRS 6600, Université de Technologie de Compiègne, Centre de Recherches de Royallieu, Compiègne, France; [2]ACRIM-Polyclinique Saint Côme, Compiègne, France

Muscle tissue is strongly solicited during all the life. The structural and functional properties of the muscle can be affected by its perpetual stretches and contractile activities but also by specific muscle pathologies. Imaging techniques can determine the muscle composition and morphological properties but no quantification of the mechanical properties is recorded with such imaging techniques. Magnetic Resonance Elastography technique is capable of giving the

morphological and the mechanical parameters for the same exam, allowing a complete characterization of the muscle tissue. The purpose of this study is to characterize the Vastus Medialis muscle stiffness from childhood to adulthood

15:18 ***421*. Quantification of Fat Infiltration in Thigh and Calf Muscles in Oculopharyngeal Muscular Dystrophy: Comparison of Three MRI Methods**

Monika Gloor[1], Arne Fischmann[2], Susanne Fasler[2], Tanja Haas[2], Oliver Bieri[1], Klaus Scheffler[1], Dirk Fischer[3]
[1]Radiological Physics, University of Basel Hospital, Basel, Switzerland; [2]Neuroradiology, University of Basel Hospital, Basel, Switzerland; [3]Neurology, University of Basel Hospital, Basel, Switzerland

The development of non-invasive measures of the degree and progression of muscle involvement is essential for clinical trials in oculopharyngeal muscular dystrophy (OPMD) patients. In this study, three quantitative MRI measures of muscular fat infiltration are compared with regard to applicability for longitudinal studies. A very high linear correlation is observed between fat infiltration according to the 2-point Dixon method and quantitative T_2 values (R^2 = 0.95). Fat infiltration according to SSFP histogram analysis exhibit a lower linear correlation with T_2 values (R^2 = 0.88). Dixon or T_2 mapping techniques may be promising quantitative tools to study the pattern and involvement of fat infiltration longitudinally.

SPECIAL SYMPOSIUM
Ethics & Economics

Room A9 13:30 – 15:30 *Organizers & Moderators*: Georg M. Bongartz, Claudia M. Hillenbrand and Pia C. Maly Sundgren

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the main issues and recognize the main costs related to the increasing number of incidental findings seen in clinical MRI practice;
- Determine which incidental findings discovered during research scans need to be reported and which can be ignored;
- Describe strategies for implementation of evidence–based medicine in radiology; and
- Maintain integrity when participating in clinical, drug or other trials sponsored by companies.

13:30 **How Much Ethics Can We Afford?**
Peter Aspelin, M.D., Ph.D.

14:00 **What To Do with Incidental Findings in Research**
A. Gregory Sorensen, M.D.

14:30 **Challenges to the implementation of evidence-based practice in radiology**
Aine Marie Kelly, M.D., F.R.C.R.

15:00 **How to Keep Your Integrity When Performing Sponsored Trials.**
Paul M. Parizel, M.D., Ph.D.

CLINICAL INTENSIVE COURSE
MR Physics & Techniques for Clinicians

Room K1 16:00-18:00 *Organizers & Moderators*: Marcus T. Alley and Michael Markl

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Define and describe the fundamental principles of MR imaging, including the definition of spin magnetization, the Larmor relationship, relaxation phenomena, and the process of using the spin magnetization to produce an image;
- Explain imaging pulse sequences based upon spin and gradient echoes, including fast spin-echo and echo planar techniques;
- Design MR imaging protocols for diagnostic applications considering image contrast, spatial resolution, acquisition time, signal-to-noise ratio, and artifacts; and

- Describe the principles of parallel imaging, high-field imaging, perfusion imaging, diffusion imaging, and functional MR imaging.

16:00 **Ultrafast Imaging**
Jeffrey Tsao, Ph.D.

16:40 **Parallel Imaging**
Stefan O. Schoenberg, M.D.

17:20 **High Field Imaging**
Gunnar Krueger, Ph.D.

CLINICAL INTENSIVE COURSE
Pitfalls in Diffusion-Perfusion-fMRI Quantification Processing: What Artifacts Should I Worry About in Practice? Case-Based Teaching

Room K2 16:00-18:00 *Moderators*: Fernando Calamante and Laura M. Parkes

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Recognize the most common artifacts in quantitative diffusion MR;
- Identify the major sources of errors in cerebral perfusion imaging;
- Evaluate the presence of common artifacts in studies using fMRI; and
- List the sources of artifacts more commonly encountered in diffusion, perfusion and fMRI studies.

16:00 **Diffusion MRI**
Pratik Mukherjee, M.D., Ph.D.

16:30 **Perfusion MRI: Dynamic-susceptibility Contrast MRI**
Timothy John Carroll, Ph.D.

17:00 **Perfusion MRI: Arterial Spinal Labeling**
Jeroen Hendrikse, Ph.D.

17:30 **Functional MRI**
Peter Jezzard, Ph.D.

Emerging RF: From Micro to Waves

Room A1 16:00-18:00 *Moderators:* Nicola F. De Zanche and Lawrence L. Wald

16:00 ***422***. **Micro-Electromechanical Systems (MEMS) Based RF-Switches in MRI – a Performance Study**
Miguel Fuentes[1], *Ewald Weber*[1], *Stephen Wilson*[1], *Bing Keong Li*[1], *Stuart Crozier*[1]
[1]The School of Information Technology and Electrical Engineering, The University of Queensland, Brisbane, Queensland, Australia

This work presents a method of controlling and switching multiple receiver coil-arrays in a manner that will reduce power consumption, relax cabling requirements and increase overall SNR through the use of micro-electromechanical systems (MEMS) RF switches. We have focused on parameters relevant to T/R switching applications in MR coil arrays. The MEMS devices evaluated here show favourable, quantifiable performance on the bench and in MR environment testing, and are found to be acceptable for use in multi-element coil switching roles.

16:12 ***423***. **Micro-Scale Inductively Coupled Radiofrequency Resonators on Fluidic Platforms for Wireless Nuclear Magnetic Resonance Spectroscopy**

Anja Zass[1], Kailiang Wang[1], Marcel Utz[1]
[1]Mechanical and Aerospace Engineering, University of Virginia, Charlottesville, VA, United States

Nuclear magnetic resonance (NMR) spectroscopy is an ideal tool for metabolomics. On microfluidic platforms, small pickup coils are needed for good sensitivity. Usually, this requires electrical connections between chip and spectrometer. Micro-scale inductively coupled rf resonators enable the wireless investigation of small volumes in the NMR. The approach has the advantage of focussing the sensitivity and rf power on the sample, without the need for connections to the spectrometer. Preceding research demonstrated that inductively coupled coils can rival the performance of directly connected ones. We present planar inductively coupled, self-resonant microcoils that showed promising resolution and sensitivity on first tests.

16:24 ***424***. **Digitally Controlled µ-Chip Capacitor Array for an Implantable Multiple Frequency Coil**

Walker J. Turner[1], Zhiming Xiao[1], Sien Wu[1], Barbara L. Beck[2], Rizwan Bashirullah[1], Thomas H. Mareci[3]
[1]Electrical and Computer Engineering, University of Florida, Gainesville, FL, United States; [2]McKnight Brain Institute, University of Florida, Gainesville, FL, United States; [3]Biochemistry and Molecular Biology, University of Florida, Gainesville, FL, United States

This digitally controlled capacitor array is designed to have a variable capacitance, set through a digital input, to be implemented as a multiple frequency coil for the NMR measurements of multiple nuclei in an implantable artificial pancreas for Type I diabetes. The test chip of the capacitor array successfully demonstrates the effectiveness of digitally setting the capacitance for resonance while producing reasonable signal sensitivity. This design can be implemented further for the resonance at additional frequencies.

16:36 ***425***. **Thin-Film Catheter-Based RF Detector System**

Richard R. Syms[1], Ian R. Young[2], Munir M. Ahmad[3], Marc Rea[4]
[1]EEE Dept., Imperial College London, London, Middlesex, United Kingdom; [2]EEE Dept., Imperial College London, London, United Kingdom; [3]EEE Dept., Imperial College London, United Kingdom; [4]Radiology Dept., Imperial College NHS Trust

Procedures such as biliary endoscopy require imaging modalities such as MRI if soft tissue contrast is to be improved. Local signal detection is then required to achieve adequate signal-to-noise ratio at high resolution. Small RF detector coils have been integrated with catheter probes, but the reliable combination of a coil, tuning and matching capacitors and an output cable is difficult in the limited available space. Here we demonstrate a catheter-based detector entirely formed from thin-film components, fabricated by double-sided patterning of copper-clad polyimide to form a resonant detector with integrated tuning and matching capacitors and a thin-film interconnect.

16:48 ***426***. **Time-Interleaved Radiation Damping Feedback for Increased Steady-State Signal Response**

Florian Wiesinger[1], Eric W. Fiveland[2], Albert J. Byun[2], Pekka Sipilae[1], Christopher J. Hardy[2]
[1]Imaging Technologies, GE Global Research, Munich, Germany; [2]MRI Laboratory, GE Global Research, Niskayuna, NY, United States

Radiation damping (RD) describes a second-order effect where the signal-induced current in the receiver coils acts back onto the primary spin system. According to Lenz's law, the RD acts in a way to oppose its original cause. In that sense RD can be understood as a self-regulating flip-back pulse. Recently, RD feedback loops have been introduced into the RF signal path to boost the natural RD effect. While previous RD circuits were limited in terms of feedback gain, here we present a new feedback circuit, which principally circumvents this problem via time separation of RD receive and transmit.

17:00 ***427***. **A Double Maxwell Sine Field RF Coil for a TRASE RF Phase Gradient Coil Set**

Qunli Deng[1], Scott B. King[2], Vyacheslav Volotovskyy[2], Boguslaw Tomanek[1], Jonathan C. Sharp[1]
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TRASE is a new k-space imaging method which uses transmit RF phase gradients for spatial encoding instead of B0-gradients. RF coil design is particularly important for TRASE as the image quality largely depends upon the RF phase gradient fields. Here we report an improved design for a sine profile field, which is a necessary component of an RF phase gradient set. By considering the concomitant z-directed RF field, and by 2D and 3D simulations, a double Maxwell design was arrived at and constructed. The double Maxwell coil shows a 91% larger imaging volume than the previous single Maxwell design.

17:12 ***428***. **Targeted Traveling Wave MRI**

Marco Mueller[1], Stefan Alt, Reiner Umathum, Wolfhard Semmler, Michael Bock
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The travelling wave concepts can be used for whole body MRI at high fields but suffers from high energy deposition (SAR). We introduce a coaxial targeted travelling wave RF coil, which guides the wave to any desired region in the body. To limit whole body SAR, the wave-propagation range is confined to the imaging region. Imaging results with a coil prototype show that the B1 field is focused to the targeted imaging region, and a homogeneous B1 field distribution is achieved outside the magnet's symmetry axis.

17:24 ***429***. **Mid-Bore Excitation of Traveling Waves with an Annular Ladder Resonator for 7T Body Imaging with Reduced SAR**

Graham Charles Wiggins[1], Bei Zhang[1], Riccardo Lattanzi[1], Daniel Sodickson[1]
[1]Radiology, NYU Medical Center, New York, NY, United States

Traveling wave imaging has previously been demonstrated using a patch antenna placed at one end of the scanner bore. For body imaging, reflections and attenuation result in very low B1+ in the torso. Attempting torso imaging by boosting the transmit power can create too much heating of tissue between the antenna and the region of interest, particularly in the head. We propose a novel coil design which can be placed at or near isocenter to create a traveling wave excitation which is strongest in the torso, with significantly reduced SAR in distant tissues.

17:36 ***430***. **An Advantageous Combination of Travelling Wave and Local Receive for Spine MR Imaging at 7T: Local SAR Reduction and SENSE Reconstruction**

Anna Andreychenko[1], Ingmar Voogt[2], Hugo Kroeze[2], Dennis W. Klomp[2], Jan J. Lagendijk[1], Peter Luijten[2], Cornelis A.T. van den Berg[1]

[1]Radiotherapy, University Medical Center Utrecht, Utrecht, Netherlands; [2]Radiology, University Medical Center Utrecht, Utrecht, Netherlands

Spine structure contains a lot of fine details and, thus, high field spine MR imaging would benefit from the increased image resolution due to SNR gain. In case of a local transmit coil its performance is limited by SAR restrictions. In this work we explore a possible combination of the novel travelling wave RF excitation combined with local receive array to image the lumbar spine at 7T. We have demonstrated that transmitting with the travelling wave significantly reduces local SAR values, using local receive coils improves B1- sensitivity and available reference scan allows optimal SENSE image reconstruction.

17:48 ***431***. **A Comparison of a Patch Antenna to an End-Fire Helix Antenna for Use in Travelling Wave MRI**

Daniel James Lee[1], Paul M. Glover[1]

[1]Physics and Astronomy, SPMMRC, University of Nottingham, Nottingham, Notitnghamshire, United Kingdom

So far, most travelling wave studies have used a patch antenna to create the travelling wave, as they are simple in design and can be constructed rapidly at little cost. In this study, both a patch antenna and an end-fire helix antenna are simulated and constructed to allow their relative merits to be assessed. Simulations are used to asses specific absorption rates (SAR) and experimental data are used to assess the signal to noise ratio (SNR) and B1 homogeneity of both antennas.

Functional Connectivity Analysis Applied to Brain Disorders

Victoria Hall 16:00-18:00 *Moderators:* Nick F. Ramsey and Timothy L. Roberts

16:00 ***432***. **Mapping Threshold-Independent Drug Effects in Graph Theoretic Analyses of Functional Connectivity Networks: the Opioid Analgesic Buprenorphine Preferentially Modulates Network Topology in Pain-Processing Regions**

Adam J. Schwarz[1,2], Jaymin Upadhyay,[2,3], Alexandre Coimbra,[2,4], Richard Baumgartner,[2,5], Julie Anderson,[2,3], James Bishop,[2,3], Ed George,[2,6], Lino Becerra,[2,3], David Borsook,[2,3]

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Graph theoretic analyses of functional connectivity networks report on topological properties of the brain and may provide a useful probe of disease or drug effects. However, verifying node-wise effects over a range of binarization thresholds is inconvenient and often subjective for large, voxel-scale networks. We present a straightforward method for calculating graph theoretic node parameters that are robust to binarization threshold and suitable for image analysis in the study of functional connectivity. The method is applied to mapping drug modulation of localized functional network topology by the opioid analgesic buprenorphine in healthy human subjects.

16:12 ***433***. **High-Fat Diet Modulates Dopaminergic Network Activity: An Analysis of Functional Connectivity**

Robert L. Barry[1,2], Nellie E. Byun,[2,3], Jason M. Williams[1,2], Michael A. Siuta[4], Nicole K. Speed[5,6], Christine Saunders[5,6], Aurelio A. Galli,[4,5], Kevin D. Niswender,[4,7], Malcolm J. Avison[1,2]

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Functional MRI was used to determine the effect of a 14-day high-fat diet on amphetamine-evoked dopaminergic neurotransmission and functional connectivity in rats in vivo. High-fat diet blunted amphetamine-evoked activation in striatal and extrastriatal regions consistent with reduced dopamine transporter activity due to biochemically confirmed impaired insulin signaling. Functional connectivity analysis revealed weakened inter-regional correlations with a high-fat diet, notably between accumbal-cingulate and striatal-thalamic regions. These findings link high-fat diet with impaired dopamine transmission through central insulin resistance in areas subserving reward, motivation, and habit formation.

16:24 ***434***. **fMRI and Dynamic Causal Modeling Reveal Inefficient and Imbalanced Network Interactions in Developmentally Vulnerable Adolescents**

Vaibhav A. Diwadkar[1,2], Neil Bakshi[1], Patrick Pruitt[1], Ashu Kaushal[3], Eric R. Murphy[4], Matcheri S. Keshavan[5], Usha Rajan[3], Caroline Zajac-Benitez[3]

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We used fMRI and dynamic causal modeling to study altered functional organization of sustained attention networks in adolescent offspring of schizophrenia patients. This group is at increased risk for psychiatric disorders, demonstrating impairments in cognitive function, making it an important one in whom to study developmental vulnerabilities. Modeling focused on interactions between control systems such as the anterior cingulate cortex, and frontal, parietal and striatal regions. Offspring evinced reduced cingulate-striatal coupling, but increased cingulate-prefrontal coupling. Reduced cortico-

striatal coupling, along with increased cortico-cortical coupling may reflect the impact of abnormal development on the role of control processes in the adolescent brain.

16:36 ***435***. **Short-Term Effects of Antipsychotic Treatment on Cerebral Function in Drug-Naive First-Episode Schizophrenia Revealed by RfMRI**

Su Lui[1], Tao Li, Wei Deng, Lijun Jiang, Qizhu Wu[1], Hehan Tang[1], Qiang Yue[1], Xiaoqi Huang[1], Raymond C. Chan[2], David A Collier[3], Shashwath A. Meda[4], Godfrey Pearlson[4], Andrea Mechelli[3], John A. Sweeney[5], Qiyong Gong[1]
[1]Huaxi MR Research Center, West China Hospital, Chengdu, Sichuan, China; [2]Neuropsychology and Applied Cognitive Neuroscience Laboratory, Institute of Psychology, Bei Jin, China; [3]Institute of Psychiatry King's College London, London, United Kingdom; [4]Neuropsychiatry Research Center, Institute of Living, Hartford, United States; [5]Center for Cognitive Medicine, University of Illinois at Chicago, Chicago, United States

Amplitude of low-frequency fluctuations in conjunction with the analysis of the resting state functional connectivity was applied to both regional cerebral function and functional integration in drug-naive schizophrenia patients before and after pharmacotherapy. Thirty-four antipsychotic-naive first-episode schizophrenia patients and 34 age, sex, height, weight, handedness and years of education matched controls were scanned using an EPI sequence on a 3T MR imaging system. Patients were rescanned after six week¡¯s treatment. For first time, we characterized that widespread increased regional synchronous neural activity occurs after antipsychotic therapy, accompanied with decreased integration of function across widely distributed neural networks.

16:48 ***436***. **Increased Local Connectivity in Children with ADHD**

Suresh Emmanuel Joel[1,2], Priti Srinivasan[3], Simona Spinelli, [3,4], Stewart H. Mostofsky, [3,4], James J. Pekar[1,2]
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Resting state functional connectivity MRI performed on neurotypical children and children with attention deficit hyperactivity disorder (ADHD), revealed increased local connectivity of pre-supplementary motor area (an important atypically behaving neural substrate in rapid motor response inhibition tasks in ADHD) and increased local connectivity of the precunues (a locus of the default mode network) in children with ADHD. Local connectivity has been previously shown to decrease with age in TD children. Our results suggest a delay in this typical maturation process in children with ADHD.

17:00 ***437***. **Converging Results from Resting State and Task Response FMRI-Studies in ASD**

Vesa Kiviniemi[1], Jukka Rahko[2], Xiangyu Long[3], Jyri-Johan Paakki[1], Jukka Remes[1], Juha Nikkinen[1], Tuomo Starck[1], Irma Moilanen[2], Mikko Sams[4], Synnove Carlson[5], Osmo Tervonen[1], Christian Beckmann[6], Yu-Feng Zang[7]
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Resting state signal and GLM task activations were able to detect converging differences right anterior insula, visual cortex, S1 and IFG dominantly in right hemisphere. Background brain activity abnormality may intefere with task responses in these key regions of ASD.

17:12 ***438***. **Alterations of Brain Structure and Functional Connectivity in Chronic Cocaine Users**

Hong Gu[1], Xiujuan Geng[1], Betty Jo Salmeron[1], Thomas J. Ross[1], Elliot A. Stein[1], Yihong Yang[1]
[1]Neuroimaging Research Branch, National Institute on Drug Abuse, NIH, Baltimore, MD, United States

Cocaine dependence is associated with various deficits in brain function, structure and metabolism. In this study, anatomic abnormalities and their relationship to functional network integrity in cocaine users were examined using voxel-based morphometry and resting-state functional connectivity analyses. Our data show that regions with reduced gray matter volume are closely associated with altered functional connectivity strength in corresponding brain networks.

17:24 ***439***. **Resting State Functional Connectivity in Patients with Periodic Hypersomnia**

Maria Engström[1], Thomas Karlsson[2], Anne-Marie Landtblom[3]
[1]IMH/Radiological Sciences/CMIV, Linköping University, Linköping, Sweden; [2]Behavioural Sciences and Learning/CMIV, Linköping University, Linköping, Sweden; [3]IKE/Neurology/CMIV, Linköping University, Linköping, Sweden

Functional connectivity of intrisic fluctuations in the 'resting brain' was investigated in order to scrutinize the neuropathology of patients with periodic hypersomnia, Kleine-Levin syndrome (KLS). The main findings were that KLS patients exhibited increased coupling in the middle and inferior frontal gyri (Broca's area) and decreased coupling in the left superior temporal gyrus (Wernicke's area) as compared to healthy controls. In a previous study we showed working memory dysfunction accompanied by thalamic and left prefrontal hypoactivity in KLS. These findings suggest aberrant function in the thalamo-cortical networks, which might explain the patients' symptoms.

17:36 ***440***. **Altered Resting State Functional Connectivity in a Subthalamic Nucleus - Motor Cortex - Cerebellar Network in Parkinson's Disease**

Simon Baudrexel[1,2], Torsten Witte[1], Carola Seifried[1], Frederic von Wegner[3], Johannes C. Klein[3], Helmuth Steinmetz[3], Ralf Deichmann[2], Rüdiger Hilker[3]
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It is well established that dopaminergic depletion as observed in Parkinson's Disease (PD) alters metabolic and electrophysiological functional connectivity (FC) in large scale motor networks. Here we investigated FC of the subthalamic nucleus, a key player in PD-pathophysiology, using resting state fMRI and a common seed-voxel approach. We found significantly increased subthalamic FC to the primary motor cortex (PMC) in PD patients as compared to healthy

controls. A subsequent seed-voxel analysis revealed increased FC between the left PMC and the bilateral cerebellum. The physiological and clinical relevance of this finding remains further to be determined.

17:48 ***441***. **Magnetic Resonance Imaging of Cerebral Electromagnetic Activity in Epilepsy**

Padmavathi Sundaram[1,2], William M. Wells[2], Robert V. Mulkern[1], Ellen J. Bubrick[3], Edward Barry Bromfield[3], Mirjam Münch[4], Darren B. Orbach[1,2]

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We attempt to visualize an MR signal directly linked to neuronal activity. We hypothesized that reliable detection of an MR signal directly linked to neuronal activity in vivo, would be most likely under the following conditions: (i) fast gradient echo EPI, (ii) a cohort of epilepsy subjects, and (iii) concurrent EEG. Our subjects frequently experience high amplitude cortical electromagnetic discharges called interictal discharges. We found that these interictal spikes in the EEG of our subjects induced easily detectable MR signal changes. We refer to our technique as Encephalographic Functional Magnetic Resonance Imaging (efMRI).

Advanced Imaging of the Spinal Cord

Room A4 16:00-18:00 *Moderators:* Olga Ciccarelli and Frederik B. Laun

16:00 ***442***. **Vascular Alterations and Recruitment in Spinal Cord Injury Revealed by Multislice Arterial Spin Labeling (ASL) Perfusion Imaging**

Guillaume Duhamel[1], Tanguy Marqueste[2], Michaël Sdika[1], Mohamed Tachrount[1], Patrick Decherchi[2], Patrick J. Cozzone[1], Virginie Callot[1]

[1]CRMBM / CNRS 6612, Faculté de Médecine, Université de la Méditerranée, Marseille, France; [2]ISM, Université de la Méditerranée, Marseille, France

The combination of diffusion tensor imaging (DTI) and perfusion imaging has the potential to be a useful tool in spinal cord injury (SCI) investigation. Assessment of mouse SC blood flow (SCBF), recently demonstrated to be feasible by flow-sensitive alternating inversion recovery arterial spin labeling (FAIR-ASL), was based on single slice technique. However, multislice perfusion imaging matching DTI acquisitions would be required for lesion characterization. We then modified the original FAIR sequence to a FAIR-QUIPPSSII sequence, multislice compatible and optimized to mouse SC, and applied it along with DTI in a follow-up study performed over time on mice having received SCI.

16:12 ***443***. **Quantification of Spinal Cord Blood Volume in Humans Using VASO MRI**

Jinsoo Uh[1], Yan Cao[2], Hanzhang Lu[1]

[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Department of Mathematical Sciences, University of Texas at Dallas, Dallas, TX, United States

We have developed a technique based on Vascular-Space-Occupancy (VASO) MRI to measure spinal cord blood volume. The VASO sequence has been carefully adjusted to deal with the challenging aspects in imaging spinal cord such as small dimensions, tissue inhomogeneities, and cord motions. We compared two VASO protocol schemes and the one using multiple spin echoes showed better performance. The scBV values with this protocol were 1.8±0.2 ml/100 ml tissue for gray matter and 1.1±0.1 for white matter. To our knowledge, this is the first report of blood volume in gray and white matters of human spinal cord.

16:24 ***444***. **Rapid Three-Dimensional Myelin Water Fraction Imaging of the Cervical Spinal Cord**

Shannon Kolind[1,2], Sean Deoni[2]

[1]FMRIB Centre, University of Oxford, Oxford, United Kingdom; [2]Centre for Neuroimaging Sciences, King's College London, London, United Kingdom

The pathology of myelin in spinal cord disease is poorly understood due to the technical challenges of measuring myelin noninvasively. Our goal was to assess the efficacy of multi-component Driven Equilibrium Single Pulse Observation of T_1 and T_2 (mcDESPOT) for obtaining high spatial resolution spinal cord myelin water fraction (MWF) data covering the entire cervical spinal cord. Our results demonstrated the ability to reliably acquire high quality MWF data, at a spatial resolution of 1x1x1.5mm over a 12x12x18cm field-of-view, with MWF values consistent with prior literature values and a coefficient of variation of less than 3%.

16:36 ***445***. **Correlating Spinal Cord Diffusion Tensor Imaging Metrics to Clinical Measures in Patients with Adrenomyeloneuropathy**

Aliya Gifford[1], Kathy Zackowski[2,3], Joseph Wang[2], Peter C.M. van Zijl[4,5], Gerald Raymond[1,3], Seth Smith[6,7]

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Pathologic changes in adrenomyeloneuropathy (AMN) are associated with the spinal cord and characterized by primary distal axonopathy with secondary demyelination. We hypothesized that diffusion tensor imaging (DTI) metrics correlate with the disease severity and neurological and physiological deficits. Nine healthy volunteers and 40 AMN patients (20 M, 20 F) were imaged at 3T. DTI-derived metrics were measured for the upper cervical spine. Functional

measures of sensation were found to correlate significantly ($p<0.01$) with diffusivity in the dorsal column. These results support a strong structure-function relationship between the DTI-derived metrics of the spinal cord and clinical dysfunction.

16:48 ***446***. **Independent Spinal Cord Atrophy Measures Correlate to Motor and Sensory Deficits in Individuals with Spinal Cord Injury**

Henrik Lundell[1,2], Dorothy Barthelemy[2], Arnold Skimminge[1], Fin Biering-Sørensen[3], Jens Bo Nielsen[2]
[1]Danish Research Centre for Magnetic Resonance, Copenhagen University Hospital Hvidovre, Hvidovre, Denmark; [2]Department of Excercise and Sport Sciences & Department of Neuroscience and Pharmacology, University of Copenhagen, Copenhagen, Denmark; [3]Clinic for Spinal Cord Injuries, Rigshospitalet and University of Copenhagen, Copenhagen, Denmark

MRI can effectively detect lesions on the spinal cord but it has been difficult to find sensitive markers for specific functional deficits. Spinal cord atrophy due to loss of white matter can be measured as the transversal area at a given level of the spinal cord distal to the focal lesion and correlations to global functional scores has been observed in different pathologies. We suggest a simple but robust method to extract more specific and functionally relevant parameters and show independent correlations to motor and sensory deficits in individuals with spinal cord injury.

17:00 ***447***. **ASIA Scores Correlate with DTI Metrics in Non-Hemorrhagic Traumatic C-Spine Injury**

Rao Gullapalli[1,2], Jiachen Zhuo[1,2], Sendhil Cheran[1], K. Shanmuganathan[1], S. Mirvis[1]
[1]Radiology, University of Maryland School of Medicine, Baltimore, MD, United States; [2]Core for Translational Research in Imaging @ Maryland (C-TRIM), University of Maryland School of Medicine, Baltimore, MD, United States

There has been rising interest in evaluation spinal cord injury using diffusion tensor imaging (DTI) for accurate characterization of cord injury. The purpose of our retrospective study was to determine the correlation between American Spine Injury Association (ASIA) clinical injury motor score in patients with traumatic cervical cord injury and the various DT-MRI parameters. Our results indicate that DTI parameters accurately depict the severity of the injury and correlates with the ASIA scores. Further, among non-hemorrhagic cord contusions there appears to be a strong correlation of ASIA scores with the DTI parameter.

17:12 ***448***. **Wide-Band Steady State Free Precession with Small Diffusion Gradients for Spine Imaging: Application to Superior Nerve Visualization**

Ehud J. Schmidt[1], Ajit Shankaranarayanan[2], Sylvain Jaume,[1,3], Giovanna Danagoulian[1], Srinivasan Jr. Mukundan[1], Krishna S. Nayak[4]
[1]Radiology, Brigham and Womens Hospital, Boston, MA, United States; [2]GE Healthcare Applied Science Lab, Menlo Park, CA, United States; [3]Computer Science and Artificial Intelligence Lab, Massachusetts Institute of Technology, Cambridge, MA, United States; [4]Electrical Engineering, University of Southern California

3D High-resolution Wide-band Steady State Free Precession (WBSSFP) is utilized to track nerves as they exit the spinal cord. By placing the readout direction in the Superior-Inferior direction, small diffusional effects (B=40-60 s/mm2) contribute to improved contrast between Cerebro-spinal-fluid or Fat and the nerves, and remove vessel signal. In six patients with degenerative spine disease, WBSSFP aided in the diagnosis of back-pain sources, by detecting impingement on the nerves outside the spinal dura, not easily detected with conventional T2-,T1- or T2*-weighted sequences.

17:24 ***449***. **High Resolution Anatomical Imaging of the Spinal Cord at 7 T**

Eric Edward Sigmund[1], Caixia Hu[1], Giselle Suero[1], Joseph Helpern[1]
[1]Radiology, New York University Langone Medical Center, New York, NY, United States

This work presents results of novel coil development and protocol optimization for imaging of the spinal cord at the ultra-high field 7 T platform. A single-channel loop coil and a 4-chanel cervical spine cradle array were employed for anatomical c-spine imaging, using standard T2-weighted FLASH and TSE protocols. High resolution results were obtained allowing clear gray/white matter differentiation as well as depiction of small secondary structures (denticulate ligament, nerve roots, rostral-caudal vasculature). The enhanced level of detail provided by the combination of high field and coil engineering may be useful for monitoring neuropathy, injury, or surgical planning.

17:36 ***450***. **MRI Correlates of White Matter Structure in Intact Myelin Vs. Myelin Debris –*ex Vivo* Study in Injured Rat Spinal Cord**

Henry S. Chen[1], Jie Liu[2], Wolfram Tetzlaff[2], Piotr Kozlowski
[1]University of British Columbia, Vancouver, British Columbia, Canada; [2]International Collaboration On Repair Discoveries

Diffusion tensor imaging, quantitative T2, and T1 mapping were used to characterize excised rat spinal cord samples at 3 weeks post injury. Comparisons were made between injured and controlled white matter for several MR parameters, as well as for optical and electron microscopy cross-sections. Axonal damage is demonstrated by decrease in longitudinal diffusivity and fraction anisotropy, while myelin damage is more difficult to assess due to the presence of myelin debris. However the result did show increased myelin water content which is consistent with the histology result which showed increased spacing between myelin bi-layers in myelin debris.

17:48 ***451***. **Angiopoietin-1 Reduces Blood-Spinal Cord Barrier Permeability and Lesion Volume in the Acute Phase of Spinal Cord Injury: MRI and Histological Studies**

Chirag B. Patel[1], Ponnada A. Narayana[1]
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We hypothesized that attenuation of blood-spinal cord barrier (BSCB) compromise with angiopoietin-1 (Ang1) acutely after spinal cord injury (SCI) would reduce the severity of secondary pathologies (e.g., BSCB permeability and SCI lesion volume) in the acute phase of injury. The hypothesis was tested quantitatively in an experimental rat model of thoracic level 7 contusion SCI using the following methodologies: dynamic contrast-enhanced (DCE)-MRI, high resolution anatomical MRI, and immunofluorescence histology. A significant reduction in BSCB permeability and lesion volume during the acute phase of injury was observed as a result of Ang1 treatment. Histology validated DCE-MRI findings.

Novel Contrast Agents & Labels

Room A5 16:00-18:00 *Moderators:* Nicola R. Sibson and Enzo Terreno

16:00 ***452***. **A Terbium-Based PARACEST MR Contrast Agent for *in Vivo* Imaging Beyond the MT Effect**

Todd C. Soesbe[1], Federico A. Rojas-Quijano[1], A. Dean Sherry[1,2]
[1]Advanced Imaging Research Center, The University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Department of Chemistry, The University of Texas at Dallas, Dallas, TX, United States

Chemical exchange saturation transfer (CEST) agents create contrast in MR images by exchanging their saturated lanthanide bound protons with unsaturated bulk water protons. CEST agents can be selectively activated by applying a 2 to 10 second long frequency-specific saturation pulse, tuned to the bound proton frequency, just before imaging. Chemical exchange of the saturated bound protons with bulk water leads to a reduced water signal and darkening in the MR image. These agents hold great potential to further extend the functional and molecular imaging capabilities of MR. Some published applications include measuring tumor pH, angiogenesis, and the tissue distribution of glucose and other metabolites. CEST agent bound proton frequencies are typically shifted 5 to 50 ppm from bulk water (0 ppm). Unfortunately, this is the same range of the in vivo Magnetization Transfer (MT) effect. The MT effect arises from dipolar exchange of protons with endogenous tissue materials such as macromolecules and cell membranes. The MT effect typically spans from ±100 ppm (relative to bulk water) and is proportional to saturation pulse power. As a consequence, the contrast produced by the CEST agent can be totally masked by the tissue MT effects, which greatly complicates in vivo imaging. In an effort to avoid the MT effect and enhance in vivo CEST imaging, our group has recently developed a Tb3+-based paramagnetic CEST (PARACEST) agent with an unusually long bound water exchange lifetime. The bound proton frequency for this agent is at -600 ppm, which is far outside the normal tissue MT window. Although other Tb3+-based PARACEST agents have been reported, this agent's slower water exchange rate allows for an order of magnitude reduction in saturation pulse power, making it more suitable for in vivo studies. We present in vitro images of our Tb3+-based PARACEST agent to demonstrate its potential for in vivo imaging without the requirement of subtracting out tissue MT contributions.

16:12 ***453***. **A Hyperpolarized Xenon Based Contrast Agent Using a Modified M13 Bacteriophage Scaffold**

Todd K. Stevens[1], Krishnan K. Palaniappan[1], Zachary M. Carrico[1], Richard M. Ramirez[1], Matthew B. Francis[1], David E. Wemmer[1], Alexander Pines[1]
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Molecular imaging aims to detect the presence and spatial distribution of specific biomarkers in tissue. However, for many diseases the detection of these biomarkers must be done at very low concentrations to maximize diagnostic and prognostic value. Due to lack of sensitivity in conventional MRI techniques, exogenous contrast agents (e.g. SPIO, PARACEST) are being widely studied to lower concentration detection thresholds. Recently, targeted hyperpolarized xenon-based biosensors that exploit the exchange of solvated 129Xe between bulk solution (XeW) and cryptophane-A (CryA) molecular cages (XeC) have demonstrated high sensitivity (1). To build upon this work, a filamentous bacteriophage M13 was chosen as a scaffold upon which a large number of CryA copies could be assembled. M13 bacteriophage are routinely employed in phage display techniques used in panning for targeting moieties such as single chain fragment antibodies (scFv) (2), and thus can be straightforwardly targeted to biomarkers allowing for drastically increased CryA payloads per bound target. *The purpose of this study was to investigate the feasibility of using an M13 bacteriophage modified with cryptophane-A molecular cages as a sensitive xenon-based MR contrast agent and to determine the detection thresholds of CryA-modified phage.*

16:24 ***454***. **Multi-Color in Vivo MR Imaging of Lymph Nodes Using DIACEST Liposomes**

Guanshu Liu[1,2], Matthew M. Moake[3], Assaf A. Gilad[2,4], Muksit Jamil[2], Yah-el Har-el[2], Chris Long[3], Piotr Walczak[2,4], Jiangyang Zhang[2], Amanda Cardona[2], Marco A. DeLiso[2], George Sgouros[2], Jeff W.M. Bulte[2,4], Peter C.M. van Zijl[1,2], Michael T. McMahon[1,2]
[1]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States; [2]Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States; [3]Department of Biomedical Engineering, Johns Hopkins University School of Medicine, Baltimore, MD, United States; [4]Institute for Cell Engineering, Johns Hopkins University School of Medicine, Baltimore, MD, United States

We developed a new MR-visible liposome system based on labeling with three distinct diamagnetic Chemical Exchange Saturation Transfer (DIACEST) agents, L-arginine, poly-L-lysine and glycogen. Using saturation frequency swept MRI with B0-correction, the accumulation of all three types of DIACEST liposomes in mouse popliteal lymph nodes could be visualized. As a proof of concept, we demonstrate the first in-vivo multi-contrast (multi-color) MRI using two DIACEST agents, L-arginine liposomes and poly-L-lysine liposomes, that were simultaneously injected to two footpads of the same mouse. This new system allows direct monitoring of liposomal uptake in lymph nodes without any paramagnetic or super-paramagnetic contrast material.

16:36 ***455***. **Targeting the Endothelial Cell Surface: Novel Transgenic Mice for Molecular Imaging of Vascular Development**

Cesar Augusto Berrios-Otero[1], Benjamin B. Bartelle[1], Anne E. Friedland[1], Daniel H. Turnbull[1,2]
[1]Kimmel Center for Biology and Medicine at the Skirball Institute of Biomolecular Medicine, New York University School of Medicine, New York, United States; [2]Department of Radiology, New York University School of Medicine, New York, United States

Paramagnetic contrast agents targeted to cell membrane receptors or other surface proteins are currently of great interest for molecular imaging with MRI. A potential problem with current targeting methods is the limited targeting efficiency, which combined with the low sensitivity of many paramagnetic agents can severely compromise the application of these approaches for in vivo imaging. One way to circumvent problems in targeting contrast agents to surface receptors is to increase the binding affinity of the ligand to its target. An intriguing possibility is to take advantage of the high binding affinity of avidin and biotin. In the current study, transgenic mice expressing an engineered biotin ligase (BirA) and a cluster of biotinylation substrate sequences (Biotags) fused to a transmembrane protein domain were generated. Expression was driven by a minimal Tie2 promoter-enhancer, providing high transgene levels during angiogenesis in developing mouse embryos. Targeting was tested in embryos by means of intracardiac injections of an Avidin-Gd based T1-agent and high resolution 3D T1-weighted imaging.

16:48 ***456***. **Targeted Imaging of EGF Receptor Expression in Gli36 Tumor Xenografts Using Monoclonal Antibody Conjugates**

Mohammed Salman Shazeeb[1,2], Christopher Howard Sotak, [1,3], Alexei Bogdanov[3]
[1]Department of Biomedical Engineering, Worcester Polytechnic Institute, Worcester, MA, United States; [2]Graduate School of Biomedical Sciences, University of Massachusetts Medical School, Worcester, MA, United States; [3]Department of Radiology, University of Massachusetts Medical School, Worcester, MA, United States

Targeted EGF receptor imaging in Gli36 tumor xenografts implanted in the rat brain was achieved using monoclonal antibody (mAb) conjugates that facilitate local binding of a paramagnetic molecular substrate diTyr-DTPA(Gd) at the EGFR expression sites. Following mAb conjugate administration, diTyr-DTPA(Gd) was retained for a significantly longer period of time as compared to the administration of the contrast agent without mAb conjugate pre-treatment. The increased retention of diTyr-DTPA(Gd) following mAb conjugate administration is consistent with enzyme-mediated coupling of the paramagnetic agent to EGFR-overexpressing cells in the tumor; allowing effective MRI visualization of conjugate co-localization at the targeted site.

17:00 ***457***. ***In Vivo* 3D ^{19}F Fast Spectroscopic Imaging (F-UTSI) of Angiogenesis on Vx-2 Tumors in Rabbits Using Targeted Perfluorocarbon Emulsions**

Rolf Lamerichs[1], Muhammed Yildirim[1,2], Aart J. Nederveen[3], Jaap Stoker[3], Gregory M. Lanza[4], Samuel A. Wickline[4], Shelton D. Caruthers[4]
[1]Philips Research, Eindhoven, Netherlands; [2]Biomedical NMR, Department of Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands; [3]Department of Radiology, Academic Medical Center, Amsterdam, Netherlands; [4]Washington University, St Louis, MO, United States

Quantitative molecular MRI of angiogenesis using site-targeted ^{19}F agents has great potential. Many ^{19}F agents, however, possess complex spectra with many resonances over a wide ppm range. Fluorine ultra-fast Turbo Spectroscopic Imaging (F-uTSI) has been developed to overcome these drawbacks while offering the advantage of distinguishing various ^{19}F compounds based on chemical shift differences thereby allowing 'multi-color' imaging. Herein, F-uTSI is shown to be an efficient, sensitive technique for quantitatively detecting minute amounts of ^{19}F contrast agents in vivo while overcoming the confounding problems associated with chemical shift. Employing functionalized perfluorocarbon nanoparticles in Vx2 tumor-bearing rabbits, angiogenic maps were created.

17:12 ***458***. **Uptake of a Fibrin-Targeted Contrast Agent Could Direct Therapy Following Deep Vein Thrombosis**

Marcelo E. Andia[1], Prakash Saha[2], Andrea J. Wiethoff[1], Ulrike Blume[1], Tobias Schaeffter[1], Alberto Smith[2], Rene M. Botnar[1]
[1]Division of Imaging Sciences, Kings College London, London, United Kingdom; [2]Academic Department of Surgery, Cardiovascular Division, Kings College London, London, United Kingdom

The in vivo evaluation of the stage of organization or resolution of venous thrombosis could lead the medical treatment decision in venous thrombosis diseases. In this work we show that the use of EP-2104R, a fibrin specific contrast agent could give valuable information of the stage of thrombus resolution in an in vivo animal model.

17:24 ***459***. **Targeted Iron Oxide Particles for in Vivo MR Detection of Atherosclerotic Lesions Using Antibodies Against Oxidized Low Density Lipoprotein: Effect of Particle Size.**

Karen Catherin Briley-Saebo[1], Sung Kee Ryu[2], Simone Green[2], Venkatesh Mani[3], Stephen Dickson[3], Sotirios Tsimikas[2], Zahi A. Fayad[3]
[1]Radiology and Gene and Cell Medicine, Mount Sinai School of Medicine, NY, United States; [2]Vascular Medicine, University of California San Diego, La Jolla, CA, United States; [3]Radiology, Mount Sinai School of Medicine, NY, United States

Oxidized low-density lipoproteins (OxLDL) play a major role in plaque progression. Although OxLDL-targeted gadolinium micelles have been used for in-vivo detection of intraplaque macrophages, safety issues may limit clinical utility. The aim of the current study was to evaluate the in-vivo efficacy of oxLDL-targeted iron oxides. Small (<25nm) and large (>50nm) oxLDL-targeted particles were administered (4-mgFe/kg) to ApoE-/- mice. Imaging was performed 24 hours p.i. at 9.4T. Significant enhancement ($f´R2^*$>50%) was observed for the small oxLDL-targeted particles. Untargeted and large formulations exhibited limited enhancement. This study suggests that small OxLDL-targeted particles may allow for safe detection of foam cells.

17:36 ***460***. **Molecular MRI of Myocardial Angiogenesis After Acute Myocardial Infarction**

Marlies Oostendorp[1], Kim Douma[1], Allard Wagenaar[1], Jos MGM Slenter[1], Tilman M. Hackeng[1], Marc AMJ van Zandvoort[1], Mark J. Post[1], Walter H. Backes[1]
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Here, a molecular MRI method is presented to non-invasively image angiogenic activity in vivo in a murine model of myocardial infarction using cyclic cNGR-labeled paramagnetic quantum dots (pQDs). The tripeptide cNGR homes specifically to CD13, an aminopeptidase that is strongly upregulated during myocardial angiogenesis. cNGR-QDs allowed specific detection of post-infarction myocardial angiogenesis, as shown by the strong contrast observed in the infarcted mouse heart on molecular MRI, and by the colocalization of cNGR-pQDs with vascular endothelial cells as detected by fluorescence microscopy.

17:48 ***461***. **Optimization of Liposomal Theragnosis: Quantitative T_1 Measurement of Drug Distribution and Release in Deep-Seated Tumor Using Multimodal Thermo-Sensitive Polymer-Modified Liposome**

Daisuke Kokuryo[1], Seiji Nakashima[2], Kai-Hsiang Chuang[3], Iwao Kanno[1], Kenji Kono[2], Ichio Aoki[1]
[1]Molecular Imaging Center, National Institute of Radiological Sciences, Chiba, Japan; [2]Graduate School of Engineering, Osaka Prefecture University, Sakai, Osaka, Japan; [3]Singapore Bioimaging Consortium, Singapore, Singapore

A multimodal thermo-sensitive polymer-modified liposome (MTPL) loaded with anticancer drugs and contrast agents would be a powerful 'Theragnostic (therapy + diagnosis)' tool. In this paper, drug concentration in deep-seated tumor was evaluated using MTPL and a rapid quantitative imaging technique. Heat-triggered drug-release from MTPL was visualized in combination with the temperature distribution. MTPL concentration in the tumor area was maintained for between 4 and 12 hours after administration. We concluded that to minimize side-effects the optimum time to apply a heat-trigger is 12 - 24 hours after MTPL administration.

Animal Models of White Matter Disease & Neurodegeneration

Room A6 16:00-18:00 *Moderators:* Matthew D. Budde and Victor Song

16:00 ***462***. **Magnetic Resonance Microscopic Angiography Visualization of Abnormal Microvasculature in a Transgenic Mouse Model of Huntington's Disease**

Chien-Yuan Lin[1], Chien-Hsiang Huang[1,2], Ming-Huang Lin[1], Yi-Hua Hsu[1], Chung-Ru Tsai[1], Hui-Mei Chen[1], Yijuang Chern[1], Chen Chang[1]
[1]Institute of Biomedical Sciences, Academia Sinica, Taipei, Taiwan; [2]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan

The underlying mechanisms of neurodegenerative disease are still unclear. However, the cerebral microcirculation may play an important role. This study aimed to explore the microvasculature in a transgenic mouse model of Huntington¡¦s disease using newly developed microscopy MRA.

16:12 ***463***. **Longitudinal Changes in the Neurochemical Profile of Hungtington R6/2 Mice**

Ivan Tkac[1], Lori A. Zacharoff[2], Silvia Mangia[1], Patrick J. Bolan[1], Janet M. Dubinsky[2]
[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States; [2]Dept. of Neuroscience, University of Minnesota, Minneapolis, MN, United States

In vivo ^{1}H NMR spectroscopy at 9.4T was used to measure neurochemical changes in striatum and cerebral cortex of R6/2 transgenic mice during their lifespan, starting from a presymptomatic age of 4 weeks. Significant differences were observed for multiple brain metabolites between R6/2 and WT controls. Concentration changes in cortex were parallel to those observed in striatum. Changes in the neurochemical profiles correlated with reduced volumes of these brain regions. Behavioral differences were observed at all time points, although different tests distinguished R6/2 mice from WT controls at early and older ages.

16:24 ***464***. **Cingulate and Sensorimotor Cortical Changes in the R6/2 Huntington's Disease Mouse: A Study of 116 Brains**

Stephen J. Sawiak[1,2], Nigel I. Wood[3], Guy B. Williams[1], A J. Morton[3], T A. Carpenter[1]
[1]Wolfson Brain Imaging Centre, University of Cambridge, Cambridge, Cambs, United Kingdom; [2]Behavioural and Clinical Neurosciences Institute, University of Cambridge, Cambridge, United Kingdom; [3]Department of Pharmacology, University of Cambridge, United Kingdom

We present an improved method of cortical thickness measurement in the mouse brain and apply it to 116 brains in the R6/2 mouse model of Huntington's disease. Significant changes are seen in the sensorimotor cortices (S1, S2, M1) which would be expected in a HD model. Cingulate cortex (Cg1, Cg2) differences are also shown which have not been previously reported in these mice.

16:36 ***465***. **Detection of Early Neurochemical Changes Related to Neurodegeneration in a Spinocerebellar Ataxia Type 1 (SCA1) Mouse Model by ^{1}H MRS at 9.4 Tesla**

Uzay Emrah Emir[1], H Brent Clark[1], Manda Vollmers[1], Dee M. Koski[1], Lynn E. Eberly[1], Harry T. Orr[1], Huda Y. Zoghbi[2], Gulin Oz[1]
[1]University of Minnesota, Minneapolis, MN, United States; [2]Baylor College of Medicine, Houston, TX, United States

In order to identify MRS biomarkers of very early neurochemical changes related to neurodegeneration, we utilized a knockin (KI) mouse model of SCA1. We measured cerebellar neurochemical profiles of KI mice and wild-type (WT) littermates longitudinally at 9.4T using short-echo LASER. Total choline, taurine and glutamine were the most robust biomarkers in this model. The KI mice displayed very mild cerebellar pathology even at 9 months, however they were distinguished from WTs by MRS starting at 6 weeks. Therefore, this study demonstrated that the MRS biomarkers are sensitive to very early changes related to neurodegeneration prior to overt pathology.

16:48 ***466***. **Hyperoximic Therapy of Hypoxic Neonatals Increases Cerebral Injury. DTI Study in Rats**

Kurt Hermann Bockhorst[1], Harriet Charmaine Rea[2], Rui Liu[3], Jarek Wosik[3], Jose Regino Perez-Polo[2], Ponnada A. Narayana[1]
[1]Diagnostic and Interventional Imaging, University of Texas, Houston, TX, United States; [2]Biochemistry & Molecular Biology, University of Texas Medical Branch, Galveston, TX, United States; [3]Electronics and Computer Science, University of Houston, Houston, TX, United States

International guidelines recommend the treatment of perinatal hypoxia with 100% oxygen. This treatment is controversial. We therefore initiated a study of a neonatal rat model, which is widely accepted for perinatal hypoxia in infants. Our findings confirm the concerns, that hyperoximia actually exacerbates the injuries caused by perinatal hypoxia

17:00 ***467***. **Region Specific-Alteration of Blood-Brain Barrier Development Caused by Prenatal Exposure to Inflammation**

Sylvie Girard[1], Luc Tremblay[2], Guillaume Sebire[1], Martin Lepage[2]
[1]Pediatric, Universite de Sherbrooke, Sherbrooke, Qc, Canada; [2]Radiobiology, Universite de Sherbrooke, Sherbrooke, Qc, Canada

Perinatal inflammation affects brain development and could modify the permeability of the developing blood-brain barrier (BBB). This can have an impact on the accessibility of both inflammatory mediators and therapeutics drugs, to the brain. This study aimed at evaluating the postnatal variations of permeability of the developing BBB. Using a contrast agent, we observed a decreased permeability of the BBB during normal development. However, prenatal exposure to a pro-inflammatory agent led to a region-specific increased permeability during the first 30 days after birth. This provides new insights into the mechanisms explaining the vulnerability to aggressions in newborns causing brain damage.

17:12 ***468***. **In-Vivo Mouse Brain Diffusion Tensor Magnetic Resonance Imaging (DT-MRI) Detects Gender and Region Specific Pathology Induced by Cuprizone**

Laura-Adela Harsan[1], Yi Sun[1], Nicoleta Baxan[1], Jürgen Hennig[1], Dominik von Elverfeldt[1]
[1]Department of Diagnostic Radiology, Medical Physics, University Hospital, Freiburg, Germany

Long-term cuprizone treatment in female and male mice, underlined the course of the disease from acute demyelinating to the chronic state. In-vivo DT-MRI, performed using 45 gradient diffusion directions sensitively assessed the myelin and axonal damage in relationship with the modifications of radial and axial diffusivity. When compared with females, the progressing pathology in the male brains had a stronger impact on the values of DT-MRI derived indices (D_radial , D_axial), suggesting a faster and more severe course of the disease. The existence of a sexual dimorphism in demyelination implies a gender-specific response to different strategies developed to induce recovery.

17:24 ***469***. **Susceptibility of the Optic Nerve and the Involvement of Retrograde Neuronal Degeneration in a Delayed Radiation Induced Injury Model: Evidence from a Diffusion Tensor Imaging Study**

Deqiang Qiu[1], Silun Wang[1,2], Kwok-Fai So[3], Ed Xuekui Wu[4], Lucullus Hing-Tong Leung[5], Pek-Lan Khong[1]
[1]Diagnostic Radiology, The University of Hong Kong, Hong Kong, China; [2]Radiology, Johns Hopkins University, Baltimore, MD, United States; [3]Anatomy, The University of Hong Kong; [4]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong; [5]Oncology, Princess Margaret Hospital, Hong Kong, China

In the present study, we evaluated changes of multiple white matter tracts following radiation using diffusion tensor imaging. A novel finding of severe changes in FA in the contralateral optic nerve as compared to the ipsilateral optic nerve was observed, and these changes were confirmed by histological evaluation. These findings cannot be explained by difference in radiation dose and suggests, for the first time, an important role of retrograde neuronal degeneration in the underlying mechanism for radiation induced injury to the visual pathway. The results also suggest susceptibility of the optic nerve relative to the cerebral peduncle.

17:36 ***470***. **Biphasic Expression of Aquaporin 4 During the Course of Brain Inflammation**

Thomas Tourdias[1], Iulius Dragonu[2], Nadège Cassagno[1], Mathilde Deloire-Grassin[1], Claudine Boiziau[1], Bruno Brochet[1], Chrit Moonen[2], Klaus Petry[1], Vincent Dousset[1]
[1]Laboratoire de Neurobiologie des affections de la myéline, EA2966, (1) Université Victor Segalen Bordeaux 2, Bordeaux, France; [2]UMR-CNRS 5231, laboratoire d'imagerie moléculaire et fonctionnelle, (1) Université Victor Segalen Bordeaux 2, Bordeaux, France

We combined MRI, histology and molecular biology to assess the time course of aquaporin 4 (AQP4) expression during brain inflammation in the rat brain. We reported a moderate AQP4 up-regulation during the active phase of inflammation that was insufficient to remove interstitial water excess as assessed by diffusion MRI. We found a second AQP4 up-regulation that was delayed and with a different pattern, i.e. pan astrocytic and not confined to the blood brain barrier interface. Again, this delayed up-regulation was insufficient to remove vasogenic edema but was probably involved in the glial scar formation.

17:48 ***471***. **Axonal Injury and Myelin Loss in Glutaric Acidemia Type I (GA-1) Mouse Model of Diet Induced Encephalopathy**

Jelena Lazovic[1], William J. Zinnanti[2], Russell E. Jacobs[1]
[1]Biology, California Institute of Technology, Pasadena, CA, United States; [2]Pediatrics, Children's hospital at SUNY Downstate, Brooklyn, NY, United States

In recent years white matter abnormalities, including leukoencephalopathy, are being increasingly recognized in patients suffering from glutaric acidemia type I (GA-1). The mechanism leading to leukoencephalopathy remains unknown, as well as the extent of myelin degradation. In this work we use a mouse model of GA-1 and combination of MRI, histology and behavioral testing to establish the basis for abnormal appearance of white matter in this disorder. Presented data suggest myelin degradation to be secondary to axonal loss in GA-1. Behavioral data implicate damaged neuronal populations to be involved in sensory-motor integration.

Prostate Cancer (Clinical Studies)

Room A7 16:00-18:00 *Moderators:* Jurgen J. Futterer and Amita Shukla-Dave

16:00 ***472***. **Delineation and Visualization of Prostate Cancer for Targeted Radiation Therapy (Rt)**

Radka Stoyanova[1], Raj Rajpara[1], Elizabeth Bossart[1], Victor Casillas[2], Jill Palma[1], May Abdel-Wahab[1], Alan Pollack[1]
[1]Radiation Oncology, University of Miami, Miami, FL, United States; [2]Diagnostic Radiology, University of Miami, Miami, FL, United States

We present an application of Pattern Recognition technique for analysis of DCE-MRI data from patients with prostate cancer and after prostatectomy. Our analysis indicates that we can detect the area of tumor burden in the prostate as well as abnormalities suggestive of residual/recurrent tumor in the prostate bed. The constructed 3D maps can be directly imported into DICOM-RT ready format to the RT planning system for targeting of the contrast enhancing areas specifically in order to improve tumor control and limit toxicity.

16:12 ***473***. **A Study of Endorectal MRI and MRSI of the Prostate as Predictive Biomarkers of Biochemical Relapse After Radical Prostatectomy**

Kristen Zakian[1], Hedvig Hricak[2], Nicole Ishill[3], Victor Reuter[4], Steven Eberhardt[5], Chaya Moskowitz[3], Amita Shukla-Dave, Liang Wang, Peter Scardino[6], James Eastham, Jason Koutcher

[1]Medical Physics, Memorial Sloan-Kettering Cancer Center, New York, NY, United States; [2]Radiology, Memorial Sloan-Kettering Cancer Center, New York, NY, United States; [3]Epidemiology and Biostatistics, Memorial Sloan-Kettering Cancer Center, New York, NY, United States; [4]Pathology, Memorial Sloan-Kettering Cancer Center, New York, NY, United States; [5]Radiology, University of New Mexico, NM, United States; [6]Surgery, Memorial Sloan-Kettering Cancer Center, New York, NY, United States

The purpose of this study was to determine whether pre-treatment endorectal MRI/MRSI can predict biochemical relapse (BCR) after radical prostatectomy (RP). 130 of 202 patients who underwent endorectal MRI/MRSI in 2000-2002 followed by RP satisfied data quality criteria and were followed until Jan. 2009. MRI risk score was assigned based on local disease extent. An MRSI index lesion comprised of voxels with elevated [Cho+Cr]/Cit volume was designated. MRI risk score, MRSI index lesion volume and the presence of high grade MRSI voxels correlated with time-to-biochemical failure after radical prostatectomy even when adjusted for clinical stage, biopsy Gleason score and PSA.

16:24 ***474***. **3D Proton MR Spectroscopic Imaging of Prostate Cancer: Accuracy Evaluation in Different Prostate Regions**

Stefan Zbyn[1,2], Martin Krssak[2], Mazda Memarsadeghi[2], Klaus Kubin[2], Andrea Haitel[3], Michael Weber[2], Thomas Helbich[2], Ewald Moser[1], Siegfried Trattnig[1,2], Stephan Gruber[1,2]

[1]MR Centre of Excellence, Medical University of Vienna, Vienna, Austria; [2]Department of Radiology, Medical University of Vienna, Vienna, Austria; [3]Department of Pathology, Medical University of Vienna, Vienna, Austria

Since spectral quality of prostate 3D-MRSI data vary dramatically within measured volume, the total inaccuracies in (choline+creatine)/citrate (CC/C) ratios using Cramér-Rao lower bounds were calculated to compare the accuracy of this method between different prostate regions and measurement resolutions. Our analysis suggests that voxels from prostate base and from periphery of the prostate suffer the most from inaccurate CC/C ratios. To prevent from misleading findings or time consuming manual inspection of spectral quality in each prostate voxel, the metabolic-quality maps, that combine the information of CC/C ratio and its accuracy in one image using the various voxel transparencies, are demonstrated.

16:36 ***475***. **MRI-Guided Transurethral Ultrasound Therapy with Real-Time Feedback – a Human Study**

Masoom Haider[1,2], Laurence Klotz[3,4], Michael Bronskill[5,6], Kashif Siddiqui[3], Alexandra Colquhoun[3], Linda Sugar[7], Rajiv Chopra[5,6]

[1]Medical Imaging, Sunnybrook Health Sciences Center, Toronto, Ontario, Canada; [2]Medical Imaging, University of Toronto, Toronto, Ontario, Canada; [3]Urology, Sunnybrook Health Sciences Center, Toronto, Ontario, Canada; [4]Surgery, University of Toronto, Toronto, Ontario, Canada; [5]Imaging Research, Sunnybrook Health Sciences Center, Toronto, Ontario, Canada; [6]Medical Biophysics, University of Toronto, Toronto, Ontario, Canada; [7]Pathology, Sunnybrook Health Sciences Center, Toronto, Ontario, Canada

MRI-guided transurethral ultrasound therapy with real-time thermometry feedback has the potential to reduce morbidity of prostate cancer therapy. To our knowledge this is the first report of the use of this technology in humans. The procedure was performed immediately prior to prostatectomy. Ultrasound energy was delivered while MR thermography was performed. The rate of rotation and output power of the applicator were adjusted by computer control. Treatment times were 9-10 minutes. The maximum temperature distribution map 55°C boundary matched the histologic section showing necrosis. It is feasible to perform accurate spatial heating of the prostate in humans using MRI-guided transurethral ultrasound.

16:48 ***476***. **Wash-Out Gradient Derived from Dynamic Contrast-Enhanced MRI Detects Cancerous Tissues and Predicts Gleason Scores in Prostate Cancer**

Yu-Jen Chen[1], Woei-Chyn Chu[1], W-Y Isaac Tseng[2,3]

[1]Institute of Biomedical Engineering, National Yang-Ming University, Taipei, Taiwan; [2]Departments of Medical Imaging National Taiwan University Hospital, Taipei, Taiwan; [3]Center for Optoelectronic Biomedicine, National Taiwan University College of Medicine, Taipei, Taiwan

DCE MRI was reported to assess microvascularity of prostate cancer, and is potentially useful to predict clinical staging. However, there are few studies demonstrating weak association between DCE MRI parameters and Gleason score. In this study, we have retrospectively analyzed the DCE MRI parameters in pathologically confirmed PCA regions. We found that washout gradient values were capable of differentiating PCA from normal tissues and best correlated with Gleason score.

17:00 ***477***. **Validation of Multiparametric Magnetic Resonance Imaging and Spectroscopy (DWI/MRSI) to Assess Prostate Cancer Aggressiveness**

Thiele Kobus[1], Thomas Hambrock[1], Christina Hulsbergen - Van de Kaa[2], Jelle Barentsz[1], Arend Heerschap[1], Tom Scheenen[1]

[1]Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; [2]Pathology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands

To validate the use of diffusion weighed imaging (DWI) and magnetic resonance spectroscopic imaging (MRSI) for tumor aggressiveness assessment, 37 patients with prostate cancer had a magnetic resonance imaging, DWI and MRSI exam on a 3T system with endorectal coil prior to prostatectomy. Individual and combined DWI and MRSI methods were used to discriminate between high- and low-grade tumors using histopathology as gold standard. Combining DWI and MRSI with linear discriminant analysis to separate tumors gave a higher sensitivity and specificity than any of the techniques separately. This suggests that DWI and MRSI provide complementary information about aggressiveness.

17:12 ***478***. **Evaluating and Relating Contrast Mechanisms in Prostate Cancer: Heterogeneity Within Normal and Tumor Regions at 3.0 T**

Sharon Giles[1], Sophie F. Riches[2], Veronica A. Morgan[1], Catherine Simpkin[1], Nandita deSouza[2]
[1]Cancer Research UK and EPSRC Cancer Imaging Centre, Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom; [2]Cancer Research UK and EPSRC Cancer Imaging Centre, Institute of Cancer Research & Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom

We report T2, magnetisation transfer ratios, and apparent diffusion coefficients for prostate tissues at 3T. ADC showed a lower coefficient of variation for all prostate regions compared to other parameters, indicating it to be more reliable at differentiating tumor from non-tumor in the prostate. Negative correlation of ADC with MTR suggests that diffusion-weighted contrast may be linked to features other than cellularity, with presence of large macromolecules playing a role.

17:24 ***479***. **Does Quantification of T2 SNR Decrease After USPIO Administration Allow Differentiation Between Benign and Malignant Normal Sized Pelvic Lymph Nodes?**

Johannes M. Froehlich[1], Benedikt Rückriem[1], Maria Triantafyllou[1], Frederic D. Birkhaeuser[2], Michael von Gunten[3], Peter Vermathen[4], Harriet C. Thoeny[1]
[1]Institute of Diagnostic, Interventional and Pediatric Radiology, University Hospital, Bern, Switzerland; [2]Department of Urology, University Hospital, Bern, Switzerland; [3]Institute of Pathology, University Hospital, Bern, Switzerland; [4]Department of Clinical Research, University Hospital, Bern, Switzerland

Methodologically the staging of lymph nodes based on uptake of USPIO is judged on a qualitative level analyzing signal decrease and distribution on T2/T2*-weighted sequences. Quantification of SI/SNR-decrease in 320 lymph nodes comprising 20 malignant lymph nodes, 57 benign inguinal and 243 benign iliacal lymph nodes revealed significant differences ($p<0.05$) when comparing benign with malignant lymph nodes. Contrary to iliacal lymph nodes (24.8% ± 54.6%) inguinal ones presented limited SNR decrease (3.4% ± 55.4%). Substantial overlap of single data, limit the diagnostic potential of quantification. In practice morphological criteria, fatty content and localization of lymph nodes must be considered.

17:36 ***480***. **Tissue Segmentation Improves Prostate Cancer Detection with Artificial Neural Networks Analysis of ^{1}H MRSI**

Lukasz Matulewicz[1], Jacobus F. Jansen[2], Herbert A. Vargas Alvarez[2], Oguz Akin[2], Samson Fine[2], Amita Shukla-Dave[2], James Eastham[2], Hedvig Hricak[2], Jason A. Koutcher[2], Kristen L. Zakian[2]
[1]Memorial Sloan-Kettering Cancer Center , New York, United States; [2]Memorial Sloan-Kettering Cancer Center, New York, United States

Artificial Neural Network (ANN) model was introduced for automatic detection of tumor voxels in the prostate from 1H-MRSI datasets with additional information about tissue segmentation. The ANN's accuracy for automatic detection of tumor voxels in the prostate MRSI datasets was demonstrated. Applying tissue segmentation from MRI as an additional input to ANN improves the accuracy of detecting tumor voxels from MRSI.

17:48 ***481***. **Absolute Quantification in 1H MRSI of the Prostate at 3T**

Paul Michael Walker[1,2], Gilles Créhange[3], Sébastien Parfait[2], Alexandre Cochet[1], Philippe Maingon[3], Luc Cormier[1], François Brunotte[1,2]
[1]University Hospital of Dijon, Dijon, France; [2]LE2I, University of Burgundy, Dijon, France; [3]Radiotherapy Department, CGFL, Dijon, France

Although, it is common in MRSI to use a Choline/Citrate ratio when evaluating PCa, the use of citrate (Cit) as a reference is questionable in the context of treatment such as hormonotherapy and radiotherapy, because Cit levels fall very sharply even in non-cancerous tissue. We have proposed an absolute quantification method at 3T and we observed significantly higher Cit in normal PZ than in CG tissue. However, in PCa, reductions in Cit were not accompanied by important increases in tCho, suggesting increases in tCho/Cit are primarily due to loss of Cit and not to a sharp rise in tCho.

Myocardial Function, Perfusion, Viability: Technical Developments & Experimental Models

Room A8 16:00-18:00 *Moderators:* James C. Carr and David Sosnovik

16:00 ***482***. **kt SPIRiT for Ultra-Fast Cardiac Cine Imaging with Prospective or Retrospective Cardiac Gating**

Peng Lai[1], Michael Lustig[2,3], Anja CS. Brau[1], Shreyas Vasanawala[4]
[1]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [2]Electrical Engineering, Stanford University, Stanford, CA, United States; [3]Electrical Engineering and Computer Science, University of California, Berkeley, CA, United States; [4]Radiology, Stanford University, Stanford, CA, United States

This work developed a new kt method, kt SPIRiT, for highly accelerated cardiac cine imaging. kt SPIRiT exploits both k-space correlations (parallel imaging) and intrinsic spatiotemporal sparsity (compressed sensing) in dynamic images and supports both prospective and retrospective cardiac gating. The proposed method was compared with kt GRAPPA and kt SPARSE on 6 volunteers. Based on our visual assessment and quantitative analysis, kt SPIRiT can improve image quality and reconstruction accuracy compared to kt GRAPPA and kt SPARSE and provide results similar to full k-space reconstruction at high acceleration factors.

16:12 ***483***. **3D Whole Heart CSPAMM Tagging in a Single Breath Hold Using K-T-PCA**

Christian Torben Stoeck[1,2], Reza Nezafat[3], Peter Boesiger[1], Sebastian Kozerke[1]
[1]Institute for Biomedical Engineering, University and ETH, Zurich, Switzerland; [2]Department of Medicine (Cardiovascular Division), Beth Israel Deaconess Medical Center and Harvard , Boston, MA, United States; [3]Department of Medicine (Cardiovascular Division), Beth Israel Deaconess Medical Center and Harvard, Boston, MA, United States

The feasibility of undersampling 3D whole heart CSPAMM tagging data using k-t PCA was investigated. In computer simulations it is shown that acceleration factors up to 3.7 can be achieved without compromising the accuracy in determining motion parameters such as circumferential strain, circumferential shortening and rotation. This opens up the possibility to acquire 3D CSPAMM data in a single breathhold thereby eliminating the need for repetitive breathholding.

16:24 ***484***. **Assessment and Validation of Cardiac MR Oximetry in Obesity**

Jie Zheng[1], Donna Lesniak[2], Robert O'Connor, David Muccigrosso, Linda Peterson, Chris Eagon, Pamela K. Woodard, Robert J. Gropler
[1]Radiology, Washington University in St. Louis, Saint Louis, MO, United States; [2]Radiology, Washington University in St. Louis, United States

Obese patients underwent gastric bypass surgery and then scanning by positron emission tomography for cardiac evaluation, including perfusion and oxygen consumption. A cardiac MR acquisition method and modeling were developed to quantify global myocardial oxygen extraction fraction and oxygen consumption in these patients and BMI matched volunteers, at rest and during the hyperemia Excellent correlation was observed for oxygen extraction fraction and consumption rate between MRI and PET. Mismatched myocardial blood flow and hyperemic OEF, observed in obesity, indicates metabolism alternation may precede myocardial microcirculation abnormality in obese.

16:36 ***485***. **Free-Breathing Perfusion Imaging with SW-CG-HYPR and Motion Correction**

Lan Ge[1], Aya Kino[1], Mark Griswold[2], James Carr[1], Debiao Li[1]
[1]Departments of Radiology and Biomedical Engineering, Northwestern University, Chicago, IL, United States; [2]Departments of Radiology and Biomedical Engineering, Case Western Reserve University, OH, United States

Time-resolved data acquisition with Sliding-Window Conjugate-Gradient HighlY constrained back PRojection (1, 2) (SW-CG-HYPR) has been used to acquire myocardial perfusion images with increased spatial coverage, better spatial resolution, and improved SNR (3). However, this method is sensitive to respiratory motion; therefore, breath-hold is required during data acquisition. In this work, we developed a motion correction method for SW-CG-HYPR, allowing free-breathing myocardial perfusion MRI. The average image quality score of the free-breathing images with motion correction (3.09 ± 0.37) is significantly higher than that without motion correction (2.26 ± 0.40), and is comparable to the successful breath-holding images (3.10 ± 0.41). The signal changes in motion corrected free-breathing images were closely correlated to the breath-holding images, with a correlation coefficient of 0.9764 for myocardial signals.

16:48 ***486***. **Comparison of Single to Dual Bolus MR Myocardial Perfusion Imaging for Detection of Coronary Artery Disease**

Frans PPJ Kremers[1], Jan GJ Groothuis[2], Aernout M. Beek[2], Stijn L. Brinckman[2], Alvin C. Tuinenburg[2], Michael Jerosch-Herold[3], Albert C. van Rossum[2], Mark B.M. Hofman[1]
[1]Physics and Medical Technology, ICaR-VU, VU University Medical Center, Amsterdam, Netherlands; [2]Cardiology, ICaR-VU, VU University Medical Center, Amsterdam, Netherlands; [3]Radiology, Brigham & Women's Hospital, Boston, MA, United States

Dual-bolus first pass MR myocardial perfusion imaging has been shown to compensate for signal saturation in arterial input function, and resulted into more realistic perfusion values. We investigated whether this dual bolus approach also improved diagnostic value for the detection of significant coronary artery disease (CAD). In 49 patients with suspected CAD adenosine stress and rest MR perfusion imaging was performed with single and dual bolus imaging. Invasive coronary angiography was used as standard of reference. Dual bolus imaging showed lower perfusion values, but ROC analysis showed no incremental diagnostic value over single bolus technique for detection of significant CAD.

17:00 ***487***. **Manganese Uptake in Heart Is Dependent of L-Type Calcium Channel Activity But Not Extracellular Calcium Concentration**

Ya Chen[1,2], Wen Li[1,2], Wei Li[1,2], Xin Yu[1,2]
[1]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States; [2]Case Center for Imaging Research, Case Western Reserve University, Cleveland, OH, United States

The present study aimed to quantify manganese (Mn2+) uptake in hearts under altered physiological and biochemical conditions. Using a rapid T1-mapping method, we investigated the dynamic Mn2+ uptake in perfused rat hearts 1) under normal workload; 2) under isoproterenol (ISO) stimulation, and 3) at elevated calcium (Ca2+) concentration. Our results show that Mn2+ uptake was increased in ISO stimulated hearts but not in hearts perfused with increased Ca2+ concentration.

17:12 ***488***. **Diffusion Weighted MRI of the Mouse Heart in Vivo Following Ischemia-Reperfusion Injury**

Shuning Huang[1], Guangping Dai[1], David E. Sosnovik[1,2]
[1]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States; [2]Center for Molecular Imaging Research, Massachusetts General Hospital, Charlestown, MA, United States

We present in the study, to the best of our knowledge, the first diffusion weighted MR images of the mouse heart to be acquired in vivo. Schemes to overcome motion artifact in the rapidly beating mouse heart are presented, and the ability of the technique to detect changes in cell death in the myocardium after an ischemic insult is demonstrated.

17:24 ***489***. **A Comparative Study of Different CMR Methods for Detecting Myocardial Edema Associated with Acute Myocardial Infarction**

Xiangzhi Zhou[1], Veronica Rundell[1], Ying Liu[1], Richard Tang[1], Rachel Klein[1], Shivraman Giri[2], Saurabh Shah[3], Sven Zuehlsdorff[3], Orlando Simonetti[2], Debiao Li[1], Rohan Dharmakumar[1]
[1]Northwestern University, Chicago, IL, United States; [2]Ohio State University, Columbus, OH, United States; [3]Siemens Medical Solutions USA, Inc., Chicago, IL, United States

The sensitivity of T1 and T2 maps, T2-prep SSFP, bSSFP, and T2-STIR, for detecting myocardial edema in AMI was assessed in a canine model subjected to ischemia reperfusion injury. T1 and T2 maps showed lower sensitivity compared to T2-STIR. However, no difference was found among T2-STIR, T2-Prep, and bSSFP methods.

17:36 ***490***. **Simultaneous T1 Mapping, Cine Imaging, and IR-Prepared Imaging of the Rat Heart Using Small Animal Look-Locker Inversion Recovery (SALLI)**

Daniel R. Messroghli[1], Martin Buehrer[2], Sebastian Kozerke[2], Sarah Nordmeyer[1], Thore Dietrich[3], Kirstin Atrott[3], Thomas Hucko[3], Ingo Paetsch[3], Felix Berger[1], Eckart Fleck[3], Titus Kuehne[1]
[1]Congenital Heart Disease and Paediatric Cardiology, Deutsches Herzzentrum Berlin, Berlin, Germany; [2]Institute for Biomedical Engineering, University and ETH Zuerich, Switzerland; [3]Internal Medicine and Cardiology, Deutsches Herzzentrum Berlin

Small Animal Look-Locker Inversion recovery (SALLI) is a novel imaging and reconstruction strategy allowing for simultaneous acquisition of cardiac T1 maps, cine movies, and IR-prepared images. Phantom experiments illustrate the T1 behavior of SALLI T1 maps using different sets of timing parameters. In-vivo images were obtained in a rat heart with acute anterior myocardial infarction and allowed to clearly identify the infarction site on all three modalities in a time-effective manner.

17:48 ***491***. **Assessment of Pericardial Enhancement in Pericarditis with a Novel Fat-Water Separated 3D Dixon Delayed Enhancement Pulse Sequence**

James F. Glockner[1], Jae K. Oh[2], Manojkumar Saranathan[3]
[1]Radiology, Mayo Clinic, Rochester, MN, United States; [2]Cardiology, Mayo Clinic, Rochester, MN, United States; [3]GE Healthcare, Waukeshau, WI, United States

Pericardial enhancement has been correlated with pathologic evidence of inflammation, and therefore can serve as a marker of pericarditis. Visualization of pericardial enhancement with MRI can be limited using traditional delayed enhancement sequences without fat suppression. We assessed a 3D Dixon FGRE fat-water separated delayed enhancement sequence in 21 patients with known or suspected pericarditis, and found that pericardial visualization and confidence in presence or absence of pericardial enhancement were significantly improved in comparison to a standard 2D DE pulse sequence.

MRI in Motion: Motion Correction Techniques

Room A9 16:00-18:00 *Moderators:* Roland Bammer and Joëlle K. Barral

16:00 **Introduction**

Overview of Motion Correction Workshop Organizing Committee

16:12 ***492***. **Highly Efficient Respiratory Gating in Whole Heart MR Employing Non-Rigid Retrospective Motion Correction**

Johannes F M Schmidt[1], Martin Buehrer[1], Peter Boesiger[1], Sebastian Kozerke[1]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

Respiratory motion artifacts in coronary MR scans were retrospectively corrected using a non-rigid motion model acquired interleaved during the sequence pauses in each heart cycle. Gating efficiency could be doubled without loss in image quality.

16:24 ***493***. **High Temporal Resolution Radial Motion Correction with GROWL**

Wei Lin[1], Feng Huang[1], Yu Li[1], Arne Reykowski[1]
[1]Advanced Concepts Development, Invivo Corporation, Philips Healthcare, Gainesville, FL, United States

The self-navigating property of radial imaging has been exploited in various motion correction methods. However, there is always a tradeoff between the robustness and temporal resolution of motion correction. In this work, a recently proposed rapid parallel imaging method, GRAPPA operator for wider radial bands (GROWL), is applied to increase the temporal resolution of motion correction in multi-coil radial imaging applications. It is demonstrated that robust in-plane rotation/translation motion detection and correction can be achieved with as few as 8 radial views using an 8-channel coil.

16:36 ***494***. **Robust 3-D Motion Correction for Spiral Projection Imaging**

Kenneth Otho Johnson[1], James Grant Pipe[1]
[1]Barrow Neurological Institute, Phoenix, AZ, United States

Using spiral planes to fill a 3-D sphere, the motion incurred during a scan can be deduced based on the geometry of how the planes overlap. A new physically based solver is tuned and used to provide robust accurate motion estimates across various scanning parameters that introduce rf coil bias, excessive off-resonance, and image space warping from gradient non-linearities. Estimates for expected accuracy of in-vivo scans are provided, which create a synthesis of multiple datasets, that are registered using an external program.

16:48 ***495***. **Robust ARC Parallel Imaging with 3D Prospective Motion Correction**

Suchandrima Banerjee[1], Philip James Beatty[1], Jian Zhang[2], Eric T. Han[1], Ajit Shankaranarayanan[1]
[1]Applied Science Laboratory, GE Healthcare, San Francisco, CA, United States; [2]Electrical Engineering, Stanford University, Palo Alto, CA, United States

Recent trends in MRI have seen an increase in volumetric acquisitions. But three-dimensional (3D) scans are prone to motion artifacts because scan times are often long even after acceleration with parallel imaging and any motion affects the entire volume measurement. Prospective motion correction provides a robust method for suppressing motion artifacts, by tracking patient motion and adjusting scan coordinates to realign with the patient. This work investigates data-driven parallel imaging approaches that account for the k-space transformations associated with prospective motion correction.

17:00 ***496***. **Towards Combining Prospective Motion Correction and Distortion Correction for EPI**

Rainer Boegle[1], Julian Maclaren[1], Maxim Zaitsev[1]
[1]Dept. of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Baden-Württemberg, Germany

Subject head motion is a serious confound in fMRI, limiting its image quality and applicability. To lift this restriction for EPI based fMRI the combination of prospective motion correction with distortion correction based on field maps, calculated from the subject's susceptibility distribution and pose, has been proposed. Here we present a proof-of-concept phantom study demonstrating the significance of motion dependent distortions in prospective motion correction and the feasibility of their correction via a field prediction method. Additionally comparative field simulations are shown, which suggest that a 'simple segmentation' of a human head would be sufficient for in vivo correction.

17:12 ***497***. **Improved Pose Detection for Single Camera Real-Time MR Motion Correction Using a Self-Encoded Marker**

Christoph Forman[1], Murat Aksoy[2], Matus Straka[2], Joachim Hornegger[1], Roland Bammer[2]
[1]Pattern Recognition Lab, Department of Computer Science, Friedrich-Alexander-University Erlangen-Nuremberg, Erlangen, Germany; [2]Department of Radiology, Stanford University, Stanford, CA, United States

A new self-encoded marker for optical pose estimation has been developed. It was designed to cover a wider range of motion and allows to be combined with cameras with a smaller aperture. In this study, we measured accuracy and precision of this novel self-encoded marker on a precision pan-tilt unit and compared the results against similar measurements performed with a standard checkerboard marker. Comparative evaluations between the new self-encoded marker and the checkerboard marker were also performed in vivo and demonstrated superiority of the new marker approach.

17:24 ***498***. **A Parallel Computing Framework for Motion-Compensated Reconstruction Based on the Motion Point-Spread Function.**

Freddy Odille[1], Philip G. Batchelor[2], Claudia Prieto[2], Tobias Schaeffter[2], David Atkinson[1]
[1]Centre for Medical Image Computing, University College London, London, United Kingdom; [2]Division of Imaging Sciences, King's College London, London, United Kingdom

Generalized reconstruction algorithms have been proposed in order to correct for artifacts induced by nonrigid motion. However they are very time-consuming because large scale inverse problems have to be solved. Here we propose a technique for splitting the reconstruction into several smaller problems, based on the properties of the point-spread function associated with motion artifacts, which uses the local nature of artifacts (blurring) in the frequency-encoding direction. The method was implemented on a cluster of workstations, and applied to the correction of real motion-corrupted data. Efficient motion correction was achieved, with reconstruction times reduced by an order of magnitude.

17:36 ***499***. **Hybrid Prospective & Retrospective Head Motion Correction System to Mitigate Cross-Calibration Errors**

Murat Aksoy[1], Christoph Forman[1,2], Matus Straka[1], Tolga Çukur[3], Samantha Jane Holdsworth[1], Stefan Tor Skare[1,4], Juan Manuel Santos[3], Joachim Hornegger[2], Roland Bammer[1]
[1]Department of Radiology, Stanford University, Stanford, CA, United States; [2]Computer Science, Friedrich-Alexander-University Erlangen-Nuremberg, Erlangen, Germany; [3]Electrical Engineering, Stanford University, Stanford, CA, United States; [4]Karolinska Institute, Stockholm, Sweden

Correction of motion artifacts in MRI is essential to assure diagnostic image quality. In case where external pose information is used for motion-correction, cross-calibration errors may impair image quality. In this study, we propose a combined prospective & retrospective approach to prospectively correct for motion and to mitigate residual image distortions which emanate from subtle cross-calibration errors. Specifically, a single camera mounted on the head coil was used to measure and correct patient motion in real-time. Resulting data inconsistencies – emanating primarily from cross-calibration errors – were removed by a retrospective autofocusing algorithm wherein k-space was divided into segments. The relative rotation and translation needed to realign these segments were determined by means of entropy-based autofocusing. Phantom and in-vivo results show that in the presence of inaccuracies in cross-calibration, the current method provides improved image quality over prospective motion correction only.

17:48 ***500***. **Spectroscopic Imaging with Prospective Motion Correction and Retrospective Phase Correction**

Thomas Lange[1], Julian Maclaren[1], Martin Buechert[1], Maxim Zaitsev[1]
[1]Dept. of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany

A method for prospective motion correction based on an optical tracking system has recently been proposed and has already been successfully applied to single voxel spectroscopy. In this work, the utility of prospective motion correction in combination with retrospective phase correction is evaluated for spectroscopic imaging in the human brain. Especially, the real-time adjustment of the outer volume suppression slabs appears to be crucial in vivo where lipid signal can drastically impair the spectral quality. The interleaved reference scan method is used to correct for motion-induced frequency drifts and to ensure correct phasing of the spectra across the whole slice.

THURSDAY

SUNRISE EDUCATIONAL COURSE
Hot Topics in Body MRI: Prostate Ablation

Room K1 07:00 – 08:00 *Organizer*s: Talissa Altes, Elmar Max Merkle, and Bachir Taouli

Educational Objectives:
Upon completion of this course participants should be able to:

- List the current available methods for local prostate ablation;
- Describe the indications and non-indications of these methods;
- Explain the results of these methods applied to prostate cancer; and
- Describe the MR results before and after local ablation of prostate cancer.

Moderators: **Clare Allen and Anwar R. Padhani**

07:00 **Prostate Ablation Methods: Overview**
Hashim Uddin Ahmed, M.D.

07:30 **MRI Pre- and Post-Ablation of Prostate Cancer**
Clare Allen, F.R.C.R.D

SUNRISE EDUCATIONAL COURSE
Tissue Contrast in MSK MRI - From Physics to Physiology

Room K2 07:00 – 08:00 O*rganizer & Moderator*: Bernard J. Dardzinski

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe contrast mechanisms in MSK imaging, most notably in imaging of articular cartilage;
- Describe the physics of advanced MR sequences;
- Identify the most suitable new MR sequences for four important indications;
- Implement current MR protocols for daily practice and be aware of the most useful indications for these techniques.

07:00 **Contrast Mechanisms for MR Imaging of Tissues and Fluids with Short T2s and/or T2*s**
Graeme M. Bydder, M.B., Ch.B.

07:30 **MSK Clinical and Research Applications of UTE Imaging**
Christine Chung, M.D.

SUNRISE EDUCATIONAL COURSE

Image Reconstruction

Victoria Hall 07:00 – 08:00 *Organizer & Moderator*: Elfar Adalsteinsson

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the main steps involved in efficient non-Cartesian image reconstruction;

- Formulate a generalized signal model incorporating gradient encoding, coil sensitivity and Bo inhomogeneity;
- List the pro's and con's of Cartesian and non-Cartesian parallel MRI;
- Compare compressed sensing, HYPR, and k-t BLAST with respect to their use of prior knowledge;
- Describe the principles of separating water and fat signals; and
- Name three different approaches for motion correction and appraise their potential to become routine methods

Sparse Data

07:00 **Compressed Sensing and HYPR**
Julia V. Velikina, Ph.D.

07:30 **Exploiting Spatiotemporal Correlations for Dynamic Imaging**
Jeffrey Tsao, Ph.D.

SUNRISE EDUCATIONAL COURSE

Imaging Biomarkers

Room A1 07:00 – 08:00 *Organizers & Moderators*: Jeffrey L. Evelhoch and Sabrina M. Ronen

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe what a biomarker is and how MR can be used as a biomarker;
- Explain how biomarkers are qualified to be fit for their intended purpose;
- List requirements for use of MR biomarkers in both preclinical studies and clinical trials; and
- Give examples of how imaging biomarkers are being used in at least two of the following areas: multiple sclerosis, oncology, cardiovascular diseases and neurodegenerative diseases.

07:00 **Imaging Biomarkers in Neurodegenerative Diseases**
Kejal Kantarci, M.D.

07:30 **Imaging Biomarkers in Multiple Sclerosis**
Douglas L. Arnold, M.D.

SUNRISE EDUCATIONAL COURSE

Brain: An Absolute Beginner's Guide to Anatomical & Functional MRI

Room A4 07:00 – 08:00 *Organizer & Moderator*: Geoffrey J.M. Parker

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Identify the neuroanatomical and neurophysiological parameters which are accessible to MR measurement;
- Describe the underlying physics of MR neuroimaging techniques;
- Describe the data acquisition and analysis techniques most commonly used for anatomical and functional MRI of the brain;
- Recognize the potential value of advances such as parallel imaging, fast imaging techniques and high magnetic field strengths for imaging the brain; and
- Name typical clinical applications for which specific MRI techniques are suited.

07:00 **Absolute Beginners' Guide to Diffusion MRI**
Derek K. Jones, Ph.D.

SUNRISE EDUCATIONAL COURSE

Potentials & Challenges of High-Field MRS

Room A5 07:00 – 08:00 *Organizers & Moderators*: Rolf Gruetter and Ivan Tkac

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe advantages and potentials of MRS at very high fields;
- Identify problems and challenges of high field MRS;
- Define the MRS detectable neurochemical profile of the brain;
- Describe principles of metabolite quantification;
- Assess spectral quality and identify main sources of spectral quality deterioration; and
- Explain the importance of B0 shimming at high fields.

Neurochemical Profile

07:00 **MRSI Beyond NAA**
Dennis W.J. Klomp, Ph.D.

07:30 **Metabolite Quantification**
Cristina Cudalbu, Ph.D.

SUNRISE EDUCATIONAL COURSE

Modeling & Quantitative Analysis for Body DCE MRI

Room A 07:00 – 08:00 *Organizers & Moderators*: Henry Rusinek and Min-Ying Lydia Su

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe various DCE models used for different organs including kidney, liver, breast, and prostate;
- Describe analysis methods used to measure vascularity, permeability, and blood flow;
- Implement Monte Carlo noise simulation method to predict parameter bias and precision;
- Compare conventional compartmental kinetic models and distributed models;
- Apply procedures for converting MRI signal intensity to tracer concentration; and
- Explain current method for measuring vascular input function and analyzing its impact on obtained DCE parameters.

07:00 **DCE-MRI Measurement Challenges**
Thomas E. Yankeelov, Ph.D.

07:30 **Contrast Agents**
Youssef Zaim Wadghiri, Ph.D.

SUNRISE EDUCATIONAL COURSE

From Bench to Bedside to Bench: Translation of Animal Models to Clinical Practice & From Clinical Practice to Animal Models

Room A7 07:00 – 08:00 *Organizers & Moderators*: Pia C. Maly Sundgren and Afonso C. Silva

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the main MRI methods used in experimental studies to understand the underlying disease mechanisms;
- Identify what is known about the underlying disease mechanisms, and which type of MRI investigations could be used for diagnosis and clinical investigation;
- Describe the main MRI methods used in the clinical setting to diagnose the condition, and the rationale behind this; and
- Make the translation from what is - and can be - done in experimental studies to what can be done clinically, and where animal models bring new insight to disease.

Oncology Imaging

Moderators: **Pia C. Maly Sundgren, M.D., Ph.D. and Afonso C. Silva, Ph.D.**

07:00 **Multimodality Radionuclide, Fluorescence, Bioluminescence Small-Animal Imaging including Animal Models for DCE-MRI and DWI MRI**
Jinha M. Park, M.D., Ph.D.

07:30 **Multimodality In-Vivo Molecular and Advanced oncologic Imaging : Human Metrics/Applications where is the Animal Model Validation?**
Meng Law, M.D.,M.B.B.S., F.R.A.C.R.

SUNRISE EDUCATIONAL COURSE

Cardiovascular Imaging: Disease or Problem Based Teaching, Practical Protocols

Room A8 07:00 – 08:00 *Organizers & Moderators*: Victor A. Ferrari, Vivian S Lee and Mitsue Miyazaki

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Recognize recent advancements and requirements in 3T cardiovascular MRI, as compared to present 1.5T MRI;
- Evaluate the strengths and limitations of current cardiovascular MRI techniques when applied to clinical diagnostic examinations;
- Describe current clinical techniques for assessment of ischemic heart disease and various cardiac diseases using new methods;
- Select the potential clinical applications of time-resolved techniques, and the technical challenges that will need to be resolved for wider applications; and
- Apply current approaches optimally to these diseases.

Image Processing & Visualization

07:00 **4D Flow**
Michael Markl, Ph.D.

07:20 **Function**
Frederick H. Epstein, Ph.D.

07:40 **Perfusion**
Christine H. Lorenz, Ph.D.

SUNRISE EDUCATIONAL COURSE

Trials & Tribulations: Multicenter Trial Headaches & Their Cures

Room A9 07:00 – 08:00 *Organizers & Moderators*: Nicola de Stefano and Jeffrey Joseph Neil

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe multiple methods for setting up and maintaining site quality and certification for multicenter imaging trials;
- Explain the issues related to performing research involving INDs or IDEs;
- Evaluate the sensitivity, specificity and reliability of current imaging methods to detect relevant quantitative changes within the brain; and
- Describe the underlying principles for adopting and evaluating potential surrogate imaging markers for assessment of drug efficacy.

Detecting Relevant Changes in the Brain

07:00 **Sensitivity and Specificity in Real Patients**
Frederik Barkhof, M.D., Ph.D.

07:30 **Data Analysis: Potential Pitfalls and Sources of Error**
Mara Cercignani, Ph.D.

PLENARY SESSION

Room A1 08:15-09:10 *Chair:* Georg M. Bongartz, ISMRM President

08:15 **Young Investigators Awards & Poster Awards**

08:30 **Mansfield Lecture: From Rodin to Radon: Some Unusual Applications of Projection Reconstruction**
Prof. Ray Freeman, D.Sc., Cambridge University, Cambridge, England, UK.
Prof. Freeman would like to acknowledge Dr. Eriks Kupce (Varian Ltd, Yarnton, Oxford, UK) as coauthor.

Clinical Needs & Technological Solutions: Atherosclerosis

Room A1 09:10-10:10 *Organizers & Moderators:* Debiao Li and Matthias Stuber

09:10 ***501***. **Pathogenesis of Atherosclerosis and Vulnerable Plaque**
Erling Falk[1]
[1]Aarhus University Hospital, Aarhus N., Denmark

Atherosclerosis is a systemic, lipid-driven inflammatory disease of the arterial wall leading to multifocal plaque development. The most dangerous plaques are those causing thrombosis, socalled vulnerable plaques. Most thrombi leading to heart attack and large artery stroke are caused by plaque rupture. A ruptured plaque contains a large and soft lipid-rich necrotic core covered by a thin and inflamed fibrous cap. Associated features include big plaque size, expansive remodeling mitigating luminal obstruction (mild stenosis by angiography), neovascularization (angiogenesis), plaque hemorrhage, adventitial inflammation, and a "spotty" pattern of calcifications. These features are potential targets for detection of vulnerable plaques by imaging.

09:30 ***502***. **Techniques and Applications of Atherosclerosis MRI**

Chun Yuan[1]
[1]University of Washington, Seattle, WA, United States

MRI of atherosclerosis is being applied in all major arteries in humans, aiming to identify key factors linked with current or future cardiovascular events, as well as for monitoring lesion progression/regression under medical treatment and for clinical diagnosis. This lecture will review the extensive technical advances of MRI atherosclerosis and the new insights into high risk lesions provided by MRI.

09:50 ***503***. **Molecular Imaging with Targeted Contrast Agents**

Zahi Adel Fayad[1]
[1]Mount Sinai School of Medicine, New York, NY, United States

Atherosclerosis is characterized by the thickening of the arterial wall to form a plaque, a process in which cholesterol deposition, inflammation, extracellular-matrix formation and thrombosis have important roles. Traditionally, diagnosis of atherosclerosis was possible either by directly revealing the narrowing of the lumen or by evaluating the effect of the stenosis on organ perfusion. New imaging approaches allow the assessment of the composition of the vessel walls, enabling atherosclerosis-associated abnormalities in the arteries to be observed, at the cellular/molecular levels. We discuss the use of new nanoparticulates not only for imaging but also for drug delivery and treatment of atherosclerosis.

Hot Topics: MRI & the Arrhythmic Patient

Room K1 10:30 – 12:30 *Organizers & Moderators*: Claudia M. Hillenbrand and Orlando P. Simonetti

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Select optimal cardiovascular MRI methods to define which patients need defibrillators, CRT, pacemakers;
- Explain the basic steps and concepts associated with MRI planning of RF ablation therapy;
- Evaluate the progress in interventional CVMR and predict future directions in MR-guided RF ablation therapy; and
- Describe the safety risks of imaging patients with pacemakers, and explain recent progress on MRI-compatible pacemakers and defibrillators.

10:30 **MRI Detection of Arrhythmic Substrate**
Katherine C. Wu, M.D.

10:55 **Role of MRI in Patient Selection for CRT**
John N. Oshinski, Ph.D.

11:20 **MR-guided RF Ablation**
Tobias R. Schaeffter, Ph.D.

11:45 **MRI of Patients with Pacemakers and Defibrillators**
Torsten Sommer, M.D.

12:10 Panel Discussion

How to Perform a Multi-Site Neuroimaging Study

Room K2 10:30 – 12:30 *Organizers*: Gary H. Glover, Bryon A. Mueller and Douglas C. Noll

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Recognize the challenges associated with performing a multi-site MRI experiment, including issues associated with QA, advanced planning, data management, and training;
- Explain how existing multi-center MRI experiments were designed and implemented;

- Describe the unique challenges associated with executing multi-center structural, diffusion tensor, functional, and perfusion imaging experiments; and
- Implement a multi-center study using best practices.

Moderator: **Douglas C. Noll**

10:30 **Foundations for Performing Any Multi-Center Neuroimaging Study**
Gary H. Glover, Ph.D.

10:48 **How to do a STRUCTURAL Multi-Center Neuroimaging Study**
Matt A. Bernstein, Ph.D.

11:06 **How to do a DTI Multi-Center Neuroimaging Study**
Carlo Pierpaoli, M.D., Ph.D.

11:24 **How to do a FUNCTIONAL Multi-Center Neuroimaging Study**
Bryon A. Mueller, Ph.D.

11:42 **How to do an ASL Multi-Center Neuroimaging Study**
Xavier G. Golay, Ph.D.

12:00 **How to do a Multi-Center Neuro-Imaging Study: A Technologist's Perspective**
Maureen Ainslie, M.S., R.T. (R) (MR)

12:18 **Panel Discussion**
Douglas C. Noll, Ph.D.

Clinical Stroke Imaging: From Vessel Wall to Neuron

Room A1 10:30-12:30 *Moderators:* Jeroen Hendrickse and Toshiaki Taoka

10:30 ***504***. **Arterial Luminal Curvature and Fibrous Cap Thickness Affects Critical Stresses Within Atherosclerotic Plaques: An in Vivo MRI-Based Finite Element Method Simulation Study**

Zhongzhao Teng[1], Umar Sadat[1], Zhiyong Li,[12], Chengcheng Zhu[1], Victoria Young[1], Martin John Graves[1], Jonathan H. Gillard[1]
[1]University Department of Radiology, University of Cambridge, Cambridge, United Kingdom; [2]School of Biological Science & Medical Engineering, Southeast University, Nanjing, Jiangsu, China

It has been widely accepted that the plaque rupture is the result of the loading due to blood pressure and flow exceeds the material strength of the fibrous cap (FC) and the site with thin FC is regarded as the vulnerable site. Considerable research has been done to discover the correlation between FC thickness and critical stress conditions, however, the relationship of arterial luminal curvature remains unexplored. We found that stress value taken from the thinnest location will significantly over-estimate the plaque stability. For a better plaque risk assessment, stress at the sites with maximum lumen curvature should be included.

10:42 ***505***. **Impact of the Age of Plaque Haemorrhage on Plaque Stress in Patients with Symptomatic Carotid Artery Disease- A Patient Specific Magnetic Resonance Imaging-Based Finite Element Method Simulation Study**

Umar Sadat[1], Zhongzhao Z. Teng[2], Zhi Yong Li[2], Cheng Cheng Zhu[2], Victoria E. Young[2], Martin J. Graves[2], Jonathan H. Gillard[2]
[1]University Department of Radiology , University of Cambridge, Cambridge, United Kingdom; [2]University Department of Radiology, University of Cambridge, Cambridge, United Kingdom

Patients suffering from a transient ischemic attack (TIA) are at high risk of recurrent TIAs, particularly within the first 4 weeks. The risk of recurrent thromboembolic events gradually decreases afterwards. The United Kingdom National Stroke Strategy warrants emergency management of high-risk patients. High resolution magnetic resonance can assist us to identify high-risk plaques and assess the morphological and biomechanical changes within plaques using computational simulations, thereby refining our risk stratification criteria for management of high-risk patients. In this study we assess the impact of age of plaque haemorrhage on plaque stress in patients suffering from TIAs.

10:54 ***506***. **Carotid Artery Plaque Burden as Measured by Magnetic Resonance Imaging: A Potential Imaging Indicator for Acute Cerebral Ischemic Lesion Volume**

Huilin Zhao[1], Xihai Zhao[2], Ye Cao[1], Jinnan Wang[3], Chun Yuan[2], Xiangyang Ma[4], Jianrong Xu[1]
[1]Radiology, Renji Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, China; [2]Radiology, University of Washington, Seattle, WA, United States; [3]Philips Research North America, Briarcliff Manor, NY, United States; [4]Philips Research Asia, Shanghai, China

Carotid atherosclerosis has been demonstrated to be associated with cerebrovascular events (TIA or stroke). Thus, atherosclerotic disease in carotid arteries may be an effective indicator for the severity and outcomes of stroke, such as cerebral infarct volumes. This study sought to determine the association between carotid plaque burden and cerebral ischemic lesion volume by MRI in 43 symptomatic patients. We found a strong correlation of left carotid artery plaque burden with ispilateral cerebral hemisphere ischemic lesion volumes. Our findings suggest that carotid plaque burden may be a potential imaging indicator for acute cerebral ischemic lesion volume.

11:06 ***507***. **Plaque Burden Measurement by Black-Blood MR Imaging Technique in Intracranial and Extracranial Carotid Arteries in Acute Stroke Patients**

Huilin Zhao[1], Xihai Zhao[2], Ye Cao[1], Jinnan Wang[3], Chun Yuan[2], Xiangyang Ma[4], Jianrong Xu[1]
[1]Radiology, Renji Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, China; [2]Radiology, University of Washington, Seattle, WA, United States; [3]Philips Research North America, Briarcliff Manor, NY, United States; [4]Philips Research Asia, Shanghai, China

Atherosclerosis is a systemic disease frequently involving multiple vascular territories, such as carotid artery and cerebral arteries, which are related to cerebrovascular events. Thus, atherosclerotic disease in one vascular bed may be an indicator for the other vasculatures. This study sought to determine the association of atherosclerotic plaque burden between carotid arteries and M1 segment of middle cerebral arteries using MR black-blood vessel wall imaging in 31 symptomatic patients. We found that development of atherosclerosis has been shown to be parallel in intracranial and extracranial cerebrovascular system in stokes. Our findings suggest that atherosclerotic disease in carotid artery may be an indicator of intracranial cerebrovascular atheroma, or vice versa.

11:18 ***508***. **Cerebrovascular Reactivity Within Perfusion-Territories in Patients with an ICA Occlusion**

Reinoud Pieter Harmen Bokkers[1], Matthias J. van Osch[2], C. J. Klijn[3], L Jaap Kappelle[3], Willem P. Mali[1], Jeroen Hendrikse[1]
[1]Department of Radiology, UMCU, Utrecht, Netherlands; [2]Department of Radiology, LUMC, Leiden, Netherlands; [3]Department of Neurology, UMCU, Utrecht, Netherlands

Patients with a symptomatic occlusion of the internal carotid artery (ICA) and hemodynamic compromise of the brain may benefit from bypass surgery. Our objective was to investigate cerebrovascular reactivity in the perfusion-territories of the cerebral arteries at brain tissue level in patients with an ICA occlusion using arterial spin labeling MRI, and determine whether cerebrovascular reactivity varies within the perfusion-territory of the remaining ICA. Our results show that ASL-MRI can visualize brain tissue with impaired cerebrovascular reactivity. The brain tissue on the side of the occlusion, supplied through collaterals originating from the unaffected ICA, was the most impaired.

11:30 ***509***. **Quantitative MR Perfusion and Ischemic Stroke: Improved Discrimination Between Ischemic and Presumed Penumbra Using QCBF Over Tmax or MTT**

Christopher S. Eddleman[1], Maulin Shah[2], Omar M. Arnaout[1], Richard Bernstein[3], Bernard R. Bendok[1], Hunt H. Batjer[1], Timothy J. Carroll[4]
[1]Neurological Surgery, Northwestern University, Chicago, IL, United States; [2]Biomedical Engineering, Pennsylvania State University, State College, PA, United States; [3]Neurology, Northwestern University, Chicago, IL, United States; [4]Radiology, Northwestern University, Chicago, IL, United States

Time-based indicators of cerebral blood flow, e.g., Tmax and MTT, are often used to grade stroke severity in both MR and CT perfusion studies. However, these measures often overestimate the infarcted territory, thus underestimating salvagable brain. We show that quantitative MR perfusion is superior to time-based measures in distinguishing normally perfused from ischemic brain tissue.

11:42 ***510***. **Is Reduced CBV a Reliable Surrogate Marker for Infarct Core and Can It Be Used to Identify Lesion Mismatch?**

Matus Straka[1], Jun Lee[2], Maarten G. Lansberg[2], Michael Mlynash[2], Gregory W. Albers[2], Roland Bammer[1]
[1]Radiology, Stanford University, Stanford, CA, United States; [2]Stroke Center, Stanford University Medical Center, Stanford, CA, United States

Mismatch between stroke core and penumbra can be used used to identify patients that could benefit from reperfusion therapies. Hyperintense DWI in MRI or hypointense CBV in CT can be used to identify stroke core, and equivalence of CT-CBV and DWI lesion volumes was tested. DSC-MRI CBV was used as a surrogate for CT-CBV and 59 patients were analyzed. Results indicate that only large lesions (>10ml) can be identified on CBV and accuracy and reliability of CBV-based mismatch is lower then of DWI. CBV-based stroke core identification yeilded generally smaller lesions and correlation with DWI was low.

11:54 ***511***. **Model-Based Permeability Estimates Are Preferable to Model-Free Initial Area Under the Curve (IAUC) Measures in the Identification of Hemorrhagic Transformation in Acute Ischemic Stroke**

Andrea Kassner[1,2], Rebecca E. Thornhill[1,2], Swati Matta[1], Fang Liu[1], David J. Mikulis[1,3]
[1]Medical Imaging, University of Toronto, Toronto, Ontario, Canada; [2]Physiology and Experimental Medicine, Hospital for Sick Children, Toronto, Ontario, Canada; [3]Medical Imaging, Toronto Western Hospital, Toronto, Ontario, Canada

Thrombolytic therapy is known to increase the risk of hemorrhagic transformation (HT) in acute ischemic stroke (AIS). Accurate and robust methods for predicting HT are required for improving treatment guidance. Model-based permeability estimation with dynamic contrast-enhanced MRI can predict HT, but the estimates (KPS coefficients) are sensitive to noise and require an arterial input function. However, studies of tumors suggest that a model-free

measure, the initial area under the contrast-concentration curve (IAUC) is more robust. We evaluated both KPS and IAUC in AIS patients and found that only KPS successfully delineated HT. Model-based estimates are recommended over IAUC in AIS.

12:06 ***512***. **Pulsed Arterial Spin Labeling Perfusion MRI Correlates with Clinical Severity in Patients with Vertebrobasilar Artery Stenoses**

Bradley J. MacIntosh[1,2], Lars Marquardt[3], Ursula G. Schulz[3], Peter M. Rothwell[3], Peter Jezzard[2]
[1]Imaging & Brain Sciences, Sunnybrook Health Sciences Centre, Toronto, ON, Canada; [2]Clinical Neurology, FMRIB Centre, Oxford, OXON, United Kingdom; [3]Clinical Neurology, Stroke Prevention Research Unit, Oxford, OXON, United Kingdom

Arterial spin labeling is a versatile perfusion MRI technique and recent studies have shown clinical merit. One clinical arena that is under-investigated is perfusion profiles in patients with vertebral or basilar artery (VBA) stenosis. The arrival of the magnetic spin tracer is expected to be delayed in these patients therefore a multiple inflow 3D-GRASE-PASL implementation is used to estimate cerebral blood flow (CBF) and the arterial arrival time (AAT). Patients with presumed severe VBA disease (N=4), on the basis of their clinical history, showed significantly prolonged AAT ($P<0.01$) and reduced CBF ($P=0.08$) when compared to patient with presumed no VBA disease (N=10).

12:18 ***513***. **MR Elastography of Stroke: A Feasibility Study**

Sebastian Hirsch[1], Kaspar Josche Streitberger[1], Jan Rodrigo Hoffmann[2], Randolf Klingebiel[3], Dieter Klatt[1], Sebastian Papazoglou[1], Jürgen Braun[4], Ingolf Sack[1]
[1]Institute of Radiology, Charité - University Medicine Berlin, Berlin, Germany; [2]Institute of Neurology, Charité - University Medicine Berlin, Berlin, Germany; [3]Institute of Neuroradiology, Charité - University Medicine Berlin, Berlin, Germany; [4]Institute of Medical Informatics, Charité - University Medicine Berlin, Berlin, Germany

The characterization of neuronal tissue inside an infarcted region is still a subject of intense research. MR elastography (MRE) is capable of measuring the mechanical connectivity of soft tissue in vivo. This feasibility study aims to assess the potential of MRE for the characterization of tissue regeneration after stroke. The hypothesis was that stroke-related changes of the biomechanical properties of neuronal tissue are detectable by MRE. The results demonstrate through both a decrease in the complex shear modulus and an increase in shear wave amplitudes that tissue integrity is degraded inside a stroke region.

Arterial Spin Labeling

Victoria Hall 10:30-12:30 *Moderators:* Susan T. Francis and Eric C. Wong

10:30 ***514***. **The Effect of Bolus Length and Dispersion on Arterial Spin Labeling Flow Quantification**

Esben Thade Petersen[1], Xavier Golay[2], T QUASAR Reproducibility study[3]
[1]Clinical Imaging Research Centre (CIRC), Singapore, Singapore; [2]UCL Institute of Neurology, London, United Kingdom; [3]28 Centers

Bolus duration and dispersion is often assumed when quantifying flow using ASL. We evaluated their impact on CBF, based on data from 284 healthy subjects (28 sites). The length and dispersion was fitted from multiple arterial-input-functions obtained from data acquired at multiple time-points. Although QUIPSS-II bolus definition (0.64s) was applied, the majority had shorter boluses, compromising the precision of ASL. Furthermore, a considerable correlation (0.63, $p<0.001$) between average bolus-length and CBF from the sites, suggest that part of site differences relates to the bolus duration. Normal Gaussian dispersion ranges from 0.05-0.15s potentially introducing large quantification errors across the brain.

10:42 ***515***. **Determination of Spin Compartment in ASL Signal Using TRUST-MRI**

Peiying Liu Wang[1], Jinsoo Uh[1], Hanzhang Lu[1]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States

Although ASL has been widely used for measurement of CBF, we do not know which compartment the labeled spins are located at the time of detection. Here we used the T2 value of the labeled spins to probe whether the detected ASL signal is located in artery, tissue or even vein. Our data suggest that, at typical delay time of 1.5 seconds, most of the detected spins in gray matter are already in the tissue space. For white matter, however, the spins are still virtually all in arteries.

10:54 ***516***. **Depression of Cortical Gray Matter $CMRO_2$ in Awake Humans During Hypercapnia**

Divya S. Bolar[1,2], Bruce R. Rosen[1,2], Karleyton C. Evans[1,3], A Gregory Sorensen[1,2], Elfar Adalsteinsson[1,2]
[1]HST/MGH/MIT Martinos Center for Biomedical Imaging, Charlestown, MA, United States; [2]Harvard-MIT Division of Health Sciences & Technology, Cambridge, MA, United States; [3]Department of Psychiatry, Massachusetts General Hospital, Boston, MA, United States

Hypercapnia induced by CO_2 inhalation causes a robust increase in cerebral blood flow. Far less understood are the effects of CO_2 on neuronal activity and cellular metabolism. In this study, a recently developed method called QUantiative Imaging of the eXtraction of Oxygen and TIssue Consumption (QUIXOTIC) was used evaluate the hypercapnic $CMRO_2$ response in cortical gray matter of awake humans. We report a statistically significant decrease of 25.3% in cortical $CMRO_2$ ($p = 0.036$), from normocapnia to hypercapnia. To our knowledge, this is the first time cortical GM $CMRO_2$ response to hypercapnia has been assessed.

11:06 ***517***. **3D-EPI ASL at Ultra High Field**

Emma Louise Hall[1], Penny A. Gowland[1], Susan T. Francis[1]
[1]Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

3D acquisitions are advantageous to ASL to eliminate slice dependent variation in signal. Here we show the feasibility of 3D-EPI arterial spin labelling (ASL) at 7T. Using SENSE acceleration in two directions the shot length can be significantly reduced allowing improved spatial coverage or spatial resolution to be achieved. 3D-EPI ASL is shown to benefit from increased signal-to-noise ratio and overcome SAR limits reached when using 2D-EPI ASL at 7T.Whole head (20 slice) $2x2x3mm^3$ 3D-EPI perfusion images can be acquired in 5 minutes.

11:18 ***518***. **Whole Brain Pseudo Continuous ASL at 7T Using a Single Coil for Imaging and Labeling.**

Wouter M. Teeuwisse[1], Andrew Webb[1], Matthias J.P. van Osch[1]
[1]C.J.Gorter Center, Radiology, Leiden University Medical Center, Leiden, Netherlands

In this study, whole brain pseudo continuous ASL (pCASL) is implemented at 7T, using the same RF coil for labeling and imaging. The magnitude of B0 inhomogeneities, RF penetration and f0-offsets were measured. For optimal labeling, B0 changes along the vessels were compensated by adjusting the average labeling gradient. A subject-specific frequency offset for the label pulses was calculated and implemented as was the incorporation of high dielectric material placed around the head and neck for higher B1 delivery in the neck. After implementing all of these improvements whole brain pCASL was successfully performed at 7T.

11:30 ***519***. **Optimizing the Inversion Efficiency of Pseudo-Continuous ASL Pulse Sequence Using B0 Field Map Information**

Hesamoddin Jahanian[1,2], Douglas C. Noll[1,2], Luis Hernandez-Garcia[1,2]
[1]Functional MRI Laboratory, University of Michigan, Ann Arbor, MI, United States; [2]Department of Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States

The recent introduction of pseudo-continuous inversion pulses (pCASL) has the potential to greatly facilitate the use of continuous Arterial Spin Labeling (ASL). However, field inhomogeneities, can compromise the tagging efficiency of pCASL, which causes loss in SNR and severe quantification error. We propose a method to restore the loss in labeling efficiency by correcting the phase of the RF pulses in combination with a z-shimming scheme. This will provide more robust perfusion measurements than the conventional pseudo-continuous technique. The method is demonstrated using numerical simulation and In-vivo data.

11:42 ***520***. **Robust Prescan for Pseudo-Continuous Arterial Spin Labeling at 7T: Estimation and Correction for Off-Resonance Effects**

Wen-Ming Luh[1], S Lalith Talagala[2], Peter A. Bandettini[1]
[1]FMRIF, NIMH, National Institutes of Health, Bethesda, MD, United States; [2]NMRF, NINDS, National Institutes of Health, Bethesda, MD, United States

Pseudo-continuous arterial spin labeling can provide optimal SNR efficiency with sufficient long tag at high fields such as 7T but is very sensitive to off-resonance fields at tagging location as often observed at 7T. Here we demonstrate a robust approach using pair-wise modulation of tagging frequency offset with high SNR images from large voxels and short post labeling delay to derive a necessary 'prescan' procedure for estimating and correcting off-resonance effects in 1 minute.

11:54 ***521***. **Partial Volume Correction for Perfusion Estimation from Multi-TI Arterial Spin Labelling**

Michael A. Chappell[1,2], Adrian R. Groves[1], Bradley J. MacIntosh[1,3], Manus J. Donahue[1], Peter Jezzard[1], Mark W. Woolrich[1]
[1]FMRIB Centre, University of Oxford, Oxford, United Kingdom; [2]Institute of Biomedical Engineering, University of Oxford, Oxford, United Kingdom; [3]Imaging Research, Sunnybrook Research Institute, Toronto, Canada

The partial voluming of gray matter (GM), white matter (WM) and CSF in ASL leads to underestimates of GM CBF. Here a correction strategy is proposed for multi-TI ASL as part of the kinetic curve model fitting analysis. The method exploits the differences in kinetics between GM and WM and also employs constraints based on partial volume estimates of the tissue types. The proposed method is shown to provide GM CBF estimates corrected for partial voluming while preserving details within the GM CBF image.

12:06 ***522***. **Voxel Based Perfusion Variability in ASL**

Sanna Gevers[1], Matthias J.P. van Osch[2], Jeroen Hendrikse[3], Reinoud P. Bokkers[3], Dennis Kies[2], Wouter M. Teeuwisse[2], Charles B.L.M. Majoie[1], Aart J. Nederveen[4]
[1]Radiology, Academic Medical Center Amsterdam, Amsterdam, Netherlands; [2]Radiology, Leiden University Medical Center, Netherlands; [3]Radiology, University Medical Center Utrecht, Netherlands; [4]Radiology, Academic Medical Center Amsterdam, Netherlands

Thus far, ASL variability studies have mainly focussed on intrasession and intracenter and multicenter variability of global perfusion and of perfusion in the flow territories of major brain feeding arteries. The purpose of this study was to analyze variability patterns over different brain regions performing a voxel based analysis of variance within and between imaging sessions. The results of our study show that pseudo-continuous ASL with background suppression is least variable over different brain regions whereas other ASL techniques show more variability mainly in vascular regions. Most striking per voxel variances were found in the posterior circulation for pulsed ASL and in the frontal region for continuous ASL.

12:18 ***523***. **Superselective Arterial Spin Labeling Applied for Flow Territory Mapping in Selected Clinical Cases - Advantages Over Existing Selective ASL Methods**

Michael Helle[1], Matthias van Osch[2], David Gordon Norris[3], Susanne Rüfer[1], Karsten Alfke[1], Olav Jansen[1]
[1]Institute of Neuroradiology, UK-SH, Kiel, Germany; [2]C.J. Gorter Center for high field MRI, Department of Radiology, Leiden University Medical Center, Leiden, Netherlands; [3]Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands

The ability to visualize perfusion territories in the brain is important for many clinical applications but the selectivity of existing methods is restricted to larger vessels. Superselective arterial spin labeling (ASL) is a recently developed technique that overcomes these limitations and permits labeling of small vessels even distal to the Circle of Willis. In this study, superselective ASL is applied for regional perfusion measurements in selected clinical cases (extra-intracranial bypass, arterio-venous malformation and steno-occlusive disease) showing advantages over conventional selective ASL methods and demonstrating benefits in diagnosis, risk analysis and treatment monitoring when added to current MR-protocols.

MR-Guided Clinical Interventions

Room A4 10:30-12:30 *Moderators:* Kim Butts-Pauly and Thomas Kahn

10:30 ***524***. **Wide-Bore 1.5 Tesla MR-System for Monitoring of Hepatic Radiofrequency Ablation: Initial Experience in the Treatment of 60 Metastases**

Stephan Clasen[1], Hansjörg Rempp[1], Andreas Boss[1], Christina Schraml[1], Diethard Schmidt[1], Fritz Schick[2], Claus Claussen[1], Philippe Pereira[3]
[1]Department of Diagnostic and Interventional Radiology, University of Tübingen, Tübingen, Germany; [2]Section of Experimental Radiology, University of Tübingen; [3]SLK Kliniken Heilbronn

MR-guided radiofrequency (RF) ablation using a wide-bore 1.5 Tesla MR-system was evaluated in the treatment of 60 hepatic metastases in 30 patients. Monitoring of ablation therapy was performed by using native T1w and T2w imaging. In addition MR temperature mapping by using the proton resonance frequency shift (PRF) method was applied. Complete coagulation was achieved in 58/60 (96.7%) metastases assessed during the mean follow-up of 5 months (range: 1 – 12 months). In conclusion, MR-guided RF ablation using a wide-bore 1.5 Tesla MR-system is an effective therapy in the local treatment of hepatic metastases.

10:42 ***525***. **Real-Time MR-Guided Biopsies to Target Focal Hepatic Fibrosis Detected with Magnetic Resonance Elastography**

Ryan Babu Perumpail[1], Ning Jin[1], Yi Wang[1], Victoria Lee[2], Jennifer Karp[1], Bradley D. Bolster, Jr.[3], Saurabh Shah[4], Sven Zuehlsdorff[4], Richard Ehman[5], Albert Andrew Nemcek[1], Josh Levitsky[2], Andrew Christian Larson[1], Frank Miller[1], Reed Ali Omary[1]
[1]Radiology, Northwestern University, Chicago, IL, United States; [2]Hepatology, Northwestern University, Chicago, IL, United States; [3]Siemens Healthcare, Rochester, MN, United States; [4]Siemens Healthcare, Chicago, IL, United States; [5]Radiology, Mayo Clinic, Rochester, MN, United States

Magnetic resonance elastography (MRE), a non-invasive method to quantify liver stiffness, has not been directly correlated with MR-targeted biopsy results. We tested the hypothesis that real-time MR-guided biopsies could target focal segments of liver for histopathologic correlation with MRE stiffness measurements. Our results demonstrate the feasibility of real-time MR guidance to biopsy focal liver segments for correlation of fibrosis using MRE targets. Since early-stage hepatic fibrosis can present as focal lesions, MRE can be used to target biopsies to avoid clinical understaging and delayed initiation of therapy.

10:54 ***526***. **Preliminary Clinical Results: MR-HIFU Ablation of Uterine Fibroids with Automatic Volumetric Ablation**

Charles Mougenot[1,2], Julia Enholm[3], Nora Frulio[4], Max O. Köhler[3], Hervé Trillaud[4]
[1]Philips Healthcare, Bordeaux, France; [2]IMF laboratory, Bordeaux, France; [3]Philips Healthcare, Vantaa, Finland; [4]CHU Bordeaux, St André Hospital, Bordeaux, France

High Intensity Focused Ultrasound under MR guidance is a non-invasive thermotherapy procedure used for ablation of uterine fibroids. To improve this treatment, a volumetric heating method combined with temperature control was evaluated at St. André hospital following good clinical practice and using a Philips MR-HIFU platform. Preliminary results based on 13 clinical cases indicate that large volumetric sonications increase the ablation efficiency by a ratio 35. In addition, temperature control provides a reproducible ablation size with a diameter accuracy of 1mm, which enhances treatment safety. No serious adverse events or skin burns were observed.

11:06 ***527***. **Interactive Mr-Guided Percutaneous Nephrostomy Using an Open 1T Mr-Scanner: First Experience in 15 Patients**

Frank Fischbach[1], Markus Porsch, Jürgen Bunke[2], Maciej Pech, Oliver Dudeck, Uwe-Bernd Liehr, Jens Ricke
[1]OvGU, Magdeburg, Germany, Germany; [2]PMS

The advantages of MR fluoroscopy including missing radiation, high tissue contrast, multiplanar imaging and the availability of open high field systems giving good access to the patient and sufficient SNR should encourage broadening the indications for MR-guided interventions. MR-guided percutaneous nephrostomy can be performed in a routine setting. This is especially of interest in patients not suited for sonographic guidance

11:18 ***528***. **Transrectal MRI-Guided Biopsy of the Prostate - Results in a Cohort with 100 Patients with Negative Ultrasound Guided Biopsy and Persisting or Increasing PSA Levels**

Matthias C. Roethke[1], David Schilling[2], Aristotelis G. Anastasiadis[3], Matthias P. Lichy, Arnulf Stenzl[2], Claus D. Claussen, Heinz-Peter Schlemmer[1]
[1]Diagnostic Radiology, University Hospital, Tuebingen, Germany; [2]Urology, University Hospital; [3]Urology, Grossburgwedel Hospital, Germany

Transrectal MRI-guided biopsy of the prostate in a cohort with 100 patients with prior negative ultrasound guided biopsy and persisting or increasing PSA levels. Results show detection rate of MRI-guided biopsy(49%)is considerably higher compared to standard repetition procedure with transrectal ultrasound guided biopsy (up to 26% even after saturation biopsy).

11:30 ***529***. **Preliminary Human Evaluation of MRI-Guided Transurethral Ultrasound Therapy for the Treatment of Localized Prostate Cancer**

Rajiv Chopra[1,2], Michael Bronskill[1,2], Masoom Haider[3,4], Laurence Klotz[5,6]
[1]Imaging Research, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [2]Medical Biophysics, University of Toronto, Toronto, Ontario, Canada; [3]Medical Imaging, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [4]Medical Imaging, University of Toronto, Toronto, Ontario, Canada; [5]Urology, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [6]Surgery, University of Toronto, Toronto, Ontario, Canada

MRI-guided transurethral ultrasound therapy is a minimally-invasive treatment for localized prostate cancer. The purpose of this study was to evaluate the feasibility of performing this treatment in humans. An initial clinical evaluation in prostate cancer patients destined for radical prostatectomy was performed. The predicted thermal damage zone was compared with the actual tissue damage measured on histology.

11:42 ***530***. **Online Guidance of Tumor Targeted Prostate Brachytherapy Using Histologically Referenced MRI**

Cynthia Menard[1], Peter Chung, Jessamine Abed, Anna Simeonov, Jenny Lee, Kristy Brock, Warren Foltz, Gerald O'Leary[2], Christine Elliott[3], Michael Milosevic, Robert Bristow, Gerard Morton[4], Padraig Warde, Masoom Haider
[1]Princess Margaret Hospital, University of Toronto, Toronto, Ontario, Canada; [2]Toronto General Hospital, University Health Network, Toronto, Ontario, Canada; [3]Sentinelle Medical Inc; [4]Odette Cancer Center, University of Toronto, Toronto, Ontario, Canada

We demonstrate feasibility and report technical and clinical performance of a needle navigation system where pathologically referenced multi-parametric interventional MRI guidance improved the determination of tumor boundaries, and enabled accurate tumor-targeted HDR prostate brachytherapy. The value of 3D imaging to document actual location of biopsy cores in reference to anatomic boundaries is emphasized.

11:54 ***531***. **Localizing Prostate Brachytherapy Seeds with SGM**

Gopal Varma[1], Peter Acher[2], Graeme Penney[1], Kawal Rhode[1], Stephen Keevil[1,3], Tobias Schaeffter[1]
[1]Imaging Sciences, King's College London, London, United Kingdom; [2]Department of Urology, Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom; [3]Medical Physics, Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom

Treatment by prostate brachytherapy involves implant of radioactive seeds. Dosimetry requires seed position and number to be accurately defined relative to prostate anatomy. The advantage of soft tissue contrast from MRI allows depiction of the prostate but localization of the seeds is relatively poor. A SGM technique is used to visualize the seeds by post-processing. The derived parameter is found to have a linear correlation with number of seeds and thus provides potential for dosimetry by MR.

12:06 ***532***. **Proof of Principle of an MR-Compatible Robot for MRI-Guided Interventions Using a Unique Tapping Device**

Michiel R. van den Bosch[1], Maaike R. Moman[1], Marco van Vulpen[1], Jan J. Battermann[1], Ed Duiveman[2], Leonard J. van Schelven[2], Jan J.W Lagendijk[1], Marinus A. Moerland[1]
[1]Department of Radiotherapy, University Medical Center Utrecht, Utrecht, Netherlands; [2]Medical Technology & Clinical Physics, University Medical Center Utrecht, Utrecht, Netherlands

This in-vivo study demonstrates the proof of principle of an MR-compatible robot dedicated for MRI-guided interventions. The robot can be placed between patient's legs inside a 1.5T closed bore scanner for transperineal needle insertion. To minimize tissue deformation, it contains a tapping device to automatically tap (rather than push) the needle towards the target position. Four fiducial gold markers were placed into the prostate of a patient with a stage T3 prostate cancer under MRI-guidance using fast MR sequences. This opens the door for MRI-guided interventions as biopsy and brachytherapy in tissue, where deformation might be problematic.

12:18 ***533***. **MR-Compatible Transrectal Prostate Biopsy Robot: A Feasibility Study**

Jurgen Futterer[1], Martijn Schouten[1], Tom Scheenen[2], Jelle Barentsz[3]
[1]Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; [2]Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; [3]Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands

The meet the demand of a better sensitivity in MR-guided biopsy of the prostate the robotic system can be employed. We introduce the in-house developed pneumatic actuated MR-compatible robot where needle guide direction can be controlled inside the controller room. Feasibility and accuracy of the MR-compatible robot were validated with phantom measurements.

MR Techniques for Evaluation of Intervertebral Disc & Bone

Room A5 10:30-12:30 *Moderators:* Won Bae and Thomas M. Link

10:30 ***534***. **Ultrashort Time-To-Echo MRI of Human Intervertebral Disc Endplate: Association with Disc Degeneration**

Won C. Bae[1], Tomoaki Yoshikawa[2], Richard Znamirowski[1], Aseem R. Hemmad[2], Bruno C. Vande Berg[3], Christine B. Chung[1], Koichi Masuda[2], Graeme M. Bydder[1]
[1]Radiology, University of California, San Diego, San Diego, CA, United States; [2]Orthopaedic Surgery, University of California, San Diego, San Diego, CA, United States; [3]Radiology, Cliniques Universitaires St Luc, Université Catholique de Louvain, Brussels, Belgium

UTE MR image of human lumbar spine reveals distinct linear signal near disc endplates, unlike signal voids seen in conventional MR images. Normal and abnormal (loss and diminution) patterns of UTE signal were evaluated in 29 lumbar spines at different levels. In addition, disc degeneration was evaluated in

T2-weighted spin echo images using Pfirrmann grading system. UTE signal abnormality did not depend on the level, but was increasingly found in levels with advanced disc degeneration. The present results demonstrated unique ability of UTE MRI to directly evaluate region near endplate, and association between endplate MR changes with disc degeneration.

10:42 ***535***. **Quantitative Comparison of T1ρ with T2 in Intervertebral Disc in Vivo at 3T**

Queenie Chan[1,2], Mina Kim[2], Marina-Portia Anthony[2], Kenneth MC Cheung[3], Aaron Chan[2], Tao Chan[2], Pek-Lan Khong[2]
[1]Philips Healthcare, Hong Kong, China; [2]Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, China; [3]Division of Spine Surgery, Department of Orthopaedics and Traumatology, Faculty of Medicine, The University of Hong Kong, Hong Kong, China

Diagnostic techniques based on conventional T2-weighted images are commonly used for disc degeneration but are subjective and not sensitive to subtle changes in the intervertebral discs (IVDs). Therefore, quantitative assessment would play an important role in greatly improving the evaluation of disc degeneration. In this study, we performed quantitative T1ρ and T2 measurements in human lumbar IVDs. Our results suggest that different degenerative-related changes taking place in between the central nucleus pulposus and the outer annulus fibrosus can be quantitatively assessed using T1ρ and T2 mapping which may provide complementary information to better understand pathophysiological mechanisms in disc degeneration.

10:54 ***536***. **T1ρ MRI and Discography Opening Pressure Are Quantitative Biomarkers of Disc Degeneration in Vivo**

Matthew Fenty[1], Chenyang Wang[1], Walter RT Witschey[1], Rachelle Berger[1], Philip Maurer[2], Dawn M. Elliott[3], Ravinder Reddy[1], Ari Borthakur[1]
[1]CMROI, Department of Radiology, University of Pennsylvania School of Medicine, Philadelphia, PA, United States; [2]3B Orthopaedics, Philadelphia, PA, United States; [3]Department of Orthopaedic Surgery, University of Pennsylvania School of Medicine, Philadelphia, PA, United States

The objective of this study is to evaluate T1ρ MRI as quantitative biomarker of disc degeneration in patients being treated for Lower Back Pain (LBP) by comparing it to invasive discography opening pressure. A significant and strong correlation exists between non-invasive MRI T1ρ values and in vivo opening pressure measurements. T1ρ is a quantitative measure of degeneration that is consistent across both control subjects and LBP patients.

11:06 ***537***. **Short Time T2 Variability of the Lumbar Intervertebral Disc – in Vivo MRI Study at 3 Tesla**

David Stelzeneder[1], Sabine Goed[1], Götz Hannes Welsch[1,2], Clemens Hirschfeld[1], Tatjana Paternostro-Sluga[3], Karin Pieber[3], Klaus Friedrich[1], Michael Reisegger[1], Tallal Charles Mamisch[4], Siegfried Trattnig[1]
[1]Department of Radiology, MR Centre, Medical University of Vienna, Vienna, Austria; [2]Department of Trauma Surgery, University of Erlangen, Erlangen, Germany; [3]Department of Physical Medicine and Rehabilitation, Medical University of Vienna, Vienna, Austria; [4]Department of Orthopedic Surgery, University of Bern, Inselspital, Bern, Switzerland

The purpose of our study was to evaluate the short-time variability of T2 relaxation time values in the supine position in different compartments of the lumbar intervertebral disc. We performed a segmental analysis of two serial T2 mapping sequences obtained with a delay of 40 minutes. There was a significant T2 decrease in the anterior nucleus and an increase in the posterior annulus region. The data can be interpreted as a water shift from the anterior to the posterior compartments of the intervertebral disc, what can be a result of supine position with slight hip flexion.

11:18 ***538***. **Quantitative Evaluation of Diffusion Tensor Imaging at 3T in Human Lumbar Intervertebral Disc Degeneration**

Queenie Chan[1,2], Marina-Portia Anthony[2], Zhongping Zhang[2], Kenneth MC Cheung[3], Mina Kim[2]
[1]Philips Healthcare, Hong Kong, China; [2]Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, China; [3]Division of Spine Surgery, Department of Orthopaedics and Traumatology, Faculty of Medicine, The University of Hong Kong, Hong Kong, China

Detecting early stages of disc degeneration is a major challenge in degenerative disc disease (DDD) as current diagnostic techniques are not sensitive or completely objective. Therefore, a quantitative assessment of disc degeneration would significantly improve the evaluation of DDD. In this study, we examined diffusion tensor imaging (DTI) in human lumbar intervertebral discs (IVDs) to investigate changes in tissue microstructure. Our results show that fractional anisotropy can quantitatively assess 1) structural difference between a nucleus pulposus and an annulus fibrosus and 2) degenerative changes in IVDs, suggesting DTI may be a potential biomarker for DDD.

11:30 ***539***. **Assessment of Glycosaminoglycan Distribution in Human Lumbar Intervertebral Discs Using Chemical Exchange Saturation Transfer**

Mina Kim[1], Queenie Chan[2], Marina-Portia Anthony[1], Kenneth MC Cheung[3], Dino Samartzis[3], Tao Chan[1], Pek-Lan Khong[1]
[1]Department of Diagnostic Radiology, The University of Hong Kong, Pokfulam, Hong Kong, China; [2]Philips Healthcare, Hong Kong; [3]Division of Spine Surgery, Department of Orthopaedics and Traumatology, The University of Hong Kong, Hong Kong

Detecting early disc degeneration is of vital importance in order to identify subjects that are suitable for treatment. However, current diagnostic techniques are not sensitive to the early stages of intervertebral disc (IVD) degeneration, which involves the loss of proteoglycans. Recently, it has been suggested that glycosaminoglycan content can be quantified by chemical exchange saturation transfer (gagCEST). In the present work, we conducted gagCEST imaging for IVDs of human volunteers. Our results show that in vivo gagCEST quantification is feasible at 3 Tesla and may potentially be a useful clinical tool in identifying early degenerative changes in the human IVDs.

11:42 ***540***. **Ultra-Short Echo-Time (UTE) Imaging Based Estimation of Cortical Bone Stiffness**

Chamith S. Rajapakse[1], Hamidreza Saligheh Rad[1], Shing Chun Benny Lam[1], James Love[1], Jeremy F. Magland[1], Felix W. Wehrli[1]
[1]University of Pennsylvania School of Medicine, Philadelphia, PA, United States

It is well known that intracortical remodeling occurs resulting in increased porosity with advancing age and impaired strength. UTE MRI now offers the potential to estimate true bone tissue fraction as 1-BWF where BWF is bone water fraction. Here, we investigated the feasibility of estimating cortical bone stiffness in healthy volunteers using micro-finite-element analysis on the basis of BWF maps derived from UTE imaging. The preliminary results suggest

that the incorporation of BWF to the FE analysis can enhance the assessment of mechanical competence of cortical bone in vivo compared to the mechanical and structural measures derived from conventional imaging.

11:54 ***541***. **Correlation of ^{1}H NMR Characteristics and Mechanical Properties in Human Cortical Bone**

R. Adam Horch[1,2], Jeffery S. Nyman[3,4], Dan F. Gochberg[1,5], Mark D. Does[1,2]
[1]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States; [2]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States; [3]VA Tennessee Valley Healthcare System, Vanderbilt University, Nashville, TN, United States; [4]Orthopaedics & Rehabilitation Medicine, Vanderbilt University, Nashville, TN, United States; [5]Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States

The complex ^{1}H NMR behavior of human cortical bone can be attributed to distinct microanatomical proton environments in the bone matrix and pore spaces. Herein, the multiexponential ^{1}H transverse relaxation of human cortical bone was studied in conjunction with numerous mechanical properties relevant to overall bone integrity. Numerous NMR-mechanical correlations were observed, indicating links between cortical bone proton pools and bone health. These correlations allow bone mechanical properties to be predicted from NMR measurements and provide a contrast mechanism that MRI protocols could exploit as a novel bone health diagnostic.

12:06 ***542***. **Bone Water Concentration as a New Metric for Cortical Bone Quality**

Hamidreza Saligheh Rad[1], James Love[1], Jeremy F. Magland[1], Mary F. Leonard[2], Felix W. Wehrli[1]
[1]Laboratory for Structural NMR Imaging, Department of Radiology, University of Pennsylvania Health System, Philadelphia, PA, United States; [2]Nephrology, Children's Hospital of Philadelphia, Philadelphia, PA, United States

Increased porosity is a major cause of impaired strength of cortical bone. Ultra-short TE MRI has been shown to be able to quantify bone water, which is either collagen-bound or residing in the pores of the Haversian and lacuno-canalicular system. In this preliminary work we compare bone water concentration (BWC) in the tibial mid-shaft in a group of subjects with 3D bone mineral density (BMD) at the same location as well as areal BMD at the hip and spine. BWC is found to be inversely related to BMD at all sites and increasing with age.

12:18 ***543***. **SWIFT Versus X-Ray in Dental Imaging**

Djaudat Idiyatullin[1], Curt Corum[1], Steen Moeller[1], Hari S. Prasad[2], Michael Garwood[1], Donald R. Nixdorf[3]
[1]CMRR, University of Minnesota, Minneapolis, MN, United States; [2]Division of Oral Pathology in the Department of Diagnostic & Biological Sciences, University of Minnesota, Minneapolis, MN, United States; [3]Division of TMD & Orofacial Pain and Department of Neurology, University of Minnesota, Minneapolis, MN, United States

A comprehensive comparison of the traditional X-ray imaging modality versus to a novel magnetic resonance imaging (MRI) technique, called SWeep Imaging with Fourier Transform (SWIFT) in dental application (in-vitro) is presented. It is shown that the distinctive feature of SWIFT images is the visualization of the morphology of densely mineralized enamel and dentin simultaneous with dental caries and neurovascular architecture in the pulp. Additionally, fine structures that are normally difficult to detect with radiographs, such as cracks within the tooth and accessory canals can be identified in scanning time relevant for in-vivo applications. All conclusions supported with histology of teeth.

Parallel Imaging: Stretching the Limit

Room A6 10:30-12:30 *Moderators:* Ricardo Otazo and Jeffery Tsao

10:30 ***544***. **Fast MR Parameter Mapping Using K-T PCA**

Frederike Hermi Petzschner[1,2], Irene Paola Garcia Ponce[3], Martin Blaimer[4], Peter M. Jakob[3], Felix A. Breuer[4]
[1]Ludwig-Maximilians University, Institute of Clinical Neurosciences, Munich, Bavaria, Germany; [2]Bernstein Center for Computational Neurosciences, Munich, Germany, Germany; [3]University of Würzburg, Experimental Physics 5, Germany; [4]Research Center Magnetic Resonance Bavaria, Germany

In this work, k-t PCA is demonstrated to be a promising acceleration technique for MR relaxation measurements, since the dynamics along the relaxation curve can be described by only a small number of principal components. In-vivo IR-TrueFISP experiments for quantitative T1, T2 & M0 parameter mapping acquired with up to 8-fold acceleration by using the k-t PCA concept are presented.

10:42 ***545***. **k-T Group Sparse Reconstruction Method for Dynamic Compressed MRI**

Muhammad Usman[1], Claudia Prieto[1], Tobias Schaeffter[1], Philip G. Batchelor[1]
[1]King's College London, London, United Kingdom

Up to now, besides sparsity, the standard compressed sensing methods used in MR do not exploit any other prior information about the underlying signal. In general, the MR data in its sparse representation always exhibits some structure. As an example, for dynamic cardiac MR data, the signal support in its sparse representation (x-f space) is always in compact form. In this work, exploiting the structural properties of sparse representation, we propose a new formulation titled 'k-t group sparse compressed sensing'. This formulation introduces a constraint that forces a group structure in sparse representation of the reconstructed signal. The k-t group sparse reconstruction achieves much higher temporal and spatial resolution than the standard L1 method at high acceleration factors (9-fold acceleration).

10:54 ***546***. **Parallel Imaging Technique Using Localized Gradients (PatLoc) Reconstruction Using Compressed Sensing (CS)**

Fa-Hsuan Lin[1], Panu Vesanen[2], Thomas Witzel, Risto Ilmoniemi, Juergen Hennig[3]
[1]A. A. Martinos Center, Charlestown, MA, United States; [2]Helsinki University of Technology, Helsinki, Finland; [3]University Hospital Freiburg, Freiburg, Germany

The parallel imaging technique using localized gradients (PatLoc) system has the degree of freedom to encode spatial information using multiple surface gradient coils. Previous PatLoc reconstructions focused on acquisitions at moderate accelerations. Compressed sensing (CS) is the emerging theory to achieve imaging acceleration beyond the Nyquist limit if the image has a sparse representation and the data can be acquired randomly and reconstructed

nonlinearly. Here we apply CS to PatLoc image reconstruction to achieve further accelerated image reconstruction. Specifically, we compare the reconstructions between PatLoc and traditional linear gradient systems at acceleration rates in an under-determined system.

11:06 ***547***. **Designing K-Space Trajectories for Simultaneous Encoding with Linear and PatLoc Gradients**

Daniel Gallichan[1], Gerrit Schultz[1], Jürgen Hennig[1], Maxim Zaitsev[1]
[1]University Hospital Freiburg, Freiburg, Germany

Recent work has shown that MR imaging can be performed using non-linear encoding gradients (PatLoc). Here we investigate the possibilities of combining non-linear encoding gradients with simultaneous use of the conventional linear gradients. We introduce the concept of a 'local k-space' to compare trajectories, as well as presenting a combination of a split-radial 4D trajectory which is able to exploit the advantages of varying spatial resolution across the FoV whilst retaining control over the resolution in the centre.

11:18 ***548***. **A Time-Efficient Sub-Sampling Strategy to Homogenise Resolution in PatLoc Imaging**

Hans Weber[1], Daniel Gallichan[1], Gerrit Schultz[1], Jürgen Hennig[1], Maxim Zaitsev[1]
[1]University Hospital Freiburg, Dept. of Diagnostic Radiology, Medical Physics, Freiburg, Germany

Varying spatial resolution is one of the characteristic properties of MR imaging when using nonlinear gradient fields for spatial encoding, as realised by PatLoc. In the particular configuration of two orthogonal quadrupolar encoding fields, voxel size is inversely proportional to the distance to the FOV centre. In this work we present an iterative reconstruction method for sub-sampled PatLoc data that improves the local resolution at the centre and leads to shorter scan times for equivalent central resolution recovery. The method is demonstrated on simulated and experimentally acquired data.

11:30 ***549***. **An Assessment of O-Space Imaging Robustness to Local Field Inhomogeneities**

Jason P. Stockmann[1], R Todd Constable[2]
[1]Biomedical Engineering, Yale University, New Haven, CT, United States; [2]Diagnostic Radiology, Neurosurgery, and Biomedical Engineering, Yale University, New Haven, CT, United States

O-Space imaging permits highly-accelerated acquisitions using non-linear gradients to extract extra spatial encoding from surface coil profiles as compared with linear gradients. For accurate reconstruction to occur, however, the curvilinear frequency contours created by the gradients must intersect one another at the appropriate locations, making the technique potentially vulnerable to local field inhomogeneity, such as the susceptibility gradients arising in the head near the sinuses. This work shows that with appropriate regularization, O-Space imaging is robust to typical levels of field inhomogeneity. Field inhomogeneity is shown to manifest itself as noise-like artifacts throughout the FOV rather than gross geometric distortion.

11:42 ***550***. **Highly Accelerated Multislice Parallel Imaging: Cartesian Vs Radial**

Stephen R. Yutzy[1], Nicole Seiberlich[2], Jeffrey L. Duerk[1,2], Mark A. Griswold[2]
[1]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States; [2]Radiology, University Hospitals of Cleveland and Case Western Reserve University, Cleveland, OH, United States

Multiband imaging allows for multiple simultaneously acquired slices, thus giving an SNR benefit over conventional slice selection without potential artifacts from secondary phase encoding. While methods have been shown that can separate the slides using parallel imaging for Cartesian trajectories, these methods are not compatible with non-Cartesian sampling. Here we demonstrate the possibility of reconstructing two simultaneously acquired radial slices using an acquisition/reconstruction method known as radial CAIPIRINHA. We show that this method is capable of higher accelerations than possible with comparable Cartesian trajectories.

11:54 ***551***. **Blipped CAIPIRHINA for Simultaneous Multi-Slice EPI with Reduced G-Factor Penalty**

Kawin Setsompop[1,2], B A. Gagoski[3], J Polimeni[1,2], T Witzel[1], V J. Wedeen[1,2], L L. Wald[1,2]
[1]Radiology, A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States; [2]Harvard Medical School, Boston, MA, United States; [3]EECS, Massachusetts Institute of Technology, Cambridge, MA, United States

The acquisition of simultaneous slices in EPI has the potential to increase the temporal sampling rate of fMRI or the number of diffusion directions obtained per unit time in diffusion imaging. In this work, we introduced a blipped CAIPIRINHA technique applicable to EPI acquisition and demonstrated its associated low g-factor penalty and 3x acceleration of the slices per second of acquisition. 3x slice-accelerated SE-EPI was acquired with retain SNR of close to unity. The 3x blipped CAIPIRINHA was also combined with 2x Simultaneous Image Refocusing (SIR) acquisition to create 6 simultaneous multi-slice GE-EPI acquisition with low g-factor penalty.

12:06 ***552***. **SNR Quantification with Phased-Array Coils and Parallel Imaging for 3D-FSE**

Charles Qingchuan Li[1], Weitian Chen[2], Philip J. Beatty[2], Anja C. Brau[2], Brian A. Hargreaves[1], Reed F. Busse[3], Garry E. Gold[1]
[1]Radiology, Stanford University, Stanford, CA, United States; [2]Global Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [3]Global Applied Science Laboratory, GE Healthcare, Madison, WI, United States

Current clinical MRI techniques often employ parallel imaging, partial Fourier and multicoil acquisition to decrease scan time while maintaining image quality. To aid in image quality assessment, image noise statistics can be measured by reconstructing noise-only acquisitions through an identical linear pipeline as signal data, which may involve signal data-dependent steps such as parallel imaging, partial Fourier homodyne and multichannel reconstructions. In this study it was shown that SNR and CNR measurements performed in 146 clinical knee MRIs using this quantification method significantly differ from the measurements obtained using the traditional foreground and background volume of interest approach.

12:18 ***553***. **A Mathematical Model Toward Quantitative Assessment of Parallel Imaging Reconstruction**

Yu Li[1], Feng Huang[1], Wei Lin[1], Arne Reykowski[1]
[1]Advanced Concept Development, Invivo Diagnostic Imaging, Gainesville, FL, United States

In this work, we propose a mathematical model that gives explicit representations for three different types of errors in parallel imaging reconstruction. These errors have different patterns in image space and affect the image quality in different fashions. This model offers a tool to extensively investigate how to quantitatively assess imaging quality beyond signal to noise ratio. Based on the proposed model, practical reconstruction techniques can be developed to suppress three types of errors to different degrees for improved overall imaging performance.

Advances in Liver MRI & New Contrast Media

Room A7 10:30-12:30 *Moderators:* Daniel T. Boll and Bachir Taouli

10:30 **Introduction**
Scott B. Reeder

10:54 ***554*. Hepatic MR Imaging for Differentiation of Biopsy-Proven Steatosis, Iron Deposition, and Combined Disease: One-Dimensional in / Opposed Phase Analysis Vs. Two-Dimensional Computer-Aided Dixon Discrimination**
Mustafa Rifaat Bashir[1], Elmar Max Merkle[1], Daniel Tobias Boll[1]
[1]Radiology, Duke University Medical Center, Durham, NC, United States

Steatosis hepatis functions as an inducer of hepatic iron metabolism dysregulation. MR two-point Dixon T1w imaging with subsequent comprehensive four-phase decomposition analysis facilitated not only metabolite decomposition of intrahepatic lipids and iron ions in steatosis hepatis and hepatic iron overload, but also allowed decomposition of metabolites in combined disease in an in-vivo patient population employing manual as well as computer-aided two-dimensional metabolite discrimination algorithms, with liver biopsy functioning as reference standard.

11:06 ***555*. Simultaneous Measurement of Hepatic Lipid and Iron with High-Speed T2-Corrected Single-Voxel Spectroscopy (HISTO): Analysis of Water-Lipid Compartments**
Puneet Sharma[1], Hiroumi D. Kitajima[1], Khalil N. Salman[2], Bobby Kalb[3], Diego R. Martin[3]
[1]Radiology, Emory Healthcare, Atlanta, GA, United States; [2]Radiology, Emory University, Atlanta, GA, United States; [3]Radiology, Emory University School of Medicine, Atlanta, GA, United States

This investigation analyzes use of a fast T2-corrected MRS method (HISTO) for the simultaneous measurement of hepatic lipid and iron. The multi-echo acquisition allows correction of lipid fraction, while providing R2 measures of water and lipid separately. HISTO was performed in lipid phantoms with variable iron content, and in 3 patients with induced iron susceptibility. It was found that R2-water exhibited strong correlation with iron amount, while R2-lipid showed no dependence, suggesting compartmental division of iron effects. Since imaging evaluates bulk R2*, correlation with iron may be influenced by lipid content. HISTO isolates R2-water and R2-lipid for robust iron assessment.

11:18 ***556*. Preliminary Clinical Experience with a Multiecho 2-Point DIXON (MDIXON) Sequence at 3T as an Efficient Alternative for Both the SAR-Intensive Acquired In- And Out-Of-Phase Chemical Shift Imaging as Well as for 3D Fat-Suppressed T1-Weighted Sequences Used**
Thomas G. Perkins[1], Jeremy L. Van Tilburg[2], Gwenael Herigault[3], Holger Eggers[4], Adri Duijndam[3], Gabriele Beck[3], Shahid M. Hussain,[2,5]
[1]Philips Healthcare, Cleveland, OH, United States; [2]The Nebraska Medical Center, Omaha, NE, United States; [3]Philips Healthcare, Best, Netherlands; [4]Philips Research, Hamburg, Germany; [5]The University of Nebraska Medical Center, Omaha, NE, United States

Body MRI protocols at 3T are often lengthy due to decreased duty cycle, high SAR, and general inefficiencies of the sequences used. This study (n=22) assessed a new sequence, 2-point mDIXON (mDIXON), which, like the original DIXON, can provide in-phase (IP), out-of-phase (OP), water, and fat images with increased duty cycle and better image quality compared to existing methods. New mDIXON is a more efficient alternative and can replace the existing 2D IP and OP as well as gadolinium-enhanced 3D T1-weighted (eTHRIVE) sequences. The new strategy based on mDIXON will lead to much shorter body MRI exam times at 3T.

11:30 ***557*. Is There an Effect of Gd-EOB-DTPA on Hepatic T2 Signal Intensity and Apparent Diffusion Coefficient?**
Hersh Chandarana[1], Ely Felker[1], Bachir Taouli[1,2]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States; [2]Radiology, Mount Sinai Medical Center, New York, NY, United States

Gd-EOB-DTPA is recently FDA approved liver-specific contrast agent which has shown potential in liver lesion detection and characterization when delayed (~ 20 min.) post-contrast imaging is performed. However, extending imaging protocol by 20 minutes is not convenient. One approach to decrease imaging time is to perform T2 (T2WI) and diffusion imaging (DWI) after contrast injection between equilibrium and delayed phases of enhancement. In this study, we evaluated effect of Gd-EOB-DTPA on liver and lesion signal intensity on T2WI and DWI and demonstrated minimal effect on liver T2 SI, and no significant change on liver and lesion apparent diffusion coefficient (ADC).

11:42 ***558*. Gd-EOB-DTPA-Enhanced MRI in Cirrhotic Liver in Rats; with Reference to Transporter Activity and Morphological Change of Bile Canaliculi**
Natsuko Tsuda[1], Osamu Matsui[2]
[1]Bayer Yakuhin, Ltd, Osaka, Japan; [2]Kanazawa University Graduate School of Medical Science, Kanazawa, Japan

The purpose of this study was to analyze the difference of signal intensity on Gd-EOB-DTPA-enhanced MRI between normal and cirrhotic livers in rats in correlation with the expressions of the transporters of Gd-EOB-DTPA and the morphopathological change of bile canaliculi and to discuss the possible mechanisms of the signal profile of Gd-EOB-DTPA-enhanced MRI in cirrhotic livers. As a result, it was found that liver cirrhosis would interfere with the uptake of Gd-EOB-DTPA mediated by oatp1 and promote the elimination of Gd-EOB-DTPA mediated by mrp2. Therefore, the combination of oatp1 down-regulation and mrp2 up-regulation would lead to significant signal loss on Gd-EOB-DTPA-enhanced MRI. In addition to the up-regulation of mrp2, the morphological change in bile canaliculi and microvilli would have an impact on Gd-EOB-DTPA elimination.

11:54 ***559***. **Lesion Detectability on T2-Weighted Liver Imaging with Parallel RF Transmission at 3.0 Tesla: Intraindividual Comparison with Conventional MR Imaging.**

Guido Matthias Kukuk[1], Juergen Gieseke[1,2], Sebastian Weber[1], Frank Traeber[1], Jan Ullrich[1], Nuschin Morakkabati-Spitz[1], Daniel Thomas[1], Hans Heinz Schild[1], Winfried Albert Willinek[1]

[1]Department of Radiology, University of Bonn, Bonn, NRW, Germany; [2]Philips Healthcare, Best, Netherlands

High field MRI has introduced new challenges especially for body imaging with respect to B1 field non-uniformities. Parallel RF transmission allows for more homogeneous excitation, thus improving image quality especially for T2-weighted liver imaging at 3.0 Tesla. Therefore, we evaluated 52 patients in an intraindividual study design to determine the effect of parallel RF transmission on lesion detectability for T2-weighted imaging as compared to conventional MR imaging. Our data demonstrate a significantly higher detection rate of focal liver lesions using parallel RF transmission.

12:06 ***560***. **Respiratory Self-Gating for Free-Breathing Abdominal R2* Mapping**

Ning Jin[1], Andrew C. Larson[1,2]

[1]Departments of Radiology and Biomedical Engineering, Northwestern University, Chicago, IL, United States; [2]Robert H. Lurie Comprehensive Cancer Center, Chicago, IL, United States

Accurate R2* measurements are critical for a wide range of applications. Abdominal R2* mapping requires breath-holding (BH) to avoid respiratory motion artifacts. However, overall spatial resolution and slice coverage is limited by the requisite BH duration. We developed a respiratory self-gated (RSG) imaging strategy for free-breathing abdominal R2* mapping. The purpose of our study was to compare conventional BH R2* measurements to FB RSG R2* measurements in the liver and kidneys. 3D RSG-mGRE effectively reduced respiratory motion induced artifacts and produced accurate FB R2* maps in the liver and kidneys.

12:18 ***561***. **Hemodynamics of Portal Hypertension with 4D Radial Phase Contrast Imaging: Feasibility at 3.0T**

Rakhee Wadhwa Verma[1], Kevin Johnson[2], Benjamin Landgraf[1], Alex Frydrychowicz[1], Christopher J. Francois[1], Oliver Wieben, [1,2], Scott B. Reeder[1,2]

[1]Radiology, University of Wisconsin-Madison, Madison, WI, United States; [2]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States

Portal hypertension (PHTN) is a secondary complication in patients with cirrhosis and is associated significant morbidity, including varices and variceal bleeding, ascites, and portal venous thrombosis. The purpose of this study is to demonstrate the feasibility of high spatial resolution time resolved 3D radial phase contrast (PC) for evaluation of the hemodynamics of PHTN using a 32-channel phased array coil at 3.0T. The feasibility of comprehensive evaluation of the hemodynamics of PHTN is demonstrated in patients with cirrhosis.

Hyperpolarized Carbon-13 MR

Rooom A8 10:30-12:30 *Moderators:* Ferdia A. Gallaher and Sarah J. Nelson

10:30 ***562***. ***In Vivo* Pyruvate Dehydrogenase Flux Measured by Hyperpolarized Magnetic Resonance Correlates with *ex Vivo* Pyruvate Dehydrogenase Activity**

Michael Samuel Dodd[1,2], Helen J. Atherton[1], Marie A. Schroeder[1], Lisa C. Heather[1], Lowri E. Cochlin[1], Kieran Clarke[1], George K. Radda[1], Damian J. Tyler[1]

[1]Department of Physiology, Anatomy and Genetics, Oxford University, Oxford, Oxfordshire, United Kingdom; [2]Department of Cardiovascular Medicine, Oxford University, Oxford, Oxfordshire, United Kingdom

The recent advent of hyperpolarized ^{13}C-MRS has opened a new window on *in vivo* cardiac metabolism. The use of hyperpolarized [1-^{13}C]pyruvate has previously been shown to provide an *in vivo* measure of pyruvate dehydrogenase (PDH) flux, which directly correlates with disease severity. The aim of this work was to compare *in vivo* measurements of PDH flux with *ex vivo* measurements of PDH enzymatic activity. Using well established mechanisms for modulating PDH activity, we have shown that *in vivo* PDH flux, as measured by hyperpolarized ^{13}C MRS, significantly correlates with *ex vivo* PDH activity, as measured by well established biochemical assay.

10:42 ***563***. **Dynamic Interleaved Imaging of Hyperpolarized Metabolites for Lactate Dehydrogenase Kinetics**

Kevin Kai-Chi Leung[1,2], Albert Pofu Chen[3], Wilfred W. Lam[1], Angus Zoen Lau[1,2], Charles H. Cunningham[1,2]

[1]Imaging Research, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [2]Medical Biophysics, University of Toronto, Toronto, Ontario, Canada; [3]GE Healthcare, Toronto, Ontario, Canada

This abstract describes the use of spectral-spatial RF pulses and rapid flyback echo planar encoding techniques to acquire 13C images of pyruvate and lactate at high spatial and temporal resolution, upon the injection of hyperpolarized [1-13C]pyruvate into in vitro lactate dehydrogenase enzyme mixture and in vivo rat model. The comparable pyruvate-to-lactate conversion time course and fit to a two-pool kinetic model obtained with dynamic imaging and MR spectroscopy demonstrate the feasibility of mapping first order enzymatic conversion rates in heterogeneous tumors and tissue types non-invasively with hyperpolarized 13C MR imaging.

10:54 ***564***. **Hyperpolarized ^{13}C MR Spectroscopic Imaging of Disease State in a Switchable MYC-Oncogene Model of Liver Cancer**

Simon Hu[1], Asha Balakrishnan[2], Robert Bok[1], Peder E. Larson[1], Sarah J. Nelson[1], John Kurhanewicz[1], Andrei Goga[2], Daniel B. Vigneron[1]
[1]Dept. of Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States; [2]Dept. of Medicine, Division of Hematology/Oncology, University of California, San Francisco, San Francisco, CA, United States

Development of hyperpolarized technology utilizing dynamic nuclear polarization has enabled the monitoring of ^{13}C metabolites *in vivo* at very high SNR. In this work, hyperpolarized ^{13}C 3D-MRSI was used to measure liver metabolism in mice after expression of the MYC proto-oncogene was switched on and then off in the liver. Mice in various disease stages were studied, and significant differences in hyperpolarized lactate and alanine levels were detected ($P < 0.01$). In addition, biochemical assays showed increased LDH expression and activity in the MYC-driven tumors.

11:06 ***565***. **Hyperpolarized [1-^{13}C]pyruvate and [1,4-^{13}C]fumarate Magnetic Resonance Spectroscopy Can Detect Response to the Vascular Disrupting Agent, Combretastatin-A4-Phosphate**

Sarah E. Bohndiek[1,2], Mikko I. Kettunen[1,2], De-en Hu[1,2], Timothy H. Witney[1,2], Ferdia A. Gallagher[1,2], Kevin M. Brindle[1,2]
[1]Department of Biochemistry, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [2]Cancer Research UK Cambridge Research Institute, Cambridge, Cambridgeshire, United Kingdom

Hyperpolarization dramatically increases the sensitivity of the 13C magnetic resonance experiment, allowing the uptake and metabolism of hyperpolarized substrates to be followed in vivo. Vascular disrupting agents target the proliferating endothelial cells in tumour vasculature, so rarely cause tumour shrinkage. Our aim was to assess whether hyperpolarized [1-13C]pyruvate and [1,4-13C]fumarate magnetic resonance spectroscopy could detect response to treatment with Combretastatin-A4-Phosphate within 24 hours of treatment and to compare these methods with data obtained by Dynamic Contrast Enhanced MRI (using Gd-DTPA) and Diffusion Weighted Imaging.

11:18 ***566***. **Imaging of Elevated Branched Chain Amino Acid Metabolism in Tumors with Hyperpolarized ^{13}C Ketoisocaproate**

Magnus Karlsson[1,2], Pernille Rose Jensen[1,2], Rene in 't Zandt[1,3], Georg Hansson[1], Anna Gisselsson[1,3], Jensen Duus[4], Sebastian Meier[4], Mathilde Hauge Lerche[1,2]
[1]Imagnia AB, Malmoe, Sweden; [2]Albeda Research Aps, Valby, Denmark; [3]Eijdo Research AB, Malmoe, Sweden; [4]Carslberg Research Center, Valby, Denmark

Hyperpolarized ^{13}C magnetic resonance (MR) spectroscopy has in many cases the potential to deliver the sensitivity and detailed spectral information to report on the chemical fate of tracer molecules in different tissues. In a preclinical study we here show that á-ketoisocaproic acid (KIC) can be used to assess molecular signatures of tumors using hyperpolarized MR spectroscopy. KIC is metabolized to leucine by the enzyme branched-chain aminotransferase (BCAT), which is a putative marker for metastasis and a target of the proto-oncogene *c-myc*.

11:30 ***567***. **Imaging of Blood Flow Using Hyperpolarized ^{13}C-Urea in Preclinical Murine Models**

Cornelius von Morze[1], Peder E. Larson[1], Simon Hu[1], Kayvan Keshari[1], David M. Wilson[1], Jan Henrik Ardenkjaer-Larsen[2], John Kurhanewicz[1], Daniel B. Vigneron[1]
[1]Department of Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States; [2]GE Healthcare, Hillerød, Denmark

We demonstrate regional imaging of blood flow in preclinical murine models with hyperpolarized (DNP) ^{13}C-urea. A bSSFP pulse sequence was developed, with progressively increasing flip angles for efficient sampling of the hyperpolarized magnetization. This allowed temporal and volumetric imaging at a spatial resolution of 2.5mm x 2.5mm x 8mm with a time resolution of 6 s. Regional signal dynamics were quantified, and estimates of relative blood flow to the kidneys and the liver were made. Differences were observed in blood flow patterns to normal and cancerous hepatic tissues. The blood flow maps were compared to results of metabolic maps of 1-^{13}C-pyruvate.

11:42 ***568***. **Detecting Response to Treatment in Human Breast Adenocarcinoma Using a Co-Administration of Hyperpolarized [1-^{13}C]pyruvate and [1,4-$^{13}C_2$]fumarate**

Timothy H. Witney[1,2], Mikko I. Kettunen[1,2], De-en Hu[1,2], Ferdia A. Gallagher[1,2], Kevin M. Brindle[1,2]
[1]Department of Biochemistry, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [2]Cancer Research UK Cambridge Research Institute, Cambridge, Cambridgeshire, United Kingdom

In the current study, we used a co-administration of hyperpolarized [1-^{13}C]pyruvate and [1,4-$^{13}C_2$]fumarate as a sensitive marker of cell death in a model of human breast adenocarcinoma following treatment with a DNA damaging agent. The results show that a decrease in pyruvate - lactate exchange coincides with the induction of cell death in breast cancer cells both *in vitro* and *in vivo*, with an increase in fumarate - malate exchange shown to correlate to the onset of necrosis.

11:54 ***569***. **Analysis of Mitochondrial Metabolism in Cancer Cells by Combining Hyperpolarization and Isotopomer Analysis**

Crystal E. Harrison[1,2], Ralph J. DeBerardinis[3,4], Ashish K. Jindal[1], Chendong Yang[3], A Dean Sherry[1,5], Craig R. Malloy[1,6]
[1]Advanced Imaging Research Center, UT Southwestern, Dallas, TX, United States; [2]Physics, UT Dallas, Richardson, TX, United States; [3]Pediatrics, UT Southwestern, Dallas, TX, United States; [4]McDermott Center for Human Growth and Development, UT Southwestern, Dallas, TX, United States; [5]Chemistry, UT Dallas, Richardson, TX, United States; [6]Veterans Affairs, NorthTexas Health Care System, Dallas, TX, United States

While most research in cancer metabolism has focused on lactate formation (the Warburg effect), less is known about the mitochondrial pathways utilized during cell growth. Hyperpolarized [1-13C]-pyruvate provides insight into both the Warburg effect and mitochondrial metabolism, including activity of pyruvate dehydrogenase (PDH) and pyruvate carboxylase (PC). To combine the sensitivity of hyperpolarization with the precision of isotopomer analysis, we pre-incubated glioblastoma cells with [3-13C]-pyruvate prior to a short incubation with hyperpolarized [1-13C]-pyruvate. Using this technique, we observed real-time accumulation of hyperpolarized, 13C-labeled lactate and bicarbonate, and determined that the latter arose from the direct activity of PDH.

12:06 ***570***. **Investigating the Metabolic Effects of Heart Failure Progression *In Vivo* Using Hyperpolarized Magnetic Resonance**

Helen Jennifer Atherton[1], Michael S. Dodd[1], Carolyn A. Carr[1], Daniel J. Stuckey[1], Kieran Clarke[1], George K. Radda[1], Damian J. Tyler[1]
[1]Physiology, Anatomy and Genetics, University of Oxford, Oxford, Oxfordshire, United Kingdom

Using hyperpolarized magnetic resonance spectroscopy (MRS), we determined *in vivo* the temporal metabolic changes associated with heart failure progression post myocardial infarction (MI). Two weeks post MI, PDH flux was equivalent in failing and control hearts. In contrast levels of [1-^{13}C]citrate, [1-^{13}C]acetyl carnitine and [5-^{13}C]glutamate were reduced in infarcted hearts reflecting a perturbation in Krebs cycle metabolism. Reduced [1-^{13}C]lactate was also observed post MI indicating decreased glucose uptake and/or glycolysis. This study highlights the importance of assessing metabolism at multiple time points *in vivo*, and demonstrates the potential of hyperpolarized MRS for investigating the metabolic effects of progressive diseases.

12:18 ***571***. **Indirect Detection of Enzymatic Processes by Hyperpolarized NMR: Temporal Information, Enhanced Spectral Resolution and Slow Spin Relaxation**

Talia Harris[1], Patrick Giraudeau[1], Lucio Frydman[1]
[1]Chemical Physics, Weizmann Institute of Science, Rehovot, Israel

The outstanding sensitivity arising from ex situ DNP has triggered high expectations concerning the in vivo monitoring of metabolism and disease. So far such gains have materialized for experiments focusing on low-γ nuclei, whose relatively long T_1s enables them to withstand the transfer from the cryogenic hyperpolarizer to the reacting centers of interest. This study demonstrates that, when suitably merged with spatially-encoded methods, also indirectly-detected ^{1}H NMR spectroscopy can be exploited in time-resolved hyperpolarized analyses. The principles and opportunities opened by this approach are exemplified by Choline's phosphorylation by Choline Kinase, and by Acetylcholine's hydrolization by Acetylcholine Esterase.

HARDI & Tissue Characterization

Room A9 10:30-12:30 *Moderators:* Cristina Granziera and Geoffrey J.M. Parker

10:30 ***572***. **Reduced Encoding Persistent Angular Structure**

Andrew Sweet[1], Daniel C. Alexander[1]
[1]Department of Computer Science, University College London, London, United Kingdom

Persistent angular structure (PAS) MRI is a method that recovers complex white matter fibre configurations within single voxels of high angular resolution diffusion MRI (HARDI) data. It continues to exhibit impressive performance in comparison to other state of the art methods, but at the expense of a longer computation time. Here, we introduce a reduced encoding representation that cuts this computation time to around a quarter of its original value, while retaining performance on synthetic data. Minor differences between the reduced and original encoding are observed in real brain data, but do not necessarily represent decreased performance.

10:42 ***573***. **Estimating the Number of Fiber Orientations in Diffusion MRI Voxels: A Constrained Spherical Deconvolution Study**

Ben Jeurissen[1], Alexander Leemans[2], Jacques-Donald Tournier[3], Derek K. Jones[4], Jan Sijbers[1]
[1]Visionlab, University of Antwerp, Antwerp, Belgium; [2]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands; [3]Brain Research Institute, Florey Neuroscience Institutes (Austin), Melbourne, Victoria, Australia; [4]CUBRIC, School of Psychology, Cardiff University, Cardiff, United Kingdom

Recent advances of high angular resolution diffusion imaging allow the extraction of multiple fiber orientations per voxel and have spawned an interest for classification of voxels by the number of fiber orientations. In this work, we estimated the number of fiber orientations within each voxel using the constrained spherical deconvolution method with the residual bootstrap approach. We showed that multiple-fiber profiles arise consistently in various regions of the human brain where complex tissue structure is known to exist. Moreover, we detect voxels with more than two fiber orientations and detect a much higher proportion of multi-fiber voxels than previously reported.

10:54 ***574***. **Can Spherical Deconvolution Give Us More Information Beyond Fibre Orientation? Towards Novel Quantifications of White Matter Integrity**

Flavio Dell'Acqua[1], Andrew Simmons[1], Steven Williams[1], Marco Catani[1]
[1]Centre for Neuroimaging Sciences, Institute of Psychiatry, King's College London, London, United Kingdom

In recent years Spherical Deconvolution methods have been applied to diffusion imaging to improve the visualization of multi-fibre orientation in brain regions with complex white matter organization. However, the potential to quantify white matter integrity with SD has not been explored. In this study we show that assuming a fibre response function based on a restricted diffusion model may lead to a better interpretation of spherical deconvolution results, relaxing the requirement of an exact knowledge of the fibre response and possibly help the development of new fibre specific indices of white matter integrity.

11:06 ***575***. **Apparent Fibre Density: A New Measure for High Angular Resolution Diffusion-Weighted Image Analysis**

David Raffelt[1,2], Stuart Crozier[2], Alan Connelly[3,4], Olivier Salvado[1], J-Donald Tournier[3,4]
[1]The Australian E-Health Research Centre, CSIRO, Brisbane, QLD, Australia; [2]Department of Biomedical Engineering, University of Queensland, Brisbane, QLD, Australia; [3]Brain Research Institute, Florey Neuroscience Institutes (Austin), Melbourne, VIC, Australia; [4]Department of Medicine, University of Melbourne, Melbourne, VIC, Australia

Apparent Fibre Density is a new measure that is based on information provided by Fibre Orientation Distributions. Voxel wise comparisons of Apparent Fibre Density can be made over all orientations permitting differences to be attributed to a single fibre within voxels with multiple fibre populations.

11:18 ***576***. **Dependence of Axon Diameter Index on Maximum Gradient Strength**

Tim B. Dyrby[1], Penny L. Hubbard[2], Maurice Ptito[3], Matt G. Hall[4], Daniel C. Alexander[4]
[1]Danish Research Centre for Magnetic Resonance, Copenhagen Univerviersity Hospital, Hvidovre, Denmark; [2]Imaging Science and Biomedical Imaging, University of Manchester, Manchester, United Kingdom; [3]School of Optometry, University of Montreal, Montreal, Canada; [4]Centre for Medical Image Computing, University College London, London, United Kingdom

We aimed to elucidate the dependence of the axon diameter index on the maximum available gradient strength (G_{max}). Optimised protocols were produced that were sensitive to a-priori axon diameters of 1, 2 and 4 $_{\mu}$ m for G_{max} = 60, 140, 200 and 300mT/m, and data were acquired on fixed monkey brain. The mapped axon diameter index was sensitive to G_{max} but relatively constant for >140mT/m. Simulations suggest that at low G_{max} (60mT/m), axon diameters $<3_{\mu}$ m are indistinguishable, which explains the unexpectedly high values at low G_{max}.

11:30 ***577***. **The Analytic Distribution of Fractional Anisotropy in Diffusion MRI**

Leigh A. Johnston[1,2], Adel Foda[2], Michael J. Farrell[2,3], Gary F. Egan[2,3]
[1]School of Engineering & NICTA VRL, University of Melbourne, Melbourne, VIC, Australia; [2]Howard Florey Institute, Florey Neuroscience Institutes, Melbourne, VIC, Australia; [3]Centre for Neuroscience, University of Melbourne, Melbourne, VIC, Australia

Statistical analyses of fractional anisotropy images in diffusion MRI studies are traditionally approached using parametric tests, under Gaussianity assumptions, or nonparametric resampling techniques. We present an analytic form for the distribution of FA, both for Gaussian distributed tensor eigenvalues for which FA follows a transformed doubly noncentral beta distribution, and a generalisation to arbitrary eigenvalue distributions. These powerful result permits application of valid inference statistical tests to FA maps in all experimental conditions.

11:42 ***578***. **Probabilistic Quantification of Regional Cortical Microstructural Complexity**

Hamied Ahmad Haroon[1,2], Richard J. Binney, [2,3], Geoff J M Parker[1,2]
[1]Imaging Science and Biomedical Engineering, School of Cancer and Imaging Sciences, The University of Manchester, Manchester, England, United Kingdom; [2]The University of Manchester Biomedical Imaging Institute, The University of Manchester, Manchester, England, United Kingdom; [3]Neuroscience and Aphasia Research Unit, School of Psychological Sciences, The University of Manchester, Manchester, England, United Kingdom

Model-based residual bootstrapping applied to constrained spherical deconvolution analysis of HARDI provides probabilities of observing *n* fiber orientations in every voxel of the brain. We hypothesized that the distribution of these probabilities for each *n* within cortical and subcortical regions would reflect the varying underlying neural microstructural complexity associated with each. We show evidence supporting this hypothesis and show consistency between hemispheres and amongst a small group of healthy subjects. This may offer non-invasive sensitivity to cortical cytoarchitecture that may be useful in cortical parcellation and in the identification of cortical lesions.

11:54 ***579***. **The FA Connectome: A Quantitative Strategy for Studying Neurological Disease Processes**

Stephen Rose[1,2], Kerstin Pannek, [1,3], Olivier Salvado[4], Parnesh Raniga[4], Fusun Baumann[5], Robert Henderson[5]
[1]UQ Centre for Clinical Research, University of Queensland, Brisbane, Queensland, Australia; [2]Centre for Medical Diagnostic Technologies in Queensland, University of Queensland, Brisbane, Queensland, Australia; [3]Centre for Magnetic Resonance, University of Queensland, Brisbane, Queensland, Australia; [4]The Australian e-Health Research Centre, CSIRO, Brisbane, Queensland, Australia; [5]Neurology, Royal Brisbane and Women's Hospital, Brisbane, Queensland, Australia

Structural connectivity indices derived using diffusion based HARDI or q-ball imaging in conjunction with functional parcellation of the cortex from high resolution MRI, has provided insight into the anatomical conformation of many of the important neural networks in the living brain. We are developing the concept of the FA connectome, i.e. combining a measure of fractional anisotropy, a quantitative diffusivity metric that reflects the integrity of WM pathways, with the connectivity matrix. When applied to study Amyotrophic Lateral Sclerosis, this technique shows identifies a number of key corticomotor pathways with reduced mean FA compared to control participants.

12:06 ***580***. **Novel Spherical Phantoms for Q-Ball Imaging Under in Vivo Conditions**

Amir Moussavi[1], Bram Stieltjes[2], Klaus H. Fritzsche[3], Frederik B. Laun[4]
[1]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany; [2]Radiology, German Cancer Research Center, Heidelberg, Germany; [3]Medical Imaging and Biological Informatics, German Cancer Research Center, Heidelberg, Germany; [4]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany

Spherical shaped diffusion phantoms that mimic in vivo fiber crossings are presented. Two crossing angles (45° and 90°) and two packing types of the fibers in the crossing were realized (stacked and interleaved). The fractional anisotropy of individual fibers is can be adjusted between 0.52 and 0.95. High quality ODF maps with a voxel resolution of 2x2x5 mm³ were acquired using a standard diffusion weighted echoplanar diffusion sequence. Thus, the presented phantoms allow for validity measurements of Q-ball imaging and reconstruction approaches.

12:18 ***581***. **A Diffusion Hardware Phantom Looking Like a Coronal Brain Slice**

Cyril Poupon[1], Laurent Laribiere[1], Gregory Tournier[1], Jeremy Bernard[1], Denis Fournier[1], Pierre Fillard[1], Maxime Descoteaux[2], Jean-Francois Mangin[1]
[1]CEA I2BM NeuroSpin, Gif-sur-Yvette, F91191, France; [2]Université de Sherbrooke, Sherbrooke, Quebec, Canada

Diffusion-weighted imaging has become an established technique to infer the micro-structure of the brain. Its more popular application, fiber tractography, is still the only possibility to infer in vivo the structural connectivity of the brain. Despite the plethora of tractography algorithms in the literature, it is almost impossible to validate them. In this work, we present a novel hardware phantom dedicated to the validation of HARDI models and tractography algorithms. Its geometry was designed to mimic a coronal slice location of a human brain, depicting a large set of specific configurations (crossings, kissings, splittings)

BRONZE CORPORATE MEMBER LUNCHTIME SYMPOSIUM
Bracco

Room A6 12:30-13:30 Moderator: Emanuel Kanal

Safety & Diagnostic Efficacy: Key Requisites For Successful MR Imaging

12:30 **MR Contrast Media Safety: the Requisites**
Emanuel Kanal, M.D.

12:42 **Improving Diagnostic Performance in Vascular Imaging**
J. Paul Finn, M.D.

12:54 **Improving Diagnostic Performance in MR Mammography**
Laura Martincich, M.D.

13:06 **Improving Diagnostic Performance in Pediatric Imaging**
Günther Schneider, M.D., Ph.D.

13:18 **Questions & Answers**
Emanuel Kanal, M.D.

Hot Topics: Emerging & Cross-Cutting Techniques in Pediatric Imaging

Room K1 13:30 15:30 *Organizers & Moderators*: Patricia Ellen Grant and Claudia M. Hillenbrand

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Identify the main issues related to basic clinical pediatric (neuro-) radiology and translational imaging research in children;
- Explain the basic steps and concepts associated with (a) cardiovascular MR planning and imaging, and (b) assessment of body organ integrity or disease (i.e., via perfusion and diffusion) in the pediatric population;
- Evaluate the progress in fetal and neonatal imaging and to explain progress in advanced neuroimaging;
- Demonstrate additional knowledge of clinically adaptable pediatric imaging strategies; and
- Transfer and implement optimized pediatric protocols in their clinical or research practice.

Part II: Hot Topics in Pediatric Imaging Outside the Brain

13:30 **Imaging of Congenital Cardiac Defects and MR Guided Planning Of Surgery**
Mark A. Fogel, M.D.

14:00 **Emerging Diffusion and Perfusion Techniques in Pediatric Body Imaging**
Shreyas S. Vasanawala, M.D., Ph.D.

14:30 **Assessment of Renal Function in Children**
Pierre-Hugues Vivier, M.D.

15:00 **Pediatric PET-MR**
Ruth Lim, M.D.

ARS Training

Room K2 13:30 15:30 *Moderator*: Walter Kucharczyk

Improving Your Educational Presentations: How to Use an Audience Response System

Session open to all registrants

The use of an Audience Response System (ARS) in educational presentations has been shown to increase knowledge retention, create a more effective learning environment through interactivity. We want our educational speakers to be able to make the most effective use of this increasingly popular technology in future meetings. This session is aimed at all educational speakers, and anyone else who would like to learn how to use an Audience Response System.

13:30 **Introduction**
Walter Kucharczyk

14:30 **Demonstration I**
Caroline Reinhold

14:45 **Demonstration II**
David A. Bluemke

Ischemic Heart Disease: What You See is What You Get

Room A4 13:30-15:30 *Moderators:* Andrew E. Arai and Jeanette Schulz-Menger

13:30 ***582***. **Integrating High Spatial-Resolution, 3D Whole-Heart Viability Imaging and Coronary MRA at 3Tesla**

Qi Yang[1], Kuncheng Li[1], Xiaoming Bi[2], Jing An[3], Heng Ma[1], Feng Huang[4], Renate Jerecic[3], Debiao Li[5]
[1]Radiology, Xuanwu Hospital,Capital Medical University, Beijing, China; [2]Siemens Medical Solutions; [3]Siemens Healthcare, MR Collaboration NE Asia; [4]Invivo Corporation; [5]Radiology, Northwestern University, Chicago, IL, United States

Previous contrast-enhanced whole-heart coronary MRA(CMRA) studies at 3.0T have shown high sensitivity and moderate specificity for the detection of stenosis in patients suspected of coronary artery disease (CAD). However, a major advantage of 3.0T contrast-enhanced CMRA is the potential to combine lumenographic information and associated myocardial viability in the same setting. The feasibility of integrating high spatial-resolution, 3D whole-heart viability imaging and coronary MRA at 3 Tesla has been evaluated in volunteer studies. No clinical results using this technique at 3T were available so far.

13:42 ***583***. **Three-Dimensional Stress Cardiac Magnetic Resonance Perfusion Imaging for the Detection of Coronary Artery Disease**

Robert Manka[1], Cosima Jahnke[2], Sebastian Kozerke[1], Viton Vitanis[1], Gerard Crelier[1], Rolf Gebker[2], Bernhard Schnackenburg[2], Peter Boesiger[1], Eckart Fleck[2], Ingo Paetsch[2]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland; [2]German Heart Institute Berlin

Dynamic 3D-CMR stress perfusion imaging provides high image quality and high diagnostic accuracy for the detection of significant coronary artery disease.

13:54 ***584***. **Fully Quantitative Perfusion Pixel Maps of First-Pass Contrast-Enhanced MRI for Coronary Artery Disease Detection: A Preliminary Evaluation in Patients**

Li-Yueh Hsu[1], Peter Kellman[1], Hui Xue[2], Jens Guehring[2], Sven Zuehlsdorff[3], Sujata M. Shanbhag[1], W Patricia Bandettini[1], Marcus Y. Chen[1], Andrew E. Arai[1]
[1]Laboratory of Cardiac Energetics, National Heart Lung and Blood Institute / NIH, Bethesda, MD, United States; [2]Imaging and Visualization, Siemens Corporate Research, Princeton, NJ, United States; [3]CMR Research and Development, Siemens Medical Solutions, Chicago, NJ, United States

In this study we present an automated approach for generating fully quantitative myocardial blood flow (MBF) pixel maps from first-pass contrast-enhanced perfusion MR images. The results of the MBF pixel maps were evaluated in patients with known or suspected coronary artery disease and correlated with coronary angiography. Our results show that the performance of MBF pixel maps is comparable to clinical interpretation. This automated approach shows the feasibility of quantitative perfusion imaging for coronary artery disease detection.

14:06 ***585***. **Free-Breathing, Black-Blood Cardiac Imaging Using Single-Shot BSSFP Sequence: A Feasibility Study**

Xiaoming Bi[1], Jingsi Xie[2], Christopher Glielmi[1], James Carr[2], Debiao Li[2], Sven Zuehlsdorff[1]
[1]Siemens Healthcare, Chicago, IL, United States; [2]Northwestern University, Chicago, IL, United States

The goal of this work was to 1) investigate the feasibility of free-breathing BB cardiac imaging using a single-shot bSSFP sequence; 2) compare the efficacy of two BB methods: double inversion recovery (DIR) and T2IR for this application. Parameters for DIR and T2IR were optimized based on numerical simulations. Volunteer studies show that good quality 2D cardiac images can be consistently acquired with effective blood suppression. DIR preparation results in images with higher SNR and CNR while T2IR provides effective blood nulling regardless of blood flow direction at the cost of myocardium signal intensity.

14:18 ***586***. **Balanced Steady-State Free Precession Magnetic Resonance Images Edema in Acute Reperfused Myocardial Infarction – a Translational Study in Animals and Humans**

Andreas Kumar[1], Nirat Beohar[2], Jain Mangalathu Arumana[3], Debiao Li[3], Matthias G. Friedrich[1], Rohan Dharmakumar[3]
[1]Stephenson CMR Centre, University of Calgary, Calgary, AB, Canada; [2]Dept. of Cardiology , Northwestern University, Chicago, IL, United States; [3]Dept. of Radiology, Northwestern University, Chicago, IL, United States

We assessed the role of balanced steady-state free precession magnetic resonance for imaging of myocardial edema in acute reperfused myocardial infarction. In an experimental animal model as well as in patients with ST-elevation myocardial infarction, we found a close correlation of hyperintense b-SSFP signal areas with T2-STIR as a reference standard. Contrast-to-noise was not different between both sequences, and the area of b-SSFP hyperintensity was consistently larger than the area of irreversible injury on late contrast enhancement, consistent with b-SSFP reflecting the area-at-risk in acute ischemia-reperfusion injury. B-SSFP may evolve as a novel approach for myocardial edema imaging.

14:30 ***587***. **Myocardial T_2 Using Single-Shot Turbo Spin Echo: Regional Trends in Healthy Controls and Myocardial Infarction**

Kelvin Chow[1], Jacqueline A. Flewitt[2,3], Jordin D. Green[4], Matthias G. Friedrich[2,3], Richard B. Thompson[1]
[1]Biomedical Engineering, University of Alberta, Edmonton, Alberta, Canada; [2]Cardiac Sciences, University of Calgary, Calgary, Alberta, Canada; [3]Radiology, University of Calgary, Calgary, Alberta, Canada; [4]Siemens Healthcare, Calgary, Alberta, Canada

A modified single-shot turbo spin echo (HASTE) sequence was used to generate quantitative T_2 maps in a single breath-hold per slice. Whole heart T_2 maps (3 short-axis slices) for a population of healthy subjects show regional variations in T_2, with increased values at the apex and decreased values on the lateral wall of the basal slice. T_2 maps for a patient with acute myocardial infarction shows elevated T_2 in inferoseptal regions overlapping with occluded artery perfusion territory and regions of late gadolinium enhancement. 11 patients showed abnormal (mean + 3SD) T_2 in 33% of regions.

14:42 ***588***. **Heterogeneous Tissue Injury After AF Ablation Defined by LGE MRI**

Christopher John McGann[1], Eugene Kholmovski, Joshua Blauer, Akram Shaaban, Brent Wilson, Josh Bertola, Carl Bohman, Edward DiBella, Rob MacLeod, Dennis Parker, Nassir Marrouche
[1]Cardiology and Radiology, University of Utah Health Sciences Center, Salt Lake City, UT, United States

Late gadolinium enhancement (LGE) weeks to months post atrial fibrillation ablation injury shows left atrial (LA) wall enhancement due to scarring. LGE imaging has proven useful in guiding repeat procedures by identifying regions of viable tissue and incomplete pulmonary vein isolation. Here we show heterogeneous LA tissue injury immediately post ablation with non-enhancing regions on LGE imaging. These imaging findings have not previously been described and may be useful to further define tissue injury caused by RF energy delivery and help predict late scarring.

14:54 ***589***. **Cardiac Fat -Water Imaging: Early Experience and Clinical Utility**

Mark L. Schiebler[1], Karl K. Vigen[2], Christopher J. Francois[2], Scott K. Nagle[2], Ann Shimikawa[3], Hanzhou Yu[3], Jean H. Brittain[4], Scott B. Reeder[2]
[1]Radiology, UW Madison , Madison, WI, United States; [2]Radiology, UW Madison, Madison, WI, United States; [3]Applied Science Lab, General Electric, Menlo Park, CA, United States; [4]Applied Science Lab, General Electric, Madison, WI, United States

Cardiac imaging with fat water separation is useful in defining a number of cardiac and extracardiac disorders:pericarditis, mediatstinal masses, and myocardial viability all show improved detection with fat water separation techniques.

15:06 ***590***. **Accurate Left Ventricular Chamber Quantification Is Feasible Using Cardiovascular Magnetic Resonance at 7T**

Florian von Knobelsdorff-Brenkenhoff[1,2], Tobias Frauenrath[3], Marcel Prothmann[2], Matthias Dieringer[2,3], Fabian Hezel[3], Wolfgang Renz,[3,4], Kerstin Kretschel[1,2], Thoralf Niendorf,[2,3], Jeanette Schulz-Menger[1,2]
[1]Franz-Volhard-Klinik for Cardiology, HELIOS Klinikum Berlin, Berlin, Germany; [2]Experimental and Clinical Research Center (ECRC), Charité Campus Buch, Humboldt-University, Berlin, Germany; [3]Berlin Ultrahigh Field Facility, Max-Delbrueck Center for Molecular Medicine, Berlin, Germany; [4]Siemens Healthcare Sector, Erlangen, Germany

We explored the feasibility to accurately assess left ventricular (LV) dimensions and function at 7T by using 2D FGRE cine imaging and comparing the results to SSFP at 1.5T as the current gold standard. FGRE at 7.0T provided excellent blood/myocardium contrast and LV parameters with close agreement to SSFP. Thus, the combination of small slice thickness (4mm) and ultrahigh field together wit local TX/RX coils facilitated a sufficient SNR and CNR, which holds the promise for accurate functional cardiac imaging at 7T.

15:18 ***591***. ***In Vivo*** **Cardiac MR Elastography in a Single Breath Hold**

Arunark Kolipaka[1], Philip A. Araoz[1], Kiaran P. McGee[1], Armando Manduca[1], Richard L. Ehman[1]
[1]Radiology, Mayo Clinic, Rochester, MN, United States

Current implementations of cardiac MRE are slow and require multiple breath holds to collect the data required for processing. This work shows an optimized MR elastography (MRE) acquisition strategy capable of obtaining 4 wave images of one polarization of motion in the diastolic and systolic phases of the cardiac cycle, each in one breath hold. The phase-difference SNR and stiffness measurements of the myocardium are comparable in volunteers at end-diastole and end-systole. This technique is also capable of acquiring multiple phases of the cardiac cycle in one breath hold.

Advanced Imaging Techniques in Psychiatric Disorders

Room A5 13:30-15:30 *Moderators:* Gabriele R. Ende and Yukio Miki

13:30 ***592***. **In Vivo 3D Lithium MRI of the Human Brain**

Fernando Emilio Boada[1], Yongxian Qian[1], Ariel Gildengers[2], Mary Phillips[2], David Kupfer[2]
[1]MR Research Center, University of Pittsburgh, Pittsburgh, PA, United States; [2]Psychiatry, University of Pittsburgh, Pittsburgh, PA, United States

Bipolar Disorder (BPD) is a devastating mental illness that is often treated using Lithium Carbonate therapy. Unfortunately, lithium carbonate therapy has life-threatening side effects. Moreover, its mechanisms of action and preferred accumulation sites in the in vivo brain continue to be unknown sixty years after its original introduction. A methodology for studying the spatial distribution of lithium carbonate in the brain of BPD subjects could, therefore, be an invaluable tool for studying this disease. In this work we present the first demonstration of 3D lithium MRI in the in Vivo human Brain at 7 Tesla.

13:42 ***593***. **4T ^{7}Li MRSI in the Brains of Bipolar Disorder Subjects**

Jing-Huei Lee[1,2], Matthew M. Norris[1], Caleb M. Adler, [2,3], Elizabeth E. Macaluso[2], Wen-Jang Chu, [2,3], Richard A. Komoroski, [2,3], Stephen M. Strakowski, [2,3]
[1]Biomedical Engineering, University of Cincinnati, Cincinnati, OH, United States; [2]Center for Imaging Research, University of Cincinnati, Cincinnati, OH, United States; [3]Psychiatry, University of Cincinnati, United States

This work proposes and compares two approaches for ^{7}Li MRSI data analysis: Method I: 1D-3D vs. Method II: 3D-1D approach. The result shows that there is virtually no difference between these two approaches. However, Method I is preferred for use in future data analysis since it is simple in practice. Furthermore, this study is the first demonstration of the ^{7}Li distribution in the brain of bipolar patients who are on lithium therapy. The distribution is not uniform throughout the entire brain for all patients, which is unexpected. Further investigations are ongoing.

13:54 ***594***. **Decreased PHi and [ADP] in Anterior Cingulate Cortex of Bipolar Disorder: Further Evidence of Mitochondrial Dysfunction**

Jonathan Dudley[1], Wen-Jang Chu[2,3], Xin Wang[1], Matt Norris[1], Jing-Huei Lee[1,3]
[1]Biomedical Engineering, University of Cincinnati, Cincinnati, OH, United States; [2]Psychiatry, University of Cincinnati, Cincinnati, OH, United States; [3]Center for Imaging Research, University of Cincinnati, Cincinnati, OH, United States

The theory of mitochondrial dysfunction in bipolar disorder (BD) has been supported by numerous MRS studies. However, the absolute quantitation of phosphor metabolites in this disease has not been well studied. This work is to determine phosphor metabolite concentrations in the anterior cingulate cortex among different subject groups. The results were in concordance with the theory of mitochondrial dysfunction, showing a decrease in intracellular pH and [ADP] in manic and mixed BD patients relative to controls.

14:06 ***595***. **Metabolic Changes in Medication-Free Patients with Bipolar and Unipolar Disorder**

Ulrike Dydak[1,2], Jonathan M. Nixon[1], Mario Dzemidzic[3], Harish Sai Karne[4], Amit Anand[4]
[1]School of Health Sciences, Purdue University, West Lafayette, IN, United States; [2]Department of Radiology and Imaging Sciences, Indiana University School of Medicine, Indianapolis, IN, United States; [3]Department of Neurology, Indiana University School of Medicine, Indianapolis, IN, United States; [4]Department of Psychiatry, Indiana University School of Medicine, Indianapolis, IN, United States

Changes in brain metabolism were studied in medication-free patients with bipolar and unipolar disorder and compared to matched healthy controls. 2D MRSI data acquired in an axial slice including thalamus, anterior and posterior cingulate cortex (ACC & PCC) were analyzed using LCModel. Significant decreases in NAA/ creatine were found in bipolar patients compared to healthy controls in the right thalamus and right ACC. Furthermore, when comparing bipolar to unipolar patients, significant decreases in the choline/creatine ratio were observed in the right thalamus. No significant group differences were found in the PCC nor any of the left hemisphere regions of interest.

14:18 ***596***. **Dissociation of Anterior Cingulate Glutamate and Induced Theta EEG Activity in Schizophrenia.**

Antonio Napolitano[1], Kathrin Doege[2], Mallikarjun Pavan[2], Peter Liddle[2], Dorothee P. Auer[1]
[1]Academic Radiology, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Division of Psychiatry, University of Nottingham, United Kingdom

The glutamate hypothesis stimulated over the last two decades several MRS studies to research alterations of glutamate levels in schizophrenia. In this study, we used a combined EEG/MRS protocol to investigate whether prefrontal glutamate levels are altered in patients with early schizophrenia and whether there is an interrelation between glutamate and theta activity in schizophrenia.

14:30 ***597***. **Tissue Specific Changes in Brain Phosphodiesters in Late Life Major Depression**

David G. Harper[1,2], J. Eric Jensen, [2,3], Caitlin Ravichandran, [2,4], E. Yusuf Sivrioglu[5], Daniel Iosifescu[6,7], Perry Renshaw[8], Brent Forester, [29]
[1]Geriatric Psychiatry, McLean Hospital, Belmont, MA, United States; [2]Psychiatry, Harvard Medical School, Belmont, MA, United States; [3]Neuroimaging Center, McLean Hospital, Belmont, MA, United States; [4]Laboratory for Psychiatric Biostatistics, McLean Hospital, Belmont, MA, United States; [5]Psychiatry, Uludag University, Bursa, Turkey; [6]Psychiatry, Massachusetts General Hospital, Boston, MA, United States; [7]Psychiatry, Harvard Medical School, Boston, MA, United States; [8]Psychiatry, University of Utah, Salt Lake City, UT, United States; [9]Geriatric Psychiatry, Mclean Hospital, Belmont, MA, United States

Biological membranes serve numerous, essential cellular functions. MRI findings in late life depression include increased white matter hyperintensities and reduced fractional anisotropy as measured by diffusion tensor imaging suggesting that membrane integrity, especially in white matter, may be compromised. Phosphatidylethanolamine, in the inner mitochondrial membrane, serves an essential function and is synthesized via a unique pathway not involving phosphoethanolamine. We hypothesized that glycerophosphocholine (GPCho) and glycerophosphoethanolamine (GPEtn), particularly in white matter, will

be increased in late-life depression, and we hypothesized that GPEtn will be altered fundamentally differently than GPCho due to the additional pathway of the inner mitochondrial membrane and that GPEtn would therefore show changes in gray matter.

14:42 ***598***. **^{1}H MRS Measurement of Brain Glutathione Supports Increased Oxidative Stress in Major Depressive Disorder**

Sanjay J. Mathew[1], Xiangling Mao[2], Sarah Pillemer[1], James W. Murrough[1], Dikoma C. Shungu[2]
[1]Psychiatry, Mount Sinai School of Medicine, New York, NY, United States; [2]Radiology, Weill Cornell Medical College, New York, NY, United States

A large body of anecdotal evidence now implicates increased oxidative stress in a number of pathophysiologic models of major depressive disorder (MDD). In this study, the first *in vivo* ^{1}H MRS measurements of the primary cellular antioxidant glutathione (GSH) were made in the occipital lobe of MDD patients and found to be significantly decreased compared to healthy control subjects, which supports the presence of increased oxidative stress in the disorder.

14:54 ***599***. **Evidence of Age Effects in Cortical Areas But Not in the Subcortex of ADHD Children: A Multi-Voxel *In Vivo* ^{31}P Spectroscopy Study at 4 Tesla**

Jeffrey A. Stanley[1], Dalal Khatib[1], Rachel M. Dick[1], Olivia A. McGarragle[1], Frank P. MacMaster[1], Vaibhav A. Diwadkar[1], Arthur L. Robin[1], David R. Rosenberg[1]
[1]Psychiatry and Behavioral Neurosciences, Wayne State University School of Medicine, Detroit, MI, United States

Attention Deficit Hyperactivity Disorder (ADHD) is a serious public health problem that affects between 3 to 9% of children and accounts for between 30 to 40% of child referrals to mental health services. While the cause of this illness remains poorly understood, ADHD is increasingly seen as a neurodevelopmental disorder. *In vivo* ^{31}P spectroscopy is a neuroimaging method that is sensitive in detecting biochemical changes as the brain develops. The purpose of this study is to provide further evidence of a developmental mechanism where early maldeveloped corticostriatal pathways may impact the maturational integration of prefrontal corticostriatal pathways in pediatric ADHD.

15:06 ***600***. **Disruption of Commissural White Matter Tracts in Pediatric Bipolar Disorder**

Hao Huang[1], Kirti Saxena[2], Annie Walley[2], Min Xu[1], Nancy Rollins[3]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Department of Psychiatry, University of Texas Southwestern Medical Center, Dallas, TX, United States; [3]Department of Radiology, University of Texas Southwestern Medical Center, Dallas, TX, United States

Identifying early signs of bipolar disorder is important because it may enable health care providers to intervene earlier and prevent progression of increased morbidity and personal dysfunction. Commissural tracts including corpus callosum (CC) and anterior commissure (AC) are the research target in this study. In our study, we acquired high resolution DTI from 10 pediatric bipolar patients and 10 age matched control subjects. We found that AC and anterior segment of CC has statistically smaller FA. Compared to DTI results of adult BP, the disruption pattern caused by BP demonstrates anterior to posterior pattern from childhood to adult.

15:18 ***601***. **Atypical Development of White Matter Microstructure in Adolescents with Autism Spectrum Disorders**

Kun-Hsien Chou[1], I-Yun Chen[2], Ya-Wei Cheng[2], Jean Decety[3], Yang-Teng Fan[2], Ching-Po Lin[2,4]
[1]Institute of Biomedical Engineering, National Yang-Ming University, Taipei, Taiwan; [2]Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan; [3]Departments of Psychology and Psychiatry, The University of Chicago, Chicago, United States; [4]Institute of Biomedical imaging and Radiological Sciences, National Yang-Ming University, Taipei, Taiwan

Autism spectrum disorders is a common brain developmental disorder that occurs in one in 150 children. It is characterized by early onset of impaired social reciprocity and communication difficulties, along with restricted interest and stereotyped behavior. Several brain morphometry studies suggested that cascade failure of neurodevelopment is the most likely the core deficit of ASD. But whether aberrant WM development persisted into later childhood and adolescence was a crucial issue to probe. The aim of the present study was to examine WM microstructure using diffusion tensor imaging (DTI) and to investigate its relations to age in adolescents with ASD.

Summits in Clinical Cardiovascular Applications: Practical Tricks for Cardiac MRI

Room A9 13:30 – 15:30 *Organizer*: Georg M. Bongartz

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Design appropriate scanning protocols for cardiac MR imaging;
- Describe the basic clinical indications for cardiac MRI;
- Discriminate among various cardiac diseases by their typical properties in MRI;
- Identify the pitfalls and challenges of the various cardiac MRI techniques; and
- Compare and optimally apply the pulse sequences used for cardiac perfusion, function, viability, and velocity imaging in MRI.

Moderators: **Victor A. Ferrari and Han Wen**

07:00 **Stress Perfusion**
Sven Plein, M.D.

13:50 **Viability**
Katherine C. Wu, M.D.

14:10 **Function**
Sandor Kovacs, M.D., Ph.D.

14:30 **Coronary Angiography**
Qi Yang, M.D.

14:50 **Phase Contrast Velocity Mapping**
Ann F. Bolger, M.D.

15:10 Panel Discussion

MR Physics & Techniques for Clinicians

Room K1 16:00 – 18:00 *Organizers & Moderators*: Marcus T. Alley and Michael Markl

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Define and describe the fundamental principles of MR imaging, including the definition of spin magnetization, the Larmor relationship, relaxation phenomena, and the process of using the spin magnetization to produce an image;
- Explain imaging pulse sequences based upon spin and gradient echoes, including fast spin-echo and echo planar techniques;
- Design MR imaging protocols for diagnostic applications considering image contrast, spatial resolution, acquisition time, signal-to-noise ratio, and artifacts; and
- Describe the principles of parallel imaging, high-field imaging, perfusion imaging, diffusion imaging, and functional MR imaging.

16:00 **Diffusion**
Christian Beaulieu, Ph.D.

16:40 **Perfusion**
Roland Bammer, Ph.D.

17:20 **fMRI**
Karla L. Miller, Ph.D.

Guess that Artifact! : Case-Based Teaching

Room K2 16:00 – 18:00 *Organizers & Moderators*: Mark A. Griswold and Harald H. Quick

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- List and evaluate principle categories of artifacts;
- Explain sources of commonly encountered artifacts and methods to avoid them; and
- Recommend further tests for problem solving and troubleshooting artifacts.

A competition in the evaluation of MR artifacts.

16:00 **Game Show Format…**
Mark A. Griswold

16:00 **Game Show Format…**
Harald H. Quick

Structural & Functional Changes of the Brain with Age

Room A1 16:00-18:00 *Moderators:* Nicola de Stefano and Stefan Sammet

16:00 ***602***. **MR Elastography and MRI Volumetry of the Aging Brain**

Kaspar Josche Streitberger[1], Dagmar Krefting[2], Friedemann Paul[3], Dieter Klatt[1], Sebastian Papazoglou[1], Sebastian Hirsch[1], Jürgen Braun[2], Ingolf Sack[1]
[1]Institute of Radiology, Charité - University Medicine Berlin, Berlin, Germany; [2]Institute of Medical Informatics, Charité - University Medicine Berlin, Berlin, Germany; [3]Neurocure, Charité - University Medicine Berlin, Berlin, Germany

Physiological aging of the brain is accompanied by ubiquitous degeneration of neurons and oligodendrocytes. An alteration of the cellular matrix of an organ impacts its macroscopic viscoelastic properties, which are characterized by mechanical parameters such as stiffness and internal friction. To date Magnetic Resonance Elastography (MRE) is the only non-invasive technique for measuring the shear viscoelastic properties of living brain. This study compares the decrease of brain stiffness with years of age in normal volunteers observed by MRE with loss of brain volume found by MRI volumetry.

16:12 ***603***. **Structural Brain Changes Throughout Adulthood**

Antonio Giorgio[1,2], Luca Santelli[3], Valentina Tomassini[1], Rose Bosnell[1], Stephen M. Smith[1], Nicola De Stefano[2], Heidi Johansen-Berg[1]
[1]FMRIB Centre, University of Oxford, Oxford, United Kingdom; [2]Neurology and Neurometabolic Unit, University of Siena, Siena, Italy; [3]Department of Neuroscience, University of Padua Medical School, Padua, Italy

Normal ageing is associated with gradual deterioration of brain structures. However, there is mixed evidence over the precise time course and spatial distribution of change. We studied a group of 66 adults aged between 23 and 81 years using voxel-based morphometry (VBM)-style analysis and diffusion tensor imaging (DTI). We found widespread reductions in GM volume from middle age onwards but earlier reductions were detected in frontal cortex. WM decline was detected earlier (in young adulthood) and more sensitively using DTI-based measures of microstructure than using markers of WM volume derived from conventional T1-weighted imaging.

16:24 ***604***. **Voxel-Based Multiple Regression of Multimodal MRI: Applications to Physiological Aging**

Andrea Cherubini[1], Patrice Péran[1], Carlo Caltagirone[1], Gianfranco Spalletta[1]
[1]Santa Lucia Foundation, Rome, Italy

We explored for the first time with a voxel-based approach the simultaneous variation induced by physiological aging on four quantitative MR parameters sensitive to complementary tissue characteristics (VBM, T2* relaxometry, DTI). This allowed us to compare the performance of different predictors and to identify without a priori information the best biomarker of age-induced structural variation for each voxel. Our results showed that brain areas most affected by age are evenly distributed between white matter and grey matter. Moreover, the best quantitative predictors in most brain areas resulted to be iron deposition and microstructural damage rather than macroscopic atrophy of tissues.

16:36 ***605***. **White Matter Structural Correlates of Cognitive Performance in the Temporal Lobe Projections**

Efrat Sasson[1], Glen M. Doniger[2], Ofer Pasternak[3], Tal Gonen[4], Yaniv Assaf[5]
[1]Neurobiology department, Tel Aviv University, Tel Aviv, Israel; [2]Department of Clinical Science, NeuroTrax Corporation, Newark, NJ, United States; [3]Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States; [4]Psychology department, Tel Aviv University, Tel Aviv , Israel; [5]Neurobiology department, Tel Aviv University, Tel Aviv , Israel

In this study we used the inter-subject variability in different cognitive domains to relate cognitive performance and WM integrity in five temporal projections: the uncinate fasciculus, fornix, cingulum, inferior longitudinal fasciculus, and superior longitudinal fasciculus. Subjects were 51 healthy volunteers, 25-80 years, completed cognitive tests and were scanned using DTI and DTI tractography was performed. The fibers exhibiting substantial correlation with cognitive performance are known to play an important part in the corresponding functional domain. Using the methodology performed here, DTI tractography enables anatomical definition of region of interest for correlation analysis of any behavioral parameters with diffusion indices.

16:48 ***606***. **DTI, T2 Relaxation and Volumetry of the Human Brain Corpus Striatum Across the Lifespan**

Khader M. Hasan[1], Indika S. Walimuni[1], Humaira Abid[1], Larry A. Kramer[1], Richard E. Frye[2], Jack M. Fletcher[3], Linda Ewing-Cobbs[2]
[1]Diagnostic and Interventional Imaging, University of Texas Health Science Center at Houston, Houston, TX, United States; [2]Pediatrics, UTHSC, Houston, TX, United States; [3]Psychology, University of Houston, Houston, TX, United States

In this work, we report for the first time a comprehensive account of the macro and microstructure of these structures using a large cross-sectional healthy cohort across the healthy lifespan (N=281 males and females aged 6-68 years). We demonstrate using a validated novel DTI and atlas-based tissue segmentation approach that the MRI microstructural correlates of volume decrease of these structures bilaterally, in both men and women are a T2 relaxation that follows a U curve that is commensurate with a fractional ansiotropy increases with age and a U curve mean diffusivity. A strong correlation between T2 and mean, radial and axial diffusivities is also noted. The interplay between T2 relaxation and DTI metrics was also examined.

17:00 ***607***. **Longitudinal Age-Related Changes in Radial and Axial Diffusion Using Tract-Based Spatial Statistics**

Thomas Richard Barrick[1], Rebecca Anne Charlton[2], Ai Wern Chung[2], Christopher Alan Clark[3], Hugh Stephen Markus[2]
[1]Centre for Clinical Neuroscience, Saint George's, University of London, London, United Kingdom; [2]Centre for Clinical Neuroscience, Saint George's, University of London, United Kingdom; [3]Institute of Child Health, University College London, United Kingdom

The aim of this study is to use tract based spatial statistics to investigate local age-related white matter structural change on a voxel-by-voxel basis over a 2-year period. 74 middle-aged and elderly individuals were scanned at both time-points and fractional anisotropy, axial and radial diffusivity were measured. Significant increases in average radial diffusivity and decreases in FA were found throughout the white matter in contrast to greater variability in change (both increase and decrease) of axial diffusivity. This study is the first to investigate longitudinal change in axial and radial diffusivity with age.

17:12 ***608***. **Assessment of Age-Related Microstructural Changes in the Thalamus by Diffusional Kurtosis Imaging**

Maria Fatima Falangola[1,2], Caixia Hu[1], Vitria Adisetiyo[1], Ali Tabesh[1], Wende R. Gelb[1], Jens H. Jensen[1], Joseph A. Helpern[1,2]
[1]Radiology, New York University Langone Medical Center, New York, NY, United States; [2]2Center for Advanced Brain Imaging, Nathan Kline Institute, Orangeburg, NY, United States

The thalamus is a major subcortical relay station that filters incoming primary sensory input and modulates processed cortical information through reciprocal cortico-thalamic connections. Therefore, it is a key region for fronto-temporal communication and is crucial for modulating emotion and cognition in humans. We applied Diffusional Kurtosis Imaging (DKI) to investigate the age-related non-Gaussian patterns of microstructure change in the thalamus. The data presented here suggest that non-Gaussian metrics, particularly MK and Kra are the most useful in detecting developmental changes in the thalamus.

17:24 ***609***. **Quantitative Mapping of the Age-Dependence of Cerebral Blood Flow Using Pulsed Arterial Spin Labeling**

J. Jean Chen[1], H. Diana Rosas,[12], David H. Salat[1]
[1]A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA, United States; [2]Department of Neurology, Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States

Accurate measurement of regional cerebral blood flow (CBF) changes in aging using conventional techniques is hampered by low repeatability and partial-volume effects. In this work, we examine the feasibility of pulsed arterial-spin labelling in obtaining quantitative CBF maps in healthy adults, evaluating the impact of potential partial-volume effects and the robustness of calibration techniques. We observed cortical CBF decrease with healthy aging, with heightened reduction co-localizing with regions previously reported to exhibit decline in metabolism. These findings were independent of the choice of CBF calibration technique, and partial-volume effects were found to bias CBF in areas of significant cortical thinning.

17:36 ***610***. **Age and Gender Variations in T_1 Measurements of White and Grey Matter Structures Within the Human Brain at 7 T**

Peter Jonathan Wright[1,2], Olivier Mougin[1], Susan Pritchard[1], Eleanor Cox[1], Penny Gowland[1]
[1]SPMMRC, University of Nottingham, Nottingham, United Kingdom; [2]LMBRU, Leeds NHS, Leeds, West Yorkshire, United Kingdom

With the increasing life expectancy of humans in the developed world and neurological diseases such as Parkinson's becoming ever more prominent, a growing interest has emerged examining normal changes in brain tissue in later life. 30 healthy subjects between 40-80 years were scanned at 7 T using an MPRAGE sequence to measure T_1 recovery values in ROI of the brain. Significant age variations were observed between grey matter, anterior and posterior white matter ($p = 0.02$) dominated by male subjects and splenium and genu of the corpus callosum ($p < 0.02$), dominated by female subjects.

17:48 ***611***. **Correlation of Change in Phase and R2* with Putative Iron Content in Deep Gray Matter of Healthy Adults**

Manju Liu[1], Mark E. Haacke[1], Charbel A. Habib[1], Yanwei Miao[2], Yashwanth Katkuri[1]
[1]Department of Radiology, Wayne State University, Detroit, MI, United States; [2]Department of Radiology, The First Affiliated Hospital, Dalian, Liaoning, China

In this project we applied a two region analysis to avoid this problem and to study not only iron increases but the overall area of iron content as a function of age.

Clinical Brain Tumor Imaging: Diagnosis to Prognosis

Victoria Hall 16:00-18:00 *Moderators:* Marco Essig and Meng Law

16:00 ***612***. **Spatially Quantifying Microscopic Tumor Invasion and Proliferation Using a Voxel-Wise Analytical Solution to a Glioma Growth Model and Serial Diffusion MRI**

Benjamin M. Ellingson[1,2], Scott D. Rand[1,2], Mark G. Malkin[1,3], Robert Prost[2], Jennifer M. Connelly[1,4], Pete S. LaViolette[1,5], Devyani P. Bedekar[1,2], Kathleen M. Schmainda[1,2]
[1]Translational Brain Tumor Program, Medical College of Wisconsin, Milwaukee, WI, United States; [2]Dept. of Radiology, Medical College of Wisconsin, Milwaukee, WI, United States; [3]Dept. of Neurology and Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States; [4]Dept. of Neurology, Medical College of Wisconsin, Milwaukee, WI, United States; [5]Dept. of Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States

The objective of the current study was to develop a voxel-wise analytical solution to a glioma growth model using serial diffusion MRI in order to spatially map and quantify regions of microscopic tumor invasion and proliferation. Results demonstrate a strong correlation between proliferation rate and MR spectroscopic measurements of choline-to-N-acetylaspartate ratio. Proliferation rate and cell motility rates were shown to increase with increasing

malignancy, as well as easily distinguish between radiation necrosis and recurrent tumor. This technique may be valuable for assessing tumor dynamics and predicting response to treatment in all types of cancers.

16:12 ***613***. **DCE MRI Derived Kep Is a Surrogate Marker of MMP-9 Expression in Patients with Glioblastoma Multiforme**

Rishi Awasthi[1], Nuzhat Husain[2], Priyanka Soni[2], Prativa Sahoo[3], Sanjay Behari[4], Shaleen Kumar[5], Rakesh Pandey[6], Ram Kishore Singh Rathore[3], Rakesh Kumar Gupta[1]

[1]Radiodiagnosis, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [2]Pathology, Chhatrapati Shahuji Maharaj Medical University, Lucknow, UP, India, Lucknow, Uttar Pradesh, India; [3]Mathematics and Statistics, Indian Institute of technology Kanpur, Kanpur, Uttar Pradesh, India; [4]Neurosurgery, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [5]Radiotherapy, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [6]Pathology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

DCE-MRI was performed on 17 patients with Glioblastoma multiforme (GBM). Various perfusion metrics were analyzed and correlated with immunohistochemically obtained MMP-9 expression. Among the perfusion metrics, Kep was found to have the best correlation with MMP-9 expression suggesting that it can be used as a surrogate for MMP-9 expression. A total of 8 patients were also followed up clinically to observe the duration of survival. The MMP-9 expression and quantified perfusion metrics were also correlated with the duration of survival. MMP-9 expression showed a significant negative correlation with the duration of survival indicating the possible role of MMP-9 in tumor progression as one of the factors. The Kep, Ktrans, Ve, rCBV and rCBF also correlated significantly with the duration of survival proving the utility of DCE MRI in forecasting tumor progression in malignant glioma. We suggest that Kep holds promise as a surrogate for MMP9 expression in GBM.

16:24 ***614***. **Metabolic Characterization of Recurrent Grade 2 Glioma Using Proton HR-MAS Spectroscopy**

Llewellyn Jalbert[1], Adam Elkhaled[1], Radhika Srinivasan[1], Hikari Yoshihara[1], Colleen Cloyd[1,2], Gabriela Bourne[1], Susan M. Chang[3], Soonmee Cha[1], John Kurhanewicz[1,4], Sarah J. Nelson[1,4]

[1]Department of Radiology & Biomedical Imaging, University of California - San Francisco, San Francisco, CA, United States; [2]School of Pharmacy, University of California - San Francisco, San Francisco, CA, United States; [3]Department of Neurological Surgery, University of California - San Francisco, San Francisco, CA, United States; [4]Department of Bioengineering & Therapeutic Sciences , University of California - San Francisco, San Francisco, CA, United States

Proton High Resolution Magic Angle Spectroscopy (^{1}H HR-MAS) has offered new insight into tumor physiology that may be valuable in understanding the process of glial tumorigenesis. Fifty-four patients w/ pathologically confirmed WHO Grade 2 recurrent glioma underwent pre-surgical MRI / 3D MRSI, image guided biopsy excision, and ^{1}H HR-MAS analysis. Patients whose tumors had histologically upgraded to WHO Grade 3 exhibited greater concentrations of PC (p=.008), GPC (p=.049), glucose (p=.002), and total choline (p=.01). Our ^{1}H HR-MAS results may contribute in identifying low-grade glioma patients whose tumors have become more aggressive and assist in treatment planning and selection.

16:36 ***615***. **Correlation of Metabolic Characteristics with Diffusion Tensor Imaging in Human Gliomas**

Greg A. Fellows[1], Alan J. Wright[2], Tom R. Barrick[3], Dominick J O McIntyre[4], Chris A. Clark[5], B Anthony Bell[6], Franklyn A. Howe[7]

[1]Department of Neurosurgery, King's College Hospital London NHS Trust, London, United Kingdom; [2]Radiology, UMC st. Radboud University Hospital, Nijmegen, Netherlands; [3]Clinical Neuroscience, St George's, University of London, London, United Kingdom; [4]CRUK Cambridge Research Institute, Cambridge, United Kingdom; [5]Radiology and Physics Unit, UCL Institute of Child Health, London, United Kingdom; [6]Academic Neurosurgery, St George's, University of London, London, United Kingdom; [7]Cardiac & Vascular Sciences, St George's, University of London, London, United Kingdom

Gliomas are the most common primary brain tumour, and in their most aggressive form, glioblastoma multiforme, are associated with a mean survival of 9-12 months. Despite maximal therapy, nearly all gliomas eventually recur. The majority of this recurrence is at the limits of previous resection / radiotherapy margins. We have combined 1H spectroscopy metabolite maps and DTI structural metrics of 30 histologically confirmed glioma patients to increase our understanding of the tissue changes that occur within the tumour and at the tumour-brain interface. We identify metabolite correlations with DTI metrics as a surrogate marker for tumour infiltration.

16:48 ***616***. **An Image Similarity-Guided Correspondence Correction for Voxel-Wise Analysis Applied to MR Imaging of Glioblastoma Multiforme Acquired Pre- And Post-Chemoradiotherapy**

Jeremy David Hoisak[1,2], Eng-Siew Koh[1,3], Eugene Yu[4], Andrea Kassner[4], Normand J. Laperriere[1,3], Cynthia Ménard[1,3], David A. Jaffray[1,2]

[1]Radiation Medicine Program, Princess Margaret Hospital, Toronto, Ontario, Canada; [2]Medical Biophysics, University of Toronto, Toronto, Ontario, Canada; [3]Radiation Oncology, University of Toronto, Toronto, Ontario, Canada; [4]Medical Imaging, University of Toronto, Toronto, Ontario, Canada

Response assessment with a voxel-wise analysis of serial image change has advantages over conventional tumor measurements, but is susceptible to uncertainties from inconsistent voxel correspondences between scans arising from a dynamic tumor morphology. A correspondence correction method based on a metric of voxel similarity was applied to a functional diffusion map (fDM) analysis of co-registered T1-weighted and diffusion-weighted images of glioblastoma multiforme acquired pre- and post-chemoradiotherapy. The correction resulted in a statistically significant alteration in the quantification of apparent diffusion coefficient (ADC) change pre- and post-therapy, and has the potential to improve the accuracy of subsequent determinations of therapy outcome.

17:00 ***617***. **Glycerolphosphocholine Is the Predominant Choline-Containing Compound and Is Correlated with Proliferation in Non-Enhancing Astrocytoma**

Tracy Richmond McKnight[1], Kenneth James Smith[1], Susan Chang[2], Mitchel Berger[2]

[1]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States; [2]Neurological Surgery, University of California San Francisco, San Francisco, CA

We performed 1D HRMAS and 2D TOCSY MR spectroscopy on a cohort of biopsies from high and low grade non-contrast-enhancing astrocytoma. We quantified PC, GPC, free Cho, and the GPC:PC concentration ratio as well as cell proliferation and cell density. Our results show that GPC is the

predominant choline-containing compound in non-enhancing astrocytoma irrespective of grade and that there is a positive association between Ki-67, tCho, and GPC, but not PC. These results suggest that the presence of contrast-enhancement influences choline metabolism in astrocytoma.

17:12 ***618***. **Correlation of DTI Metrics with Proliferation Index and Survival Analysis in Glioblastomas**

Sona Saksena[1], Rajan Jain[1], Jayant Narang[1], Lonni Schultz[2], David Hearshen[1], Lisa Scarpace[3], Norman Lehman[4], Tom Mikkelsen[3]
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DTI data were acquired from thirty-four patients with glioblastomas with an aim to retrospectively correlate the changes in fractional anisotropy (FA) and apparent diffusion coefficient (ADC) with degree of proliferation index determined histologically and patient survival analysis. We found that patients with ADCmin (¡Ü0.6) and FAmean (¡Ü0.2) had lower progression free survival rate or poorer prognosis. In conclusion, DTI can be used as a clinical prognostic biomarker for disease free survival in patients with glioblastomas and might be useful for planning initial treatment strategy in these patients.

17:24 ***619***. **Effects of Bevacizumab on the Tumor Vascularity Assessed with DCE-MRI in Recurrent Anaplastic Astrocytomas**

Weiting Zhang[1], Teri N. Kreisl[1], Jeffrey Solomon[2], Richard C. Reynolds[1], Daniel R. Glen[1], Robert W. Cox[1], Howard A. Fine[1], John A. Butman[1]
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DCE-MRI was used to monitor the effects of bevacizumab on physiologic measures of tumor vascularity, such as blood brain barrier permeability, represented as Ktrans , and vascular perfusion represented as fpv, in patiens with recurrent anaplastic astrocytoma. Bevacizumab dramatically reduces Ktrans, fpv, and enhancing tumor volume as early as 4 days and this effect persisted at least for 4 weeks. Tumors with larger baseline enhancing tumor volume and greater baseline Ktrans were related to poorer prognosis.

17:36 ***620***. **Assessing the Effects of Radiation Therapy on Normal Brain Tissue in Patients with Glioma Using Susceptibility-Weighted Imaging at 7 Tesla**

Janine M. Lupo[1], Cynthia Chuang[2], Bert Jimenez[1], Susan M. Chang[3], Igor J. Barani[2], Christopher P. Hess[1], Sarah J. Nelson[1,4]
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The potential effects of radiotherapy on neurocognitive ability and quality of life has recently become of great importance as new treatments extend survival in less malignant grade brain tumors. We used Susceptibility-Weighted Imaging at 7T to evaluate the long-term effects of radiation therapy on normal-appearing brain tissue in 20 glioma patients. Microbleeds appeared in irradiated patients after 2 years from receiving therapy, but not in patients treated with only chemotherapy. The prevalence of these lesions increased over time since receiving radiation therapy. The majority of these microbleeds resided within tissue that received 98% of the maximum dose.

17:48 ***621***. **Functional Diffusion Maps (FDMs) Applied to FLAIR Abnormal Regions Can Detect Pseudoprogression from Recurrent Tumor in Malignant Glioma**

Benjamin M. Ellingson[1,2], Mark G. Malkin[1,3], Scott D. Rand[1,2], Jennifer M. Connelly[1,4], Pete S. LaViolette[1,5], Devyani P. Bedakar[1,2], Kathleen M. Schmainda[1,2]
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Patients with malignant gliomas undergoing cytotoxic therapy have been shown to have an increase in the size of contrast-enhancing lesions due to radiation necrosis; however, growing or progressing gliomas also are trademarked by an increase in the size of contrast-enhancing lesions. This phenomenon, known as pseudoprogression, is of significant clinical interest because routine anatomical MRI techniques cannot relibly distinguish these two mechanisms of contrast enhancement during therapy. In the current study, we examine the kinetic profiles of hyper- and hypocellular volumes using functional diffusion maps (fDMs) applied in FLAIR abnormal regions in order to detect pseudoprogression from recurrent tumor in malignant glioma patients treated with cytotoxic therapies.

DSC Perfusion & DCE

Room A4 16:00-18:00 *Moderators:* Peter Gall and Kathleen M. Schmainda

16:00 ***622***. **Improving DSC-MRI by Orientation-Corrected Phase-Based AIF and VOF**

Matus Straka[1], Rexford D. Newbould[2], Milos Sramek[3], Gregory W. Albers[4], Roland Bammer[1]
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Quantitative perfusion measurements require accurate measurements of tracer concentration. Magnitude T2*-based data suffer from various artifacts and non-linearities and make quantification of (mainly vascular) tracer concentration difficult. Concentration can be derived from change in resonante frequency (phase of MR signal), however this effect depends on orientation of given vessel versus main magnetic field. Image-based filtering to enhance cylindrical structures is used to estimate vessel orientation from DSC-MRI data. This information is used to correct the phase information and improve quantification of Gd concentration in large vessels.

16:12 ***623***. **Brain Perfusion with MRI: Arterial Input Function Localization with the Support of MR Angiography**

Bora Buyuksarac[1], Mehmed Ozkan[1]
[1]Bogazici University, Istanbul, Turkey

In perfusion weighted images, the anatomic locations of the arteries are not clearly visible. The conventional arterial input function selection technique is to locate a region on a perfusion image that is supposed to include an artery and select the pixels of which time curves meet the criteria of steepness, narrowness and high signal intensity change. In this study, we alternatively employ MR angiography (MRA) images for more accurate results in localizing the arteries. With this method we achieve automated multiple AIF selection, through which regional CBF images on various brain slices are calculated.

16:24 ***624***. **New Criterion for Automatic AIF Selection in DSC Perfusion MRI to Exclude Partial Volume Effects**

Egbert JW Bleeker[1], Matthias JP van Osch[1], Alan Connelly[2,3], Mark A. van Buchem[1], Andrew G. Webb[1], Fernando Calamante[2,3]
[1]C.J.Gorter Center for High Field MRI, Department of Radiology, Leiden University Medical Center, Leiden, Netherlands; [2]Brain Research Institute, Florey Neuroscience Institutes (Austin), Melbourne, Australia; [3]Department of Medicine, University of Melbourne, Melbourne, Australia

The current criteria for AIF selection algorithms determine "correct" measurements based on the shape of the first passage. However, this shape can be altered by partial volume effects, which often occur in AIF measurements due to the relatively low spatial resolution. A new criterion is proposed, based on tracer kinetic theory, that uses the additional information of the steady state to detect partial volume effects in the AIF measurement. This study shows that the proposed criterion should be a valuable addition to the current selection criteria.

16:36 ***625***. **Quantitative Cerebral Perfusion with SCALE-PWI: Accelerated Image Acquisition and Optimized Image Reconstruction**

Jessy J. Mouannes[1], Wanyong Shin[2], Saurabh Shah[3], Anindya Sen[4], Sameer Maheshwari[1], Timothy J. Carroll[1,4]
[1]Biomedical Engineering, Northwestern University, Chicago, IL, United States; [2]National Institute on Drug Abuse, National Institute of Health, Baltimore, MD, United States; [3]Siemens Medical Solutions USA, Chicago, IL, United States; [4]Radiology, Northwestern University, Chicago, IL, United States

The multi-scan Bookend technique allows accurate, reliable and reproducible quantitative cerebreal perfusion measurements. An accelerated and simplified version of the Bookend technique protocol has been achieved through a Self-CALibrated Epi Perfusion Weighted Imaging (SCALE-PWI) MRI pulse sequence, with scan time under 2 minutes and allowing inline reconstruction of quantitative images of cerebral perfusion. A study of two different delay times between consecutive modules of SCALE-PWI and a water correction factor (WCF) parameterization for SCALE-PWI are presented at 1.5T. The results show that a fast imaging protocol for SCALE-PWI (with zero delay) with appropriate WCF parameterization provide accurate quantitative cerebral perfusion.

16:48 ***626***. **Measurement of Cerebral Blood Flow and Cerebral Blood Volume in Humans Using Washout of Hyperoxic Contrast**

David Thomas Pilkinton[1], Santosh Gaddam[1], Mark A. Elliott[1], Ravinder Reddy[1]
[1]Center for Magnetic Resonance and Optical Imaging, University of Pennsylvania, Philadelphia, PA, United States

It has long been thought that hyperoxia alters the hemodynamics of the brain substantially, confounded attempts to measure hemodynamic quantities with hyperoxic contrast. However, recent studies have shown that cerebral blood flow (CBF) experiences only a small (<4%) reduction upon breathing low to moderate oxygen concentrations ($FiO2 \leq 0.5$). . Since hyperoxic contrast exhibits fast washout times, accurate measurements of dynamic parameters are feasible. We have shown here that that accurate measurements of CBV and CBF can be made dynamically during the washout of hyperoxic contrast using indicator-dilution theory in a manner akin to traditional dynamic susceptibility contrast (DSC) measurements.

17:00 ***627***. **On the Role of Tissue–blood Exchange on the Relaxation Effect of Paramagnetic Blood Tracers**

José Rufino Solera Ureña[1], Salvador Olmos Gassó[1], Valerij G. Kiselev[2]
[1]Aragon Institute of Engineering Research, Universidad de Zaragoza, Zaragoza, Spain; [2]Dept. of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany

The signal attenuation observed in DSC–MRI measurements is considered largely to obey to susceptibility-induced magnetic inhomogeneities at the mesoscopic scale. Another mesoscopic process contributing to increased spin dephasing is the diffusion of tissue water carrying a transverse magnetisation M into the blood pool, where it then experiences faster relaxation due to the presence of paramagnetic contrast agent. To quantify this effect, an effective extravascular dephased volume is defined. Analytical expressions are given for various exchange regimes and numerical estimates are compared with the vascular volume. Results indicate that in the brain the exchange of tissue magnetisation across the blood–brain barrier is permeability limited and does not contribute significantly to the signal dephasing. However, the contribution of magnetisation exchange may be important in organs with increased capillary permeability and/or blood volume. The method is applicable to other problems in quantitative perfusion MRI.

17:12 ***628***. **PET Validation of Vascular-Space-Occupancy CBV Measurement**

Jinsoo Uh[1], Ai-Ling Lin[2], Kihak Lee[2], Peter Fox[2], Hanzhang Lu[1]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Research Imaging Institute, University of Texas Health Science Center, San Antonio, TX, United States

This study validates the use of VASO-MRI for quantitative measurement of cerebral blood volume in unit of ml blood in 100 ml brain. We measured CBV values using PET and VASO-MRI on the same subjects and compared them. The results showed that VASO-MRI provides quantitative and accurate estimations of CBV values in the human brain. Our data also demonstrated that VASO CBV has a higher SNR compared to the PET technique in addition to providing a higher spatial resolution.

17:24 ***629***. **Quantitative Assessment of Perfusion and Permeability in Multiple Sclerosis: Feasibility and Initial Results**

Michael Ingrisch[1], Steven Sourbron[1], Dominik Morhard, Lisa-Ann Gerdes[2], Tania Kümpfel[2], Reinhard Hohlfeld[2], Maximilian F. Reiser, Christian Glaser
[1]Josef Lissner Laboratory for Biomedical Imaging, Institute of Clinical Radiology, Ludwig Maximilian University, Munich, Germany; [2]Institute for Clinical Neuroimmunology, Ludwig Maximilian University, Munich, Germany

We evaluate the feasibility of a 3D DCE-MRI measurement for the absolute quantification of perfusion and permeability in Multiple Sclerosis and present initial results. 19 patients were examined, perfusion and permeability were quantified with 2-compartment models in white matter, non-enhancing(NE) and contrast-enhancing(CE) lesions. The results show clear separation of WM and CE lesions in the permeability estimates; WM perfusion was lower than standard values from literature. The parameter variation in NE- and CE-lesions was relatively large, suggesting a potential for lesion characterization and monitoring of the effects of disease-modifiying drugs.

17:36 ***630***. **Steady State Effects on Cerebral Blood Flow Measurements Using Dynamic Contrast-Enhanced Perfusion MRI: A Simulation Study**

Adam Espe Hansen[1], Henrik Pedersen[1], Henrik BW Larsson[1]
[1]Functional Imaging Unit, Glostrup Hospital, University of Copenhagen, Glostrup, Denmark

Dynamic contrast enhanced (DCE) perfusion MRI of the passage of a Gd bolus requires rapid imaging, which will introduce steady state effects. We simulate the time development of the longitudinal magnetization during a typical R_1 time course and evaluate the influence of steady state effects on the estimation of cerebral blood flow (CBF). We find that steady state effects can seriously affect CBF estimates if the saturation prepulse is not exact. The CBF bias can be minimized to a few percent if a large alfa flip angle of the order of 30 degrees is used.

17:48 ***631***. **Towards More Accurate Modeling of DCE Data: Development of a Multi-Compartment Phantom**

Jeff R. Anderson[1], Joseph J H Ackerman[1], Joel R. Garbow[1]
[1]Washington University in St. Louis, St. Louis, MO, United States

Dynamic contrast enhanced (DCE) MRI is a powerful tool for the imaging of cancer in vivo. However, debate still remains in the literature about which DCE signal model(s) best reflect(s) the image time-course data. An in vitro phantom, based on semi-permeable hollow fibers, has been constructed as a novel platform to assess the quantitative limits of DCE-MRI parameter estimation. Time-of-flight effects allow the intra-lumen signal to be suppressed in the presence of lumen flow and, thus, the kinetic characteristics defining contrast-agent diffusion through the fiber walls into the extra-lumen space to be quantitatively assessed.

Methodology for MR Elastography

Room A5 16:00-18:00 *Moderators:* Richard L. Ehman and Jessica A. Mende

16:00 **Introduction**

Richard L. Ehman

16:12 ***632***. **Wide Dynamic Range MR Elastography of Liver**

Dieter Klatt[1], Detlef Stiller[2], Thomas Kaulisch[2], Heiko Nießen[2], Kerstin Riek[1], Sebastian Papazoglou[1], Thomas Elgeti[1], Ingolf Sack[1], Jürgen Braun[3]
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MR elastography (MRE) enables the measurement of the complex shear modulus G* of biological tissue. Using MRE, the frequency dependency of G* has been examined in the past within a limited dynamic range due to inherent technical restrictions. In this study, G* of liver in a wide dynamic range of more than 4.5 octaves was measured by combining MRE at a 1.5T human scanner system with MRE at a 7T animal scanner. The results of both systems agreed excellently and revealed a power-law behavior of G* between 25Hz and 600Hz vibration frequency. The springpot-model was used for calculating viscoelastic parameters.

16:24 ***633***. **Frequency Dependence of Mouse Brain Tissue Stiffness Measured in Vivo with MR Elastography**

Erik Holt Clayton[1], Joel R. Garbow[2], Philip V. Bayly[1,3]
[1]Mechanical Aerospace & Structural Engineering, Washington University in St. Louis, Saint Louis, MO, United States; [2]Biomedical MR Laboratory, Mallinckrodt Institute of Radiology, Washington University School of Medicine, Saint Louis, MO, United States; [3]Biomedical Engineering, Washington University in St. Louis, Saint Louis, MO, United States

Multifrequency MR elastography (MRE) has been used to measure mechanical stiffness of human brain tissue. The development of cancer treatment protocols may benefit from similar studies in rodent models. Here the viscoelastic material properties of mouse brain were determined by MRE over a range of driving frequencies (600 - 1800 Hz). A novel non-invasive brain actuator was devised to introduce propagating shear waves. Wave motion was imaged with a phase-locked spin echo pulse sequence. Displacement data were inverted in a least-squares manner to obtain complex modulus estimates. Results suggest the frequency response of brain tissue may provide diagnostic value.

16:36 ***634***. **Improving Spatial Resolution of Strain-Encoded (SENC) Magnetic Resonance Elastography (MRE) for Enhancing Stiff-Mass Detection**

Ahmed Amr Harouni[1], Jakir Hossain[1], Michael A. Jacobs[2], Nael Fakhry Osman[1,2]
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Early detection through periodic screening is the key to decrease beast cancer mortality. Fast Strain-encoded (FSENC) MR with a limited hardware was previously introduced to detect different stiffness by measuring the strain. In this work, we introduce a new hardware capable of periodically compressing the breast, which allows us to achieve higher resolution while maintaining same SNR by prolonging scan time. Simple controls and redundant safety measures were added to ensure accurate, repeatable and safe in-vivo experiments. Results show that high-resolution SENC images have four-fold CNR increase relative to low-resolution FSENC images, which leads to better tumor detection.

16:48 ***635***. **Focused Acoustic Driver to Generate High-Frequency Shear Waves in Deep Regions for Magnetic Resonance Elastography**

Mikio Suga[1,2], Takayuki Obata[2], Masashi Sekine[3], Masaya Hirano[4], Hisayuki Miura[5], Ken Arai[5], Shinya Ozawa[5], Hiroo Ikehira[2]
[1]Graduate School of Technology, Chiba University, Chiba , Japan; [2]Molecular Imaging Center, National Institute of Radiological Sciences, Chiba, Japan; [3]Research Center for Frontier Medical Engineering, Chiba University, Japan; [4]GE Healthcare Japan, Tokyo, Japan; [5]Graduate School of Technology, Chiba University, Chiba, Japan

Magnetic resonance elastography (MRE) can noninvasively visualize shear waves patterns within tissue. To acquire an accurate shear modulus map in high spatial resolution in deep regions, external drivers must generate a precisely controlled high frequency and a large amplitude vibration. In this study, we develop a simple and robustly designed focused acoustic driver to enhance shear wave amplitude in deep regions by high frequency using a piezoelectric actuator. From the results of the experimental studies, it was shown that the focused acoustic driver increases the SNR of the shear wave image in the deep region and improves shear modulus quantitatively.

17:00 ***636***. **Effect of Off-Frequency Encoding in Magnetic Resonance Elastography**

Curtis L. Johnson[1], Danchin Chen[1], Harish Sharma[2], Bradley P. Sutton,[2,3], William C. Olivero,[2,4], John G. Georgiadis[1,2]
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The effects of encoding displacement at a frequency other than the driving frequency with Magnetic Resonance Elastography (MRE) were investigated. Off-frequency responses can occur due to possible nonlinearities in the overall dynamic system being actuated. Results demonstrated that undesired off-frequency encoding could result in errors in mean estimated stiffness of tissue, as well as local fluctuations in estimated stiffness, which will have implications for MRE with nonlinear dynamic systems.

17:12 ***637***. **SSFSE Sequence for Fast Elastography in the Presence of Susceptibility**

Ken-Pin Hwang[1,2], Zhenghui Zhang[3], Brandy J. Reed[4], Michelle L. Underwood[4], Roger Jason Stafford[4], Peggy T. Tinkey[5], David C. Alsop[6,7], Rajesh Uthamanthil[5]
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The use of a modified phase contrast gradient echo sequence has been shown to be a robust technique for MR elastography of the liver. However, each phase encoded view requires long motion encoding gradients that extended the echo time, making the sequence sensitive to susceptibility and lengthening overall acquisition time. In this work we combine a motion encoding preparation sequence with an SSFSE sequence originally designed for diffusion weighted imaging. Phase information from a single set of motion encoding gradients is preserved for each echo in the echo train, thus accelerating acquisition in a spin echo based sequence.

17:24 ***638***. **Improvements in Shear Modulus Reconstruction In-Vivo Breast Data Using a Viscoelasitc Material Model in Optimization Driven Mr Elastography**

Matthew Mcgarry[1], Irina Perreard[2], Adam Jeffry Pattison[1], Elijah van Houten[3], John Weaver[2], Keith Paulsen[1]
[1]Thayer School of Engineering, Dartmouth College, Hanover, NH, United States; [2]Department of Radiology, Dartmouth-Hitchcock Medical Center, Lebanon, NH, United States; [3]Department of Mechanical Engineering, University of Canterbury, Christchurch, New Zealand

This work demonstrates the improvements in in-vivo breast shear modulus reconstruction gained through considering the effects of viscoelasticity in a model-based, optimization driven MR elastography algorithm. Three cases with 12 reconstructions are presented where increased shear modulus in the region of a malignant tumor is apparent using a viscoelastic material model. It is shown that using an undamped linear elastic model produces inconclusive results. The improvements are due to a reduction in the model-data mismatch by using a viscoelastic model to fit tissue, which is known to have a significant viscous component.

17:36 ***639***. **Validity Study of Spin Echo EPI Based Hepatic MR Elastography at 3.0T**

David W. Stanley[1], Kevin J. Glaser[2], Meng Yin[2], Jun Chen[2], Richard L. Ehman[2]
[1]MR, GE Healthcare, Proctor, MN, United States; [2]Department of Radiology, Mayo Clinic, Rochester, MN, United States

The purpose of this study was to evaluate a SE-EPI MRE protocol and compare it to a standard GRE MRE protocol at both 1.5T and 3.0T in healthy volunteers with no known liver disease to determine if the signal variations characteristic of the different imaging sequences and field strengths cause a significant change in the SNR of the data or adversely affect the estimates of tissue stiffness.

17:48 ***640***. **Measuring the Effect of Formalin Fixation on Ex Vivo Tissue Material Properties Using High Resolution 3D Quasi-Static MR Elastography at 7 Tesla for Improved Biomechanical Registration of Histopathology, and Correlation with the Effect of Fixation on T<su**

Deirdre Maria McGrath[1], Warren D. Foltz[1], Kristy K. Brock[1,2]
[1]Radiation Medicine Program, Princess Margaret Hospital, Toronto, Ontario, Canada; [2]Department of Radiation Oncology, University of Toronto, Toronto, Ontario, Canada

Correlation of 3D histopathology with in vivo images improves the understanding of disease representation in imaging. The pathology fixation process changes the material properties of tissue non-uniformly and if biomechanical registration is used, measures of these effects are required. A high resolution 3D quasi-static MR elastography (MRE) method at 7 T is presented for voxel-wise mapping of Young's modulus across tissue volumes, and is applied to ex vivo canine prostate samples, pre- and post-fixation. The measures are validated using indentation testing. The effect of fixation on T1, T2 and ADC is also measured, to determine the relationship with material property changes.

Receive Arrays & LNAs

Room A6 16:00-18:00 *Moderators:* James A. Bankson and Mary P. McDougall

16:00 ***641***. **An 8-Channel TX, 16-Channel RX Flexible Body Coil at 7 Tesla Using Both Branches of Centrally Fed Strip Lines as Individual Receive Elements**

Stephan Orzada[1,2], Stefan Maderwald[1,2], Mark Oehmigen[1], Mark E. Ladd[1,2], Klaus Solbach[3], Andreas K. Bitz[1,2]
[1]Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, NRW, Germany; [2]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, NRW, Germany; [3]High Frequency Engineering, University Duisburg-Essen, Duisburg, NRW, Germany

To further increase the capabilities of centrally fed strip line elements, they can be split up into two branches for reception, thereby doubling the number of elements. In this work a flexible body coil with 8 transmit and 16 receive channels built from centrally fed strip line elements with meanders is presented for imaging at 7 Tesla. The new array shows enhanced parallel imaging performance, while good decoupling and transmit penetration are maintained.

16:12 ***642***. **A 7-Tesla High Density Transmit with 28-Channel Receive-Only Array Knee Coil**

Matthew Finnerty[1], Xiaoyu Yang[1], Tsinghua Zheng[1], Jeremiah Heilman[1], Nicholas Castrilla[1], Joseph Herczak[1], Hiroyuki Fujita[1,2], Tamer S. Ibrahim[3,4], Fernando Boada[3,4], Tiejun Zhao[5], Franz Schmitt[6], Bernd Stoeckel[5], Andreas Potthast[6], Karsten Wicklow[6], Siegfried Trattnig[7], Charles Mamisch[7], Michael Recht[8], Daniel Sodickson[8], Graham Wiggins[8], Yudong Zhu[8]
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As more advanced 7T MRI technology continues to emerge, the development of a wider anatomical range of RF coils has become a greater priority. In an effort to take advantage of the greater spatial resolution and higher SNR at 7T, a 12-rung birdcage transmitter and 28-channel receive-only array coil has been developed. To overcome the challenges associated with the shorter wavelength within the human body at 7T, several novel design strategies have been utilized.

16:24 ***643***. **Age-Optimized 32-Channel Brain Arrays for 3T Pediatric Imaging**

Boris Keil[1], Azma Mareyam[1], Kyoko Fujimoto[1], James N. Blau[1], Veneta Tountcheva[1], Christina Triantafyllou[1,2], Lawrence L. Wald[1,3]
[1]A.A. Martinos Center for Biomedical Imaging, Department of Radiology, MGH, Harvard Medical School, Charlestown, MA, United States; [2]A.A. Martinos Imaging Center, Mc Govern Institute for Brain Research, MIT, Cambridge, MA, United States; [3]Harvard-MIT Division of Health Sciences and Technology, MIT, Cambridge, MA, United States

Compromising the size and shape of pediatric brain arrays so that "one size fits all" or using adult brain or knee arrays causes a significant degradation of SNR and parallel imaging performance compared to a coil of the appropriate size and shape for a given aged child. Unfortunately, rapid head growth in the first years of life requires either a flexible array approach or multiple sizes which span the size range with reasonable discrete increments. In this work, we developed and tested four incremental sized 32-channel receive only head coils for pediatric patients spanning an age range of 6 months to 7 years old. The constructed coils show significant SNR gains for both accelerated and unaccelerated imaging in pediatric brain imaging.

16:36 ***644***. **16-Channel Custom-Fitted Bilateral Breast Coil for Parallel Imaging in Two Directions**

Anderson N. Nnewihe[1,2], Thomas Grafendorfer[3], Bruce L. Daniel[1], Paul Calderon[3], Marcus T. Alley[1], Fraser Robb[3], Brian A. Hargreaves[1]
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High spatial and temporal resolution imaging could be used to better classify breast lesions with the potential to improve breast cancer diagnosis. In this work we compare a novel 16-channel bilateral breast coil to a standard commercially-available 8-channel coil, in terms of SNR and parallel imaging capability in two directions. Overall we have demonstrated that a closely-fitted surface array can substantially improve both SNR and parallel imaging capability compared with standard 8-channel bilateral breast coils.

16:48 ***645***. **Modular Multi-Channel Parallel-Imaging Microfluidics Platform with Exchangeable Capillary Diameters**

Dario Mager[1], Andreas Peter[1], Elmar Fischer[2], Patrick James Smith[1], Jürgen Hennig[2], Jan Gerrit Korvink[1,3]
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Solenoidal receiver coils have been directly patterned onto glass capillaries using inkjet printing; in an extension of work that has successfully been used to produce planar receiver coils. Each patterned capillary is housed in a PCB/PMMA holder, which acts as a parallel imaging system for microfluidic analysis.

17:00 ***646***. **Travelling Wave Parallel Imaging**

David Otto Brunner[1], Jan Paska[2], Ingmar Graesslin[3], Jürg Froehlich[2], Klaas Paul Pruessmann[1]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland; [2]Electromagnetic Fields and Microwave Laboratory, ETH Zurich, Zurich, Switzerland; [3]Philips Research Europe, Hamburg, Germany

Since the sample becomes considerably larger than the wavelength in human ultra high field MRI, the electrodynamic degrees of freedom within the loaded bore increases. Using a mode selectively fed waveguide section coupling into the loaded bore it is demonstrated that parallel imaging techniques in transmission and reception such as RF shimming and SENSE can be applied in a travelling wave approach in the absence of a RF array coil close by the object. A direct dependence between the parallel imaging performance of this 8 channel system and the number of modes in the waveguide could be shown.

17:12 ***647***. **A Modular Automatic Matching Network System**

Matteo Pavan[1], Klaas Paul Pruessmann[1]
[1]ETH Zurich, Zurich, Switzerland

In MR measurement, coils are detecting proton signal; they are usually connected through a matching network to very low noise amplifier. The Noise Figure of the amplifier depends on the impedance that its input port sees. To optimize SNR, is important to match this impedance to the one that is reducing at the minimum the noise figure. A new approach for automatic impedance measurement is here presented. This new approach is easy and modular in such a way that it can be scaled to any number of reception channels.

17:24 ***648***. **Accurate Noise Level and Noise Covariance Matrix Assessment in Phased Array Coil Without a Noise Scan**

Yu Ding[1], Yiu-Cho Chung[2], Orlando P. Simonetti[1]
[1]The Ohio State University, Columbus, OH, United States; [2]Siemens Medical Solutions, Columbus, OH, United States

In this study, we propose an novel method to assess noise level and noise covariance matrix in the k-space data when both signal and noise are present. Experimental results show that the noise level as well as the noise covariance matrix can be accurately derived from multi-frame k-space data without deploying a separate noise scan.

17:36 ***649***. **A Magnetic-Field-Tolerant Low-Noise SiGe Pre-Amplifier and T/R Switch**

David Ian Hoult[1], Glen Kolansky[1]
[1]Institute for Biodiagnostics, National Research Council Canada, Winnipeg, Manitoba, Canada

The noise figure and gain of GaAs field effect transistors degrade in magnetic fields. A SiGe bipolar transistor is advocated as a replacement giving at 123 MHz a noise figure of 0.6 dB with ~ 20 dB current blocking. Our SiGe pre-amplifier has a noise figure < 1dB from 90 to 200 MHz, a gain of 30 dB, a bandwidth of 73 to 163 MHz and a group delay of 5.4 ns. The accompanying 300 W quarter-wave PIN diode transmit/receive switch has 0.1 dB noise figure, an insertion loss of 1 dB and isolation of ~ 65 dB.

17:48 ***650***. **Frequency Selective Negative Feedback to Avoid Preamplifier Oscillation in Multi-Channel Arrays**

Thomas Grafendorfer[1,2], Greig Scott[2], Paul Calderon[3], Fraser Robb[4], Shreyas Vasanawala[5]
[1]RX & ATD Coils, GE Healthcare, Stanford, CA, United States; [2]Electrical Engineering, Stanford University, Stanford, CA, United States; [3]MR Hardware Engineering, GE Healthcare, Fremont, CA, United States; [4]Advanced Technology, GEHC Coils, Aurora, OH, United States; [5]Radiology, Stanford University, Stanford, CA, United States

Placing the preamplifiers close to the coil elements in multi-channel arrays increases preamplifier-decoupling performance, which leads to better SNR and better acceleration performance. Unfortunately it also opens a new feedback path that can easily lead to oscillation. We developed a new strategy by applying frequency selective negative feedback that suppresses the gain at the so-called match split peaks outside the frequency band relevant for MRI. This greatly reduces the possibility for oscillation, and the gain within the signal band stays more or less unaffected.

MR of Cancer Cell Models

Room A7 16:00-18:00 *Moderators:* Kristine Glunde and John R. Griffiths

16:00 ***651***. **De Novo Lipogenesis from Glutamine in Human Glioma Cells**

Anthony Mancuso[1], Justin R. Cross, Craig B. Thompson
[1]Cancer Biology, University of Pennsylvania, Philadelphia, PA, United States

Rapidly growing cancer cells require high rates of phospholipid biosynthesis for the formation of new membranes. Cancer cells produced fatty acids for lipids de novo, primarily from glucose. An improved understanding of the pathways involved in de novo lipogenesis could greatly advance the development of new therapeutics that inhibit cancer cell growth. In this work, FA synthesis from both glucose and glutamine was examined with ^{13}C NMR spectroscopy

in cultured human glioma cells. Cells were cultured in T-flasks and extracted for high-resolution analysis. The results show that glucose is the primary source for de novo lipogenesis while glutamine contributes ~30%.

16:12 ***652***. **The Interdependence of Choline Kinase and Phospholipase D: Adaptation Mechanisms in Choline Phospholipid Metabolism of Human Breast Cancer Cells**

Balaji Krishnamachary[1], Mayur Gadiya[2], Noriko Mori[1], Yelena Mironchik[1], Kristine Glunde[1], Zaver M. Bhujwalla[1]
[1]JHU ICMIC Program, Russell H. Morgan Department of Radiology & Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]JHU ICMIC Program, Russell H. Morgan Department of Radiology & Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States

A hallmark of cancer is an increase of cellular phosphocholine (PC) and total choline-containing compounds (tCho), which are closely related to malignant transformation, invasion and metastasis. Enzymes in choline metabolism present attractive targets that can be exploited for treatment. Here we have shown that at least two of these enzymes are interdependent. Downregulation of choline kinase (Chk) with siRNA results in increased phospholipase D1 (PLD1) expression and downregulation of PLD1 results in increased Chk expression, typifying the ability of cancer cells to adapt. These data support multiple targeting of enzymes in the choline pathway using a multiple siRNA approach.

16:24 ***653***. **Down Regulation of HIF-1 Alpha in MDA-MB-231 Human Breast Cancer Cells Alters Choline Phospholipid Metabolism**

Tariq Shah[1], Balaji Krishnamachary[2], Flonne Wildes[2], Zaver M. Bhujwalla[1]
[1]JHU ICMIC Program, Russell H Morgan Department of Radiology and Radiological Sciences, Johns Hopkins School of Medicine , Baltimore, MD, United States; [2]JHU ICMIC Program, Russell H Morgan Department of Radiology and Radiological Sciences, Johns Hopkins School of Medicine, Baltimore, MD, United States

The hypoxia inducible factor (HIF) recognizes and binds to consensus sequences called hypoxia response elements on the promoter regions of several genes, increasing their transcription. As a result hypoxia plays an important role in the cancer phenotype. Here we silenced HIF-1 alpha expression in invasive MDA-MB-231 breast cancer cells and characterized metabolic changes using a magnetic resonance compatible cell perfusion system with cells maintained under controlled pH, temperature, and oxygenation conditions. HIF-1 alpha silenced cells acquired a less aggressive metabolic phenotype with reduced choline kinase expression, together with reduced total choline and phosphocholine, compared to parental cells.

16:36 ***654***. **MRS Detection of Altered Choline Metabolism Following HSP90 Inhibition**

Alissa Brandes[1], Chris S. Ward[1], Judy S. Hwang[1], Sabrina M. Ronen[1]
[1]Radiology, UCSF, San Francisco, CA, United States

Although most anticancer therapies cause a drop in PC levels,, treatment with the HSP90 inhibitor 17-AAG has been shown to have the unique consequence of increasing PC. Our study investigated the mechanism behind this observed increase by monitoring the uptake and metabolism of [1,2-13C]-choline in live cells and cells extracts using 1H, 31P and 13C MRS and performing assays on the activity of enzymes involved in choline metabolism. Our data indicate that the observed increase in PC levels in 17-AAG-treated cancer cells is due to an increase in the synthesis of PC from extracellular choline, along with increased breakdown of PtdCho via PLC.

16:48 ***655***. **Silencing GDPD5, a Novel Anticancer Target, Increases Glycerophosphocholine in Human Breast Cancer Cells**

Mailin Döpkens[1,2], Tiffany R. Blackwell[1], Farhad Vesuna[1], Venu Raman[1], Balaji Krishnamachary[1], Zaver M. Bhujwalla[1], Dieter Leibfritz[2], Kristine Glunde[1]
[1]JHU ICMIC Program, Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Department of Chemistry and Biology, University of Bremen, Bremen, Germany

Altered choline phospholipid metabolism in breast cancers provides multiple targets for anticancer therapy. In addition to increasing total choline levels, malignant transformation of breast cancer cells results in a switch from high glycerophosphocholine (GPC) and low phosphocholine (PC) to low GPC and high PC. The glycerophosphocholine phosphodiesterase (GPC-PDE) genes responsible for the low GPC levels in breast cancer cells have not been identified. Here we demonstrate that glycerophosphodiester phosphodiesterase domain containing 5 (GDPD5), a gene encoding a GPC-PDE, is at least partially responsible for the low GPC levels in breast cancer cells, and may be a useful therapeutic target.

17:00 ***656***. **Noninvasive Monitoring of PI3K Inhibition: Reduced Hyperpolarized Lactate and PC Are Independent of Genetic Background in Glioblastoma**

Humsa S. Venkatesh[1], Charles D. James[2], Daphne A. Haas-Kogan[2], Sabrina M. Ronen[1]
[1]Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States; [2]Neurological Surgery, University of California, San Francisco

As the PI3K pathway is activated in 88% of glioblastomas, it is the target of several novel therapies. The purpose of this investigation is to study GBM cells with different genetic backgrounds in order to establish hyperpolarized lactate and PC as biomarkers of PI3K inhibition. Two inhibitors of PI3K signaling and agents that do not affect signaling were investigated. Hyperpolarized lactate and PC dropped only when signaling was inhibited and this observation was mechanistically linked to a drop in HIF-1, which controls expression of LDH and choline kinase. This suggests an application for these metabolites as noninvasive biomarkers for PI3K-targeted anticancer treatments.

17:12 ***657***. **Hyperpolarized [1-13C] Pyruvate Metabolism in a Human Prostate Tissue Culture Bioreactor**

David J. Joun[1], Mark Albers[1], Kayvan Keshari[1], Robert Bok[1], Christopher Ward, Donna Peehl[2], Sabrina Ronin, Daniel Vigneron, John Kurhanewicz
[1]Radiology, UCSF, San Francisco, CA, United States; [2]Urology, Stanford, Stanford, CA, United States

We demonstrate for the first time that the pathologic and metabolic integrity of benign and malignant human prostate tissues can be maintained in a NMR compatible 3-D tissue culture bioreactor for 32 hours. After administration of hyperpolarized [1-13C] pyruvate, the generation of labeled hyperpolarized lactate and LDH activity was significantly higher in malignant tissues (N=3) relative to benign human prostate tissues (N=3). Moreover, there was minimal

overlap of the labeled hyperpolarized lactate signal between individual cancer and benign tissues suggesting that hyperpolarized lactate will be an accurate biomarker of prostate cancer in patients.

17:24 ***658***. **The Glucose Dependent Transcription Factor ChREBP Contributes to Glucose-Dependent Anabolic Synthesis and Cell Proliferation**

Xuemei Tong[1], Anthony Mancuso[2], Fangping Zhao, Joshua J. Gruber, Craig B. Thompson
[1]University of Pennsylvania, Philadelphia, PA, United States; [2]Cancer Biology, University of Pennsylvania, Philadelphia, PA, United States

Many human tumors display high rates of aerobic glycolysis, de novo fatty acid synthesis and nucleotide biosynthesis. Although these metabolic alterations might not be initiating events in oncogenesis, blocking them may be a useful strategy for slowing carcinogenesis. The carbohydrate responsive element binding protein (ChREBP) is a critical mediator of glucose-dependent metabolism. In this study, the metabolic effects of ChREBP knockdown in human colon cancer cells were examined with ^{13}C NMR and ^{14}C scintillation. The results demonstrated that knockdown reduced aerobic glycolysis and growth-related biosynthesis. It also increased TCA cycle flux and oxygen consumption, resulting in a less cancerous phenotype.

17:36 ***659***. **Metabolic Profiling of Post-Radiation Prostate Biopsy Tissues**

Vickie Yi Zhang[1,2], Mark Swanson[1], Laura Tabatabai[3], Jeff Simko[3], Lynn DeLosSantos[1], Daniel Vigneron[1], John Kurhanewicz[1]
[1]Radiology, University of California, San Francisco, San Francisco, CA, United States; [2]Joint Bioengineering Program, University of California, Berkeley/San Francisco, San Francisco, CA, United States; [3]Pathology, University of California, San Francisco, San Francisco, CA, United States

Synopsis: This study used quantitative 1-D 1H HR-MAS spectroscopy of snap frozen prostate biopsies to investigate the metabolic profiles of healthy versus cancer prostate tissues after radiation therapy. Metabolite concentrations were correlated with pathology and Ki-67 immunohistochemistry to identify a metabolic phenotype of proliferating residue cancer. Significantly higher concentrations of PC+GPC, lactate and glutamate were observed in benign versus residual proliferating cancer tissues after radiation treatment.

17:48 ***660***. **Measurements of Mean Nuclear and Cell Sizes Using Ultra-Short Diffusion Times**

Junzhong Xu[1], Jingping Xie[1], Ke Li[1], Jerome Jourquin[2], Mark D. Does[1], Daniel F. Gochberg[1], Vito Quaranta[2], John C. Gore[1]
[1]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States; [2]Cancer Biology, Vanderbilt University, Nashville, TN, United States

Tumor cell nuclear size usually can be found only by invasive biopsy. In the present work, a novel approach, which employs an oscillating gradient spin echo (OGSE) method, has been developed to measure nuclear size with ultra-short diffusion times (low as ~0.13ms). Both simulations and experiments were performed and the results obtained from OGSE diffusion measurements are consistent with light microscopy, proving the feasibility of our method. This new approach provides structural parameters which may be helpful for the assessment of tumor malignancy, tracking intracellular changes in tissues, and potentially monitoring tumor response to treatment in vivo.

Atherosclerosis, Coronary & Vessel Wall Imaging

Room A8 16:00-18:00 *Moderators:* Suzanne C. Gerretsen and Yi Wang

16:00 ***661***. **Diagnostic Performance of Non-Contrast Whole-Heart Coronary Magnetic Resonance Angiography Combined with Black-Blood Arterial Wall Imaging in Patients with Suspected Coronary Artery Disease**

Qinyi Dai[1], Zhaoqi Zhang[1], Yi He[1], Wei Yu[1], Biao Lu[1], Zhanming Fan[1], Jing An[2], Lixin Jin[3], Renate Jerecic[3], Guobin Li[4], Wolfgang Rehwald[5], Debiao Li[6]
[1]Radiology, AnZhen Hospital, Beijing, China; [2]Siemens Mindit Magnetic Resonance, Siemens Healthcare, MR Collaboration NE Asia; [3]Siemens Limited China, Siemens Healthcare, MR Collaboration NE Asia; [4]Siemens Mindit Magnetic Resonance Ltd.; [5]Siemens Healthcare USA; [6]Northwestern University, Chicago, IL, United States

The combined Whole-heart coronary MRA and black-blood-coronary-wall-imaging hasn't been reported to detect CAD yet. Continuous slices for wall imaging of 48 segments were positioned along the suspected lesions of WH CMRA. A positive diagnosis of CAD was made when stenosis ¡Ý50% at least one of the techniques. 15/48 segments were diagnosed as CAD by x-ray angiography. The sensitivities of WH CMRA only and both techniques were (12/15) and (14/15), NPVs were (33/36) and (33/34), respectively. There was no difference in specificity or PPV. The combination of two techniques improves the diagnostic accuracy to detect CAD over WH CMRA alone.

16:12 ***662***. **Contrast-Enhanced Whole-Heart Coronary MRA in 5 Minutes Using Radial EPI**

Himanshu Bhat[1], Qi Yang[2], Sven Zuehlsdorff[3], Debiao Li[1]
[1]Radiology and Biomedical Engineering, Northwestern University, Chicago, IL, United States; [2]Radiology, Capital Medical University, Xuanwu Hospital, Beijing, China; [3]Siemens Medical Solutions USA, Inc., Chicago, IL, United States

Whole-heart coronary MRA is challenging due to the long data acquisition time on the order of 8-12 minutes. The purpose of this work was to optimize a radial EPI technique for contrast-enhanced whole-heart coronary MRA, with the goal of combining the scan efficiency of EPI with the motion insensitivity of radial sampling.

16:24 ***663*. MRI Assessment of Endothelial Damage and Angiogenesis in Porcine Coronary Arteries Using Gadofosveset**

Steen Fjord Pedersen[1], William P. Paaske[2], Troels Thiem[3], Steffen Ringgaard[4], Samuel A Thrysøe[4], Won Yong Kim[5]
[1]Aarhus University Hospital, Aarhus, Denmark; [2]1Dept. of Cardiothoracic and Vascular Surgery T, Aarhus University Hospital, Skejby, Denmark; [3]Dept. of Cardiology, Aarhus University Hospital, Skejby, Denmark; [4]MR-center, Aarhus University Hospital, Skejby, Denmark; [5]Dept. of Cardiology, and MR-center, Aarhus University Hospital, Skejby, Denmark

Endothelial damage and angiogenesis are essential in atherosclerotic plaque development and destabilization .We sought to examine whether contrast enhanced MRI using gadofosveset would enable the detection of endothelial damage and neovessels in balloon injured porcine coronary arteries. MRI showed contrast enhancement of the injured vs. the non-injured control artery with a significant increase in the diameter of (30±19 % versus 4±8%; P=0.01). Ex-vivo coronary vessel wall MRI contrast enhancement was in agreement with extravasated Evans blue with a kappa value of 0.64 ($p<0.001$). and there was a linear correlation between coronary MRI contrast-enhancement and microvessel density ($r=0.78$, $p<0.001$).

16:36 ***664*. Assessment of Coronary Endothelial Dysfunction in Young Healthy Smokers Using 3T Phase Contrast Cine MRI and Cold Pressor Test**

Shingo Kato[1], Hajime Sakuma[1], Kakuya Kitagawa[1], Motonori Nagata[1], Yeonyee. E Yoon[1], Shinichi Takase[1]
[1]Department of Radiology, Mie University Hospital, Tsu, Mie, Japan

Blood flow volumes in the LAD artery and in coronary sinus (CS) at rest and during cold pressor test were quantified in 10 young non-smokers and 6 age-matched smokers using 3T MR imager. Coronary flow was significantly augmented during CPT in non-smokers (LAD: 28.5 ± 6.8mL/min to 36.5 ± 7.3mL/min, $p=0.017$). However, the CPT/rest coronary flow ratio was significantly reduced in smokers when compared with non-smokers (0.86 ± 0.26 vs 1.33 ± 0.38, $p=0.02$). CPT test using 3T MR imager allows for non-invasive assessment of coronary endothelial dysfunction.

16:48 ***665*. Reproducible Coronary Vessel Wall Imaging at 3T Using Improved Motion Sensitized Driven Equilibrium (IMSDE).**

Suzanne Gerretsen[1], Jinnan Wang[2,3], Jeffrey H. Maki[3], Caroline Jaarsma[1], Daniel Herzka[4], Boacheng Chu[3], Vasily V. Yarnykh[3], Chun Yuan[3], Tim V. Leiner[1]
[1]Radiology, Maastricht University Medical Center, Maastricht, Netherlands; [2]Clinical Sites Research Program, Philips Research North America, Seattle, WA, United States; [3]Radiology, University of Washington, Seattle, WA, United States; [4]School of Medicine, Johns Hopkins University, Baltimore, MD, United States

This study investigated the reproducibility of the recently developed improved Motion Sensitized Driven Equilibrium (iMSDE) technique for MR imaging of the coronary vessel wall at 3T. 19 volunteers underwent MRI of the right coronary artery lumen and vessel wall twice. Lumen diameter and vesselwall thickness measurements were performed, and measurements of the two scanning sessions were compared. In 15/19 volunteers two measurements of both coronary lumen and vessel wall were acquired successfully. This study demonstrated that iMSDE is able to visualize the coronary vessel wall of healthy volunteers at 3T with good reproducibility of lumen diameter and wall thickness measurements.

17:00 ***666*. Correlation of Atherosclerotic Plaque Compositions in Coronary and Carotid Arteries**

Qian Zhao[1], Xihai Zhao[2], Jianming Cai[3], Feiyu Li[2], Jianli Yang[1], Chun Yuan[2], Zulong Cai[3]
[1]Radiology, The General Hospital of Beijing Military Area Command of People's Liberation Army, Beijing, China; [2]Radiology, University of Washington, WA, Seattle, United States; [3]Radiology, The General Hospital of Chinese PLA, Beijing, China

Atherosclerosis has been shown to be a systematic disease which often involves multiple arterial vascular beds. Recently, a number of studies demonstrated that there is a significant correlation between coronary and carotid atherosclerosis. This study sought to evaluate the association between coronary and carotid plaque compositions. Our results showed coronary plaque types significantly associating with carotid plaque compositions. In particular, coronary mixed plaque might be may be effective classifiers of carotid plaque compositions, especially for carotid IPH.

17:12 ***667*. Wall Shear Stress as a Stimulus for Intra-Plaque Hemorrhage in Carotid Atherosclerotic Plaque: An MRI-Based CFD Pilot Study**

Gador Canton[1], Huijun Chen[1], Minako Oikawa[2], Hunter R. Underhill[1], Wei Yu[3], Thomas S. Hatsukami[4], Chun Yuan[1], William Sean Kerwin[1]
[1]Radiology, University of Washington, Seattle, WA, United States; [2]Cardiovascular Medicine, Tohoku University, Sendai, Japan; [3]Radiology, Beijing Anzhen Hospital, Beijing, China; [4]Surgery, University of Washington, Seattle, WA, United States

The aim of this study was to explore the hypothesis that intra-plaque hemorrhage, a feature associated with adverse outcomes and atherosclerotic plaque progression, is more likely to occur in plaques with elevated levels of wall shear stress (WSS). We used multi-sequence MRI to characterize seven human carotid atherosclerotic plaques and an MRI-based computational fluid dynamics (CFD) model to solve the equations governing the blood flow. The results from this pilot study indicate a possible link between the presence of hemorrhage within a lipid-rich necrotic core in human carotid atherosclerotic plaques and the shear stress force acting on the luminal surface.

17:24 ***668*. Identification of Lipid Deposits and Quantification of Carotid Endarterectomy Plaque Components Using High Resolution MRI and Image-Guided Proton MRS at 11.7T**

Haiying Tang[1], Vladimir Reiser[1], Zhi-Qiang Zhang[1], Ting-Chuan Wang[1], Suzanne S. Eveland[1], Zhu Chen[1], Ben T. Chen[1], Edward A. O'Neill[1], Michael Klimas[1]
[1]Merck Research Laboratories, Rahway, NJ, United States

Patients with carotid plaque undergo endarterectomy based on empirical guidelines, primarily the magnitude of stenosis. Patients who would derive benefit from carotid endarterectomy are those with lipid rich, vulnerable plaque at high risk of rupture. We hypothesis that non-invasive MRI technique can provide distinguishable signal features of plaque components such as fibrous tissue, lipid-rich necrotic core, intra-plaque hemorrhages, and calcifications, therefore can help identify at-risk patients preoperatively. The purpose of this study is to demonstrate the capability of MRI and MRS methods for characterizing plaque composition and quantifying lipid deposition, thereby facilitating development of noninvasive, quantitative predictor of plaque stability.

17:36 ***669***. **3D Projection Reconstruction Based Respiratory Motion Correction Technique for Free-Breathing Coronary MRA**

Himanshu Bhat[1], Lan Ge[1], Sonia Nielles-Vallespin[2], Sven Zuehlsdorff[3], Debiao Li[1]
[1]Radiology and Biomedical Engineering, Northwestern University, Chicago, IL, United States; [2]Cardiovascular MR Unit, Royal Brompton And Harefield NHS Foundation Trust, London, United Kingdom; [3]Siemens Medical Solutions USA, Inc., Chicago

Current navigator based free-breathing coronary MRA techniques measure the position of the diaphragm and use a fixed correlation factor to estimate the position of the heart. Such techniques suffer from errors due to the indirect estimation of heart position and are plagued by low scan efficiencies (typically between 30 and 50 %). The purpose of this work was to develop a 3D projection reconstruction (3D PR) based coronary MRA technique which accepts all the data during the scan, irrespective of respiratory position, and retrospectively corrects for respiratory motion by using 3D image registration.

17:48 ***670***. **Multimodality Imaging of Carotid Artery Plaques: 18F-FDG PET, CT, and MRI**

Robert Kwee[1], Gerrit Teule, Robert van Oostenbrugge, Werner Mess, Martin Prins, Rob van der Geest[2], Paul Hofman, Jos van Engelshoven, Joachim Wildberger, Eline Kooi
[1]Maastricht University Medical Center, Maastricht, Limburg, Netherlands; [2]Leiden University Medical Center,Leiden, Netherlands

The present study demonstrated that overall correlations between 18F-FDG PET findings and morphological and compositional CT/MRI findings of carotid plaques are weak. Correlations between CT and MRI findings are moderate-to-strong, but measurements of lipid-rich necrotic core and calcifications are significantly larger at CT, whereas measurements of fibrous tissue are significantly larger at MRI. There is also considerable variation in absolute differences between CT and MRI measurements, implying that CT and MRI are not interchangeable. Future prospective longitudinal studies should determine which imaging modality is most effective for risk stratifying patients for stroke.

Novel Approaches to Image Analysis

Room A9 16:00-18:00 *Moderators:* Babak A. Ardekani and Ting Song

16:00 ***671***. **Ultra Fast Registration of Multiple MR Volumes Using MOPED**

Mark E. Bastin[1], Benjamin D. Panter[2], Robert J. Tweedie[2], William J. Hossack[3], Alan F. Heavens[2]
[1]Medical Physics, University of Edinburgh, Edinburgh, Midlothian, United Kingdom; [2]Institute for Astronomy, University of Edinburgh, Edinburgh, United Kingdom; [3]Physics, University of Edinburgh, Edinburgh, United Kingdom

Registration is a critical step in the calculation of imaging biomarkers derived from functional, diffusion, perfusion and permeability MRI. These datasets typically comprise many tens of volumes, and contain up to 100 individual images, registration of which leads to a significant computational overhead in the processing pipeline. In this abstract we present initial results from the application of a novel registration method based on the MOPED algorithm, developed in the field of astronomy, which has the potential to reduce significantly the time taken to align high dimensional MRI data.

16:12 ***672***. **Multi-Modal Structural Networks: Mapping of Connectivity Through Diffusion, Functional, and Structural Assessment of Intervening Pathways**

John A. Bogovic[1], Min Chen[1], Aaron Carass[1], Pierre-Louis Bazin[2], Dzung Pham[2], Susan M. Resnick[3], Jerry L. Prince[1,4], Bennett Allan Landman[4,5]
[1]Electrical and Computer Engineering, Johns Hopkins University, Baltimore, MD, United States; [2]Radiology, Johns Hopkins University, Baltimore, MD, United States; [3]Laboratory of Personality and Cognition, National Institute on Aging, Baltimore, MD, United States; [4]Biomedical Engineering, Johns Hopkins University, Baltimore, MD, United States; [5]Electrical Engineering, Vanderbilt University, Nashville, TN, United States

Understanding anatomical connectivity and multivariate relationships in neuroimaging data may be essential to elucidate multiple small changes across the brain that combine to manifest in observable phenotypes. While there are powerful tools to assess connectivity through graphs using diffusion weighted MRI (DW-MRI), association of DW-MRI metrics with connectivity necessitates ad hoc choices. Herein, we show how connectivity can be interpreted by multimodal characterization of the tissues through which estimated tracts pass (in addition to metrics on the DW-MRI tracts). We define and compute multi-modal structural networks, which are multivariate graphs representing connectivity among structural regions.

16:24 ***673***. **MR-Based Whole-Body PET Attenuation Correction in Hybrid PET/MRI: A Computationally Inexpensive Algorithm for T1, T2, and Proton Density Weighted Images**

Harry Robert Marshall[1,2], Robert Z. Stodilka, [12], Benoit Lewden[2], Jean Theberge[1,2], Eric Sabondjian, [12], Alexandre G. Legros[2], Andrea J. Mitchell[2], Lela Deans[2], Jane M. Sykes[2], R Terry Thompson, [12], Frank S. Prato[1,2]
[1]Medical Biophysics, The University of Western Ontario, London, ON, Canada; [2]Imaging, Lawson Health Research Institute, London, ON, Canada

Whole-body attenuation correction of PET images remains a crucial unsolved problem in hybrid PET/MRI. We present an algorithm capable of taking any of T1, T2, or proton density weighted MRI images as input and producing a PET attenuation map of comparable quality to a gold standard CT-derived attenuation map. The idea is that no “special” MRI sequences need to be acquired solely for the purposes of attenuation correction. The algorithm was tested on nine low resolution canine images with significant motion artefacts to ensure robustness.
The algorithm ran to completion in under one minute making it practical for clinical use.

16:36 ***674***. **MRI Measurement of Ischemic Brain Penumbra Using an Inelastic Collision Model**

Hassan Bagher-Ebadian[1,2], Panayiotis D. Mitsias[1], Mohammad Hossein Asgari[1], Michael Chopp[1,2], James Russel Ewing[1,2]
[1]Department of Neurology, Henry Ford Hospital, Detroit, MI, United States; [2]Department of Physics, Oakland University, Rochester, MI, United States

Experimental and clinical studies indicate that the likelihood for progression to infarction in the penumbra of physiologically impaired but potentially salvageable tissue surrounding the central core of focal cerebral ischemia is an important factor in evaluating treatment efficacy. Thus, a multi-parametric

analysis that increases the ability of investigators to detect and characterize ischemic penumbra in the early stages of stroke have a profound clinical significance. In this study, a mechanical model of inelastic collision is recruited and adapted to information theory for constructing a model-based algorithm for multi-parametric analysis of MR information in acute stroke to detect ischemic brain penumbra.

16:48 ***675***. **A General Framework for the Analysis of Vessel Encoded Arterial Spin Labelling**

Michael A. Chappell[1,2], Tom W. Okell[1], Peter Jezzard[1], Mark W. Woolrich[1]
[1]FMRIB Centre, University of Oxford, Oxford, United Kingdom; [2]Institute of Biomedical Engineering, University of Oxford, Oxford, United Kingdom

Vessel Encoded ASL offers non-invasive vascular territory images. By spatially modulating the ASL label over a series of acquisitions blood from individual arteries is uniquely encoded such that its contribution can subsequently be extracted in the analysis. We propose a framework for the analysis of VE-ASL that combines the advantages of the two leading analysis approaches and is able to estimate perfusion even in areas supplied by multiple arteries in the face of limited data quality and quantity.

17:00 ***676***. **In Vivo Myelin Water Imaging Using 3D Multi-Gradient-Echo Pulse Sequences**

Claudia Lenz[1], Klaus Scheffler[1], Markus Klarhöfer[1]
[1]Radiological Physics, University of Basel Hospital, Basel, Switzerland

Quantitative imaging of the myelin water fraction (MWF) is able to show demyelinating processes and therefore provides insight into the pathology of white matter diseases such as multiple sclerosis. So far, mapping of the MWF most often was performed using single-slice multi-echo spin-echo sequences. Lately, a different approach, using multi-gradient-echo pulse sequences, was introduced by one study measuring formalin-fixed brains and has been adapted to in vivo measurements by different groups since then. In this work, we present a solution for 3D in vivo myelin water imaging with whole brain coverage by applying multi-gradient-echo pulse sequences and using a non-negative least squares algorithm to analyze the T2* decay.

17:12 ***677***. **Inferring Axon Properties with Double-PGSE MRI Using Analytical Water Diffusion Model**

Wenjin Zhou[1], David H. Laidlaw[1]
[1]Computer Science, Brown University, Providence, RI, United States

We present an analytical water diffusion model for inferring axon properties using double-PGSE MRI accounting for finite gradient pulses. Our estimation results demonstrate the feasibility of revealing axon properties including axon caliber using this approach. The model utilizes the signal intensity dependency on two gradient-pair direction variation to compensate for high-q requirement in single-PGSE experiments. Since many gradient directions can be acquired in rather short time on the current MRI scanner, this approach may suggest potential for clinical axonal-property estimation.

17:24 ***678***. **A Rapid, Robust, Anatomy and Atlas Guided Lesion Quantification Framework from Diffusion Weighted MR Images**

Sumit K. Nath[1], Dattesh Dayanand Shanbhag[1], Rakesh Mullick[1], Uday Patil[1], Marie Luby[2], Katherine D. Ku[2], Lawrence L. Latour[2], Steven Warach[2], - NINDS Natural History of Stroke Investigators[2]
[1]Imaging Technologies, GE Global Research, Bangalore, Karnataka, India; [2]NINDS, NIH, Bethesda, MD, United States

A novel anatomical and atlas guided split-and-merge algorithm is presented for quantifying potential lesions in diffusion weighted MR images. Compared with a conventional non split-and-merge method, our approach leads to highly improved results when analyzed with ground truth.

17:36 ***679***. **Robust Automatic Rodent Brain Extraction Using Pulse-Coupled Neural Networks in 3D**

Nigel Chou[1], Jolena Tan[1], Asad Abu Bakar Md Ali[1], Kai-Hsiang Chuang[1]
[1]Laboratory of Molecular Imaging, Singapore Bioimaging Consortium, Agency for Science, Technology and Research (A*STAR), Singapore, Singapore

We present an automatic brain-extraction algorithm optimized for rodents, based on a pulse-coupled neural network (PCNN) operating in 3D. PCNN 'links' pixels with similar intensity, then a morphological operation is used to separate regions, of which the largest is selected as the brain mask. Using Jaccard index and True-positive Rate as a measures of similarity to a manual gold-standard, this method showed improved performance compared to an existing algorithm (Brain Surface Extraction) and a PCNN algorithm operating in 2D mode (on slices). Additional advantages include reduced user intervention and accurate segmentation of the olfactory bulb and paraflocculus of cerebellum.

17:48 ***680***. **Non-Invasive and Temporally Resolved Measurement of Ischaemic Tissue Damage in Acute Stroke Using Quantitative ^{23}Na Magnetic Resonance Microscopy at 7 T**

Friedrich Wetterling[1], Lindsay Gallagher[2], Mhairi I. Macrae[3], Sven Junge[4], Andrew John Fagan[5]
[1]School of Physics, Trinity College Dublin, Dublin, Ireland; [2]Glasgow Experimental MRI Centre, , Division of Clinical Neuroscience, Faculty of Medicine, University of Glasgow, Glasgow, Scotland, United Kingdom; [3]Glasgow Experimental MRI Centre, Division of Clinical Neuroscience, Faculty of Medicine, University of Glasgow, Glasgow, Scotland, United Kingdom; [4]Bruker BioSpin GmbH, Ettlingen, Germany; [5]Centre for Advanced Medical Imaging, St. James's Hospital, Dublin, Ireland

In the current study, quantitative ^{23}Na Magnetic Resonance Microscopy (qNa MRM) was used to measure the time course of Tissue Sodium Concentration (TSC) in order to investigate regional variations in TSC behavior in the first 8 hours after stroke in a rodent model. The timecourse of the TSC evolution was reproducible (n=5) with similar regional delays evident in the timepoint at which the TSC increased during the first hours after MCAO in each rat. The delay time parameter could be used as a measure of ischaemic core tissue growth, non-invasively and temporally resolved, thereby offering an alternative method to post-mortem histology.

FRIDAY

SUNRISE EDUCATIONAL COURSE
Hot Topics in Body MRI: NSF Update

Room K1 07:00 – 08:00 *Organizers*: Talissa Altes, Elmar Max Merkle and Bachir Taouli

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the current knowledge on NSF;
- Explain current guidelines and regulations involving the use of Gadolinium contrast agents;
- Evaluate the impact of NSF on body MR practice; and
- Describe the results of non contrast sequences applied to body imaging.

NSF Update ***Moderators:*** **Talissa Altes and Elmar Max Merkle**

07:00 **NSF Update & Impact on Your Practice**
Jeffrey C. Weinreb, M.D.

07:30 **Non Contrast MRI of the Abdomen: Does It Work?**
Christoph J. Zech, M.D.

SUNRISE EDUCATIONAL COURSE
Tissue Contrast in MSK MRI - From Physics to Physiology

Room K2 07:00 – 08:00 *Organizer & Moderator*: Bernard J. Dardzinski

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe contrast mechanisms in MSK imaging, most notably in imaging of articular cartilage;
- Describe the physics of advanced MR sequences;
- Identify the most suitable new MR sequences for four important indications;
- Implement current MR protocols for daily practice and be aware of the most useful indications for these techniques.

07:00 **T1rho Imaging: Techniques and Basis for Image Contrast**
Ravinder Reddy, Ph.D.

07:30 **MSK Clinical and Research Applications of UTE Imaging**
Christine Chung, M.D.

SUNRISE EDUCATIONAL COURSE

Image Reconstruction

Victoria Hall 07:00 – 08:00 *Organizer & Moderator*: Elfar Adalsteinsson

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the main steps involved in efficient non-Cartesian image reconstruction;
- Formulate a generalized signal model incorporating gradient encoding, coil sensitivity and Bo inhomogeneity;
- List the pro's and con's of Cartesian and non-Cartesian parallel MRI;
- Compare compressed sensing, HYPR, and k-t BLAST with respect to their use of prior knowledge;
- Describe the principles of separating water and fat signals; and
- Name three different approaches for motion correction and appraise their potential to become routine methods

Chemical Shift and Motion

07:00 **Separating Water and Fat**
Scott B. Reeder, M.D., Ph.D.

07:30 **Motion Correction**
David Atkinson, Ph.D.

SUNRISE EDUCATIONAL COURSE

Imaging Biomarkers

Room A1 07:00 – 08:00 *Organizers & Moderators*: Jeffrey L. Evelhoch and Sabrina M. Ronen

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe what a biomarker is and how MR can be used as a biomarker;
- Explain how biomarkers are qualified to be fit for their intended purpose;
- List requirements for use of MR biomarkers in both preclinical studies and clinical trials; and
- Give examples of how imaging biomarkers are being used in at least two of the following areas: multiple sclerosis, oncology, cardiovascular diseases and neurodegenerative diseases.

07:00 **Imaging Biomarkers in Oncology**
Daniel C. Sullivan, M.D.

07:30 **Imaging Biomarkers in Cardiovascular Disease**
Chun Yuan, Ph.D.

SUNRISE EDUCATIONAL COURSE

Brain: An Absolute Beginner's Guide to Anatomical & Functional MRI

Room A4 07:00 – 08:00 *Organizer & Moderator*: Geoffrey J.M. Parker

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Identify the neuroanatomical and neurophysiological parameters which are accessible to MR measurement;
- Describe the underlying physics of MR neuroimaging techniques;
- Describe the data acquisition and analysis techniques most commonly used for anatomical and functional MRI of the brain;
- Recognize the potential value of advances such as parallel imaging, fast imaging techniques and high magnetic field strengths for imaging the brain; and
- Name typical clinical applications for which specific MRI techniques are suited.

07:00 **Absolute Beginners' Guide to Functional MRI**
Peter A. Bandettini, Ph.D.

SUNRISE EDUCATIONAL COURSE

Potentials & Challenges of High-Field MRS

Room A5 07:00 – 08:00 *Organizers & Moderators*: Rolf Gruetter and Ivan Tkac

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe advantages and potentials of MRS at very high fields;
- Identify problems and challenges of high field MRS;
- Define the MRS detectable neurochemical profile of the brain;
- Describe principles of metabolite quantification;
- Assess spectral quality and identify main sources of spectral quality deterioration; and
- Explain the importance of B0 shimming at high fields.

Application of High-Field MRS On Animal Models

07:00 **Ultra High-Field MRS of Rodents**
Vladimir Mlynarik, Ph.D., D.Sc.

07:30 **MRS of Transgenic Mice**
Gulin Oz, Ph.D.

SUNRISE EDUCATIONAL COURSE

Modeling & Quantitative Analysis for Body DCE MRI

Room A6 07:00 – 08:00 *Organizers & Moderators*: Henry Rusinek and Min-Ying Lydia Su

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe various DCE models used for different organs including kidney, liver, breast, and prostate;
- Describe analysis methods used to measure vascularity, permeability, and blood flow;
- Implement Monte Carlo noise simulation method to predict parameter bias and precision;
- Compare conventional compartmental kinetic models and distributed models;
- Apply procedures for converting MRI signal intensity to tracer concentration; and
- Explain current method for measuring vascular input function and analyzing its impact on obtained DCE parameters.

07:00 **ROI or Voxel**
Min-Ying Lydia Su, Ph.D.

07:30 **The Future**
Thomas E. Yankeelov, Ph.D.

SUNRISE EDUCATIONAL COURSE

From Bench to Bedside to Bench: Translation of Animal Models to Clinical Practice & From Clinical Practice to Animal Models

Room A7 07:00 – 08:00 *Organizers:* Pia C. Maly Sundgren and Afonso C. Silva

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe the main MRI methods used in experimental studies to understand the underlying disease mechanisms;
- Identify what is known about the underlying disease mechanisms, and which type of MRI investigations could be used for diagnosis and clinical investigation;
- Describe the main MRI methods used in the clinical setting to diagnose the condition, and the rationale behind this; and
- Make the translation from what is - and can be - done in experimental studies to what can be done clinically, and where animal models bring new insight to disease.

Multiple Sclerosis
Moderators: **Diana M. Gomez-Hassan and Afonso C. Silva**

07:00 **MRI Tracking of Stem Cells in Multiple Sclerosis**
Vincent Dousset, M.D.

07:30 **Connectivity in MS**
Tarek Yousry, M.D.

SUNRISE EDUCATIONAL COURSE

Cardiovascular Imaging: Disease or Problem Based Teaching, Practical Protocols

Room A8 07:00 – 08:00 *Organizers & Moderators*: Victor A. Ferrari, Vivian S. Lee and Mitsue Miyazaki

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Recognize recent advancements and requirements in 3T cardiovascular MRI, as compared to present 1.5T MRI;
- Evaluate the strengths and limitations of current cardiovascular MRI techniques when applied to clinical diagnostic examinations;
- Describe current clinical techniques for assessment of ischemic heart disease and various cardiac diseases using new methods;
- Select the potential clinical applications of time-resolved techniques, and the technical challenges that will need to be resolved for wider applications; and
- Apply current approaches optimally to these diseases.

T2/T2* Imaging

07:00 **Edema**
Subha V. Raman, M.D.

07:20 **Bold**
Rohan Dharmakumar, Ph.D.

07:40 **Iron Overload**
Wynnie Lam, M.D.

SUNRISE EDUCATIONAL COURSE

Trials & Tribulations: Multicenter Trial Headaches & Their Cures

Room A9 07:00 – 08:00 *Organizers & Moderators*: Nicola de Stefano and Jeffrey Joseph Neil

EDUCATIONAL OBJECTIVES
Upon completion of this course participants should be able to:

- Describe multiple methods for setting up and maintaining site quality and certification for multicenter imaging trials;
- Explain the issues related to performing research involving INDs or IDEs;
- Evaluate the sensitivity, specificity and reliability of current imaging methods to detect relevant quantitative changes within the brain; and
- Describe the underlying principles for adopting and evaluating potential surrogate imaging markers for assessment of drug efficacy.

Surrogate Markers

07:00 **MR Metrics as Biomarkers for Pharma Studies**
Paul M. Matthews, M.D., Ph.D.

07:30 **The Lesson of MS: Is MRI Useful as Surrogate Marker?**
Maria Pia Sormani, Ph.D.

PLENARY SESSION

Genotyping & MR Phenotyping

Room A1 08:15-09:35 *Organizers & Moderators:* Jeff W.M. Bulte and Stefan Sunaert

08:15 ***681***. **Genotyping and Anatomical Abnormalities**
Alan F. Scott,[1]
[1]Johns Hopkins University School of Medicine, Baltimore, MD, United States

The advances in human genetics during the past three decades have resulted from a series of technological and organizational breakthroughs. As the limits of genotyping are realized a renewed emphasis on cheaper and faster sequencing approaches has emerged and various new and exciting approaches to whole genome sequencing are fast appearing. This talk will outline some of the technologies that have been and are being developed to increase the speed and accuracy of genetic data and how such information will revolutionize the way medicine is practiced for the rest of the century.

08:40 ***682***. **MR Imaging for Mouse Phenotyping**
R. Mark Henkelman[1]
[1]Hospital for Sick Children, Toronto, ON, Canada

Comprehensive phenotyping of large numbers of mutant mice is laborious and expensive. Three-dimensional imaging is a promising approach for providing overviews of anatomical and functional phenotypes. This talk will describe some of the developments in high throughput imaging methods such as MR, X-ray CT, and optical imaging. Equally, or even more importantly, quantitative computer methods for analyzing differences in the 3D sets will be described. Example applications to a variety of mutants will be shown. Particular emphasis will be given to imaging of embryonic mutations given the expected large numbers of embryonic lethals from the single gene knockout programs.

09:05 ***683***. **Genetic Dysregulation and White Matter MR Phenotype**
Marjo S. van der Knaap[1]
[1]VU University Medical Center, Amsterdam, Netherlands

Different causes, both genetic defects and acquired causes, for white matter disorders lead to different patterns of abnormalities on brain MRI. These patterns are homogeneous among patients with the same disorder and different for patients with other disorders. These different and consistent MRI phenotypes can

be used to diagnose known disorders and to identify novel disorders. The MRI phenotypes are based on selective vulnerability of brain structures and parts of structures for different adverse influences. Similarities in MRI phenotypes may reflect similarities in basic defects or pathophysiological mechanisms.

High Resolution Brain Imaging

Room A1 10:30-12:30 *Moderators:* Joseph J.H. Ackerman and Essa Yacoub

10:30 ***684***. **T2-Weighted MRI Visualizes Cortical Layers in Living Mice**

Susann Boretius[1], Anastasia Stoykova[2], Roland Tammer[1], Thomas Michaelis[1], Jens Frahm[1]
[1]Biomedizinische NMR Forschungs GmbH, Max-Planck-Institut für biophysikalische Chemie, Göttingen, Germany; [2]Molekulare Zellbiologie, Max-Planck-Institut für biophysikalische Chemie, Göttingen, Germany

The delineation of cortical layers in living animals is of major interest for a variety of questions ranging from developmental biology to studies of genetic alterations. Here, high-resolution T2-weighted MRI at 9.4 T is demonstrated to detect layer-like structures in mouse brain in vivo, which at least in part correspond to the histologically defined 6-layer structure of mammalian cortex. For the first time age-related cortical differences in healthy mice and severe alterations in layer architecture in cortex-specific Pax6 conditional knockout mice are visualized by in vivo MRI.

10:42 ***685***. **Magnetic Susceptibility Anisotropy of Central Nervous System**

Chunlei Liu[1,2]
[1]Brain Imaging and Analysis Center, Duke University, Durham, NC, United States; [2]Radiology, Duke University, Durham, NC, United States

Magnetic susceptibility difference between gray and white matter results in strong phase contrast at high magnetic field strength. We report, for the first time, a surprising observation of tissue-level magnetic susceptibility anisotropy in central nervous system (CNS). Specifically, we found that susceptibility of the white matter exhibits strong orientation dependence. Such orientation variation is extensive throughout the white matter area, but is relatively weak in the gray matter. We anticipate that imaging this anisotropy will provide a unique contrast that is unknown previously. In addition, it will provide a novel tool to further quantify the substructures of the CNS.

10:54 ***686***. **Reliable Cortical Thickness Estimation with Reduction of Susceptibility-Induced Signal Loss Using Optimized T1-Weighted Single-Slab 3D Turbo Spin Echo Pulse Sequence**

Hyunyeol Lee[1], Eung Yeop Kim[2], Jin-Suck Suh[2], Jaeseok Park[2]
[1]Medical Science, Yonsei University, Seoul, Seodaemun-gu, Korea, Republic of; [2]Radiology, Yonsei University

MP-RAGE, currently has gained popularity in volumetric studies, is highly influenced by susceptibility-indeced magnetic field inhomogeneities, yielding signal losses or image distortions. In this work, we investigated the feasibility of the optimized sinlge-slab 3D fast/turbo spin echo imaging for the accurate measurement of cortical thickness. Our Results demonstrated that the proposed method alleviated susceptibility-induced problems, and thereby yielding more reliable volumetric values, as compared to those from conventional MP-RAGE. We concluded that the proposed sequence could be an alternative to conventional MP-RAGE for brain volumetry.

11:06 ***687***. **The First MRI Detection of Prion Protein Plaques in the Cerebral Cortex in Variant Creutzfeldt-Jakob Disease: Post Mortem MR Microscopy at 9.4 Tesla**

Harpreet Hyare[1], Po-Wah So[2], Caroline Powell[1], Thornton John[3], Tarek Yousry[3], Sebastian Brandner[1], Harry Parkes[4]
[1]MRC Prion Unit, UCL Institute of Neurology, London, United Kingdom; [2]Institute of Psychiatry, London, United Kingdom; [3]National Hospital for Neurology and Neurosurgery; [4]Department of Brain Repair and Rehabilitation, UCL Institute of Neurology, London, United Kingdom

Magnetic resonance microscopy at 9.4T with in plane resolution of 58 microns can depict amyloid plaques composed of the abnormal prion protein in the cortex of patients with vCJD. Formalin fixed cortical samples, passively stained with gadoteric acid and scanned with a high resolution 3D gradient echo sequence (TR 20, TE 5, 16 averages) demonstrate prion protein (PrP) plaques as hypointense foci in the cortex which correspond to PrP immunostaining. As high field strength magnets enter clinical practice, in vivo MRI of the cortex may improve diagnosis and monitoring of vCJD.

11:18 ***688***. **MRI Laminar Resolution of the Human Retina**

Qi Peng[1,2], Yi Zhang[2], Timothy Q. Duong,[12]
[1]Radiology, UT Health Science Center at San Antonio, San Antonio, TX, United States; [2]Research Imaging Institute, UT Health Science Center at San Antonio, San Antonio, TX, United States

MRI of the awake human retina is challenging because the thin retina is located in a region of high magnetic susceptibility, is susceptible to eye motion and high resolution is needed. This study successfully demonstrated for the first time MRI anatomical laminar resolution of the in vivo human retina at 3 T. Laminar thicknesses were quantified. Potential challenges, solutions and outlooks for future applications are discussed.

11:30 ***689***. **High Resolution 1H MRI of Postmortem Human Brain Sections Performed at 21.1 T**

Parastou Foroutan[1], Katherine J. Schweitzer[2], Dennis W. Dickson[3], Daniel F. Broderick[4], Uwe Klose[5], Daniela Berg[6], Zbigniew K. Wszolek[2], Samuel C. Grant[1]
[1]Chemical & Biomedical Engineering, The Florida State University, Tallahassee, FL, United States; [2]Department of Neurology, Mayo Clinic Florida, Jacksonville, FL, United States; [3]Department of Neuroscience, Mayo Clinic Florida, Jacksonville, FL, United States; [4]Department of Radiology, Mayo Clinic Florida, Jacksonville, FL, United States; [5]Department of Radiology, Section for Experimental ZNS Imaging, University hospital Tuebingen, Tuebingen, Germany; [6]Hertie Institute for Clinical Brain Research, University of Tuebingen, Tuebingen, Germany

The first MRM evaluations of human tissue (Alzheimer/Parkinson related pathology) at 21.1 T, the highest magnetic field available for MRI, are presented. Quantitative analysis of relaxation proved very sensitive in identifying control versus pathological tissue, while parametric mapping demonstrated the potential for categorizing severity. Generally, neurodegeneration appeared more pervasive than expected, extending well beyond the regions normally

considered to be affected by either Alzheimer's or Parkinson's disease alone. As a pathological tool, MRM has potential to elucidate the extent and severity of such neurodegeneration, and hopefully, may improve the diagnostic capabilities of MRI as higher magnetic fields become available.

11:42 ***690***. **Dependence of R2* Bias on Through-Voxel Frequency Dispersion and Gradient Echo Train in High-Resolution 3D R2* Mapping**

Gunther Helms[1], Peter Dechent[1]
[1]MR-Research in Neurology and Psychiatry, University Medical Center, Göttingen, Lower Saxony, Germany

An empirical model for the influence of through-voxel gradients on log regression of R2* was derived from simulations. This advocates trains of many gradient echoes that start early and are short compared to local frequency dispersion, that is, use of non-selective high-resolution 3D acquisitions. The general trade-off is between statistical error of R2* and sensitivity to bias. For 1mm resolution at 3T, excessive bias can be confined to small orbito-frontal and temporo-basal regions, whereas correction of bias is unreliable. High-resolution R2* mapping of (almost) the whole brain seems feasible.

11:54 ***691***. **Visualization of the Subthalamic Nuclei Using High-Resolution Susceptibility Mapping at 7T**

Andreas Schäfer[1], Birte U. Forstmann[2], Jane Neumann[1], Robert Turner[1]
[1]Max-Planck-Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; [2]Department of Psychology, University of Amsterdam, Amsterdam, Netherlands

Deep brain stimulation targeting the subthalamic nucleus (STN) is an important treatment for Parkinsonâ€™s disease patients. The STN has been previously visualized at 3T and 7T using T2-weighted imaging, short inversion recovery sequences, phase imaging or susceptibility-weighted imaging, but contrast is inadequate or misleading, and the STN's borders are poorly defined. Here we used high-resolution phase imaging at 7T to calculate susceptibility maps of the STN and its surrounding areas. These show far clearer visualization of the STN, with excellent discrimination from the adjacent substantia nigra.

12:06 ***692***. **Assessment of Motion and F0 Artifacts in 7T High Resolution T2*-Weighted Imaging in Alzheimer's Disease Patients, and Application of a Navigator-Based Correction Scheme**

Maarten J. Versluis[1,2], Johannes M. Peeters[3], Sanneke van Rooden[1,2], Jeroen van der Grond[1], Mark A. van Buchem[1], Andrew G. Webb[1,2], Matthias J. van Osch[1,2]
[1]Radiology, Leiden University Medical Center, Leiden, Netherlands; [2]CJ Gorter Center for High Field MRI, Leiden University Medical Center, Leiden, Netherlands; [3]Philips Healthcare, Best, Netherlands

Image quality is decreased substantially in 7T high resolution T2*-weighted images in Alzheimer's disease (AD) patients compared to younger volunteers. The source of the image artifacts was investigated in phantom experiments using translational/rotational motion parameters and f0 fluctuations from AD patients. It was found that image degradation by f0 fluctuations was a factor-of-four times larger than artifacts caused by movement typical of AD patients. By implementing a navigator echo correction for f0 fluctuations, the image quality increased considerably. This technique was succesfully applied in four AD patients showing significant image quality improvements.

12:18 ***693***. **Phase-Based Regional Oxygen Metabolism (PROM) at 3T and Feasibility at 7T**

Audrey Peiwen Fan[1], Thomas Benner[2], Divya S. Bolar[3], Bruce R. Rosen[2,3], Elfar Adalsteinsson, [1,3]
[1]Electrical Engineering and Computer Science, MIT, Cambridge, MA, United States; [2]Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States; [3]Health Sciences and Technology, Harvard-MIT, Cambridge, MA, United States

The cerebral metabolic rate of oxygen (CMRO2) is an important indicator for brain function and disease, including stroke and tumor. CMRO2 can be quantified from measurements of venous oxygen saturation (Yv) and cerebral blood flow (CBF) in cerebral veins. Bulk susceptibility measurements based on gradient-echo phase maps has been used to estimate Yv in vivo at 3T. Challenges of this technique include partial volume effects, phase wrapping, and background susceptibility gradients. Here we combine phase-based measurements of Yv with ASL measurements of CBF to quantify CMRO2 in cerebral vessels at 3T. Further, we extended estimates of Yv to 7T, achieving a 1/5 reduction in voxel size. The improved spatial resolution allows examination of smaller vessels more indicative of regional brain function. Future work includes extending the method to estimate CMRO2 at 7T.

Short TE & Susceptibility MRI

Victoria Hall 10:30-12:30 *Moderators:* E. Mark Haacke and Franciszek Hennel

10:30 ***694***. **Simultaneous Short T2 Excitation and Long T2 Suppression RF Pulses**

Michael Carl[1], Mark Bydder[2], Eric Han[1], Graeme Bydder[2]
[1]GE Healthcare, Waukesha, WI, United States; [2]University of California, San Diego

We present a specialized RF technique based on applying a 180° RF excitation pulse that can achieve short T2 tissue excitation and long T2 tissue suppression simultaneously, which may open the possibility for direct excitation of only short T2 tissues, in place of additional separate long T2 suppression techniques. We optimized the RF pulse parameters and experimentally tested the sequence.

10:42 ***695***. **MRI with Zero Echo Time: Hard Versus Sweep Pulse Excitation**

Markus Weiger[1,2], Klaas Paul Pruessmann[2], Franciszek Hennel[3]
[1]Bruker BioSpin AG, Faellanden, Switzerland; [2]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland; [3]Bruker BioSpin MRI GmbH, Ettlingen, Germany

Zero echo time (TE) is achieved in an MRI sequence when the readout gradient is already on during the excitation. 3D radial techniques designed in this way have been proposed using either a hard pulse excitation or a pulse with a frequency sweep, as in the SWIFT technique. The two versions are compared in this work. It is demonstrated that they are equivalent with respect to T2 sensitivity but that the SNR of zero ZE MRI with hard pulse excitation is superior to its sweep pulse counterpart due to the periodical acquisition gapping required in a practical implementation of the latter.

10:54 ***696***. **Optimization of Iron Oxide Nanoparticles Detection Using Ultrashort TE Imaging**

Olivier Maciej Girard[1], Kazuki N. Sugahara[2], Lilach Agemy[2], Erkki Ruoslahti[2], Graeme M. Bydder[3], Robert F. Mattrey[3]
[1]Department of Radiology , University of California, San Diego, CA, United States; [2]Vascular Mapping Center, Burham Institute for Medical Reserach at UCSB, Santa Barbara, CA, United States; [3]Department of Radiology, University of California, San Diego, CA, United States

Iron oxide nanoparticles (IONPs) are used in various MRI applications. They are usually considered to be negative contrast agents due to their strong T2* effect, but they also have intrinsic T1 shortening properties that can produce positive contrast using appropriate pulse sequences. Here we show that a multiecho ultrashort TE sequence can be used very efficiently to generate three different contrasts (T1, T2* and hybrid T1-T2*) in a single acquisition, providing increased detection sensitivity and specificity while benefiting from positive contrast Contrary to conventional wisdom, T1-contrast can be superior to the T2*-contrast when imaging with IONPs.

11:06 ***697***. **Highly Localized Positive Contrast of Small Paramagnetic Objects Using 3D Center-Out RAdial Sampling with Off-Resonance Reception (RASOR)**

Peter Roland Seevinck[1], Hendrik De Leeuw[1], Clemens Bos[2], Chris JG Bakker[1]
[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands; [2]Philips Healthcare, Best, Netherlands

We present a 3D imaging technique, applying RAdial Sampling with Off-resonance Reception (RASOR), to accurately depict and localize small paramagnetic objects with high positive contrast. The RASOR imaging technique is a fully frequency encoded 3D ultrashort TE (UTE) center-out acquisition method, which utilizes a large excitation bandwidth and off-resonance reception. By manually introducing an offset, Äf0, to the central reception frequency (f0), the magnetic field disturbance causing the typical radial signal pile in 3D center-out sampling can be compensated for, resulting in a hyperintense signal at the exact location of the small paramagnetic object. This was demonstrated by 1D simulations and experiments of gel phantoms containing three paramagnetic objects with very different geometry, viz., subvoxel stainless steel spheres, paramagnetic brachytherapy seeds and a puncture needle. In all cases, RASOR is shown to generate high positive contrast exactly at the location of the paramagnetic object, as confirmed by X-ray computed tomography (CT).

11:18 ***698***. ***In Vivo* Demonstration of Enhancing Gas-Filled Microbubble Magnetic Susceptibility with Iron Oxide Nanoparticles**

April M. Chow[1,2], Kannie W.Y. Chan[1,2], Ed X. Wu[1,2]
[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR, China

Gas-filled microbubbles have been shown as an MR susceptibility contrast agent; however, microbubble susceptibility effect is relatively weak when compared with other contrast agents. Studies have indicated that, by embedding magnetic nanoparticles, the magnetic susceptibility of the shell can be increased, thus enhancing the microbubble susceptibility effect. In this study, we further demonstrated the synergistic effect of gas core with iron oxide nanoparticles in achieving the overall microbubble susceptibility effect and characterized *in vivo* enhancements of microbubble susceptibility effects by entrapping iron oxide nanoparticles at 7 T, leading to the practical use of microbubbles as an intravascular MRI contrast agent.

11:30 ***699***. **A Novel Approach to Positive Contrast Using SPIOs in the Motional Averaging Regime**

Jon Furuyama[1], Yung-Ya Lin[2]
[1]Radiology, University of California, Los Angeles, CA, United States; [2]Chemistry and Biochemistry, University of California, Los Angeles, CA, United States

Currently, positive contrast with superparamagnetic iron oxide nanoparticles (SPIOs) is limited to large particles within the static dephasing regime. We present a novel approach to generating positive contrast from SPIOs within the motional averaging regime. By simply adding a T2-weighted sequence prior to an inversion recovery sequence, we show a 30-fold improvement in contrast-to-noise ratio (CNR) over ordinary inversion recovery sequences. By taking advantage of the latest advances in nanotechnology, we expect an even greater improvement by making use of nanoparticles that have both T1 and T2 enhancement.

11:42 ***700***. **Susceptibility Tensor Imaging**

Chunlei Liu[1,2]
[1]Brain Imaging and Analysis Center, Duke University, Durham, NC, United States; [2]Radiology, Duke University, Durham, NC, United States

We propose a susceptibility tensor imaging (STI) technique to measure and quantify anisotropy of magnetic susceptibility. This technique relies on the measurement of resonance frequency offset at different orientations. We propose to characterize the orientation variation of susceptibility using an apparent susceptibility tensor. The susceptibility tensor can be decomposed into three eigenvalues (principle susceptibilities) and associated eigenvectors that are coordinate-system independent. We show that the principle susceptibilities offer strong contrast between gray and white matter while the eigenvectors provide orientation information of an underlying magnetic network. We believe that this network may further offer information of white matter fiber orientation.

11:54 ***701***. **Midbrain Nuclei Visualization Improved by Susceptibility-Enhanced 3D Multi-Echo SSFP for Deep Brain Stimulation Guidance**

Ming-Long Wu[1], Geoffrey S. Young[2], Nan-Kuei Chen[1]
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MRI is routinely used for stereotactic guidance and surgical preparation for deep brain stimulation implantation. In preoperative MRI, a high contrast between midbrain nuclei and surrounding white matter is needed for more accurate electrode placement. Although conventional T2- and T2*-weighted imaging can be used for visualization of midbrain nuclei, a long TE value is needed and thus the scan time cannot be shortened. In this study, a 3D multi-echo steady-state free precession method is used to provide superior contrast at TE < 10ms. By further integrating SWI reconstruction and multi-echo SSFP, a direct and highly robust visualization of midbrain nuclei can be achieved.

12:06 ***702***. **Brain Iron: Comparison of Postmortem SWI with Chemical Tissue Analysis**

Nikolaus Krebs[1], Christian Langkammer, [12], Walter Goessler[3], Franz Fazekas[2], Kathrin Yen[1], Stefan Ropele[2], Eva Scheurer[1]
[1]Ludwig Boltzmann Institute for Clinical-Forensic Imaging, Graz, Austria; [2]Department of Neurology, Medical University of Graz, Graz, Austria; [3]Institute of Chemistry - Analytical Chemistry, University of Graz, Graz, Austria

Certain neurodegenerative diseases are associated with increased iron concentration in specified brain regions. To provide an up to date basis for validation of MR-based assessment of brain iron content, iron concentrations in selected grey and white matter regions of postmortem human brains were determined using inductively coupled plasma mass spectrometry (ICPMS) and compared to corresponding susceptibility weighted images (SWI). Measured iron concentrations were in good agreement in most brain regions with values published before. Visual comparison of the measured results with contrast in SWI showed that areas with high iron content correlate well with hypointense regions.

12:18 ***703***. **Microscopic Susceptibility Variation and Transverse Relaxation for the De Facto Brain Tumor Microvasculature**

David Bonekamp[1], Eugene Kim[2], Barney Douglas Ward[3], Jiangyang Zhang[1], Arvind P. Pathak[1]
[1]Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States; [2]Department of Biomedical Engineering, Johns Hopkins University, Baltimore, MD, United States; [3]Department of Biophysics, Medical College of Wisconsin,, Milwaukee, WI, United States

Development of new susceptibility-based contrast MR imaging biomarkers of angiogenesis (e.g. susceptibility-based blood volume and vessel size index) requires biophysical models that incorporate accurate representations of the brain tumor vasculature to establish an accurate relationship to the molecular basis of angiogenesis. We investigate the relationship between brain tumor angiogenesis and susceptibility-based contrast MRI by incorporating the de facto brain vasculature in a state-of-the-art computational model of MR image contrast called the finite perturber method (FPM). Our simulations show substantial signal differences between regions of tumor vascularity and normal brain while enabling to study the entire vascular network of a mouse brain at the same time.

fMRI in Genetics & phMRI

Room K1 10:30-12:30 *Moderators:* Timothy Q. Duong and Christopher Pawela

10:30 ***704***. **Optogenetic Functional Magnetic Resonance Imaging (OfMRI): Genetically Targeted in Vivo Brain Circuit Mapping**

Jin Hyung Lee[1], Remy Durand[2], Viviana Gradinaru[2], Feng Zhang[2], Dae-Shik Kim[3], Karl Deisseroth[2]
[1]Electrical Engineering, University of California, Los Angeles, Los Angeles, CA, United States; [2]Bioengineering, Stanford University, Stanford, CA, United States; [3]Boston University, Boston, MA, United States

Despite an enormous, rapidly-growing functional brain imaging literature based on blood oxygenation level dependent (BOLD) signals, it remains controversial which classes of local activity and cellular elements (e.g., glia, axonal tracts, or excitatory neurons) can trigger BOLD responses. Using a novel methodology integrating Optogenetics with high-field fMRI, we show here that robust BOLD signal can be triggered in primary motor cortex by specific recruitment of CaMKIIa-expressing excitatory neurons. We further show that this approach allows for highly specific in vivo circuit identification, in which the functional role of cell types defined by location and genetic identity, can be directly observed and globally mapped in the living mammal.

10:42 ***705***. **Light-Induced Activation of Light-Sensitive Pumps Modulates FMRI Responses**

John E. Downey[1,2], Piotr Walczak[3,4], Suresh E. Joel[1,2], Assaf A. Gilad[3,4], Michael T. McMahon[1,2], Heechul Kim[3,4], James J. Pekar[1,2], Galit Pelled,[2,5]
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Recent developments in optical-genetic (optogenetics) approaches enable immediate manipulations of neuronal firing rate by using light-induced activation of light sensitive pumps. We have engineered the excitatory neurons in rat somatosensory cortex to express halorhodopsin (light-sensitive chloride pump) using direct neuronal infection with lentivirus. Thus, in the presence of light, the chloride pumps open and trigger neuronal hyperpolarization i.e. decreases in neuronal firing rate. Consistent with electrophysiology results, light induced activation of halorhodopsin during forepaw stimulation, decreased the amplitude and the extent of fMRI responses. These results introduce an exciting and novel approach to study neuronal behavior in vivo.

10:54 ***706***. **In-Vivo Optogenetic Activation of Cortical Astrocytes with FMRI at 9.4T: OptoMRI**

Jack A. Wells[1], Simon Walker-Samuel[1], Nephtali Marina[2], Melina Figueiredo[3], Anja G. Teschemacher[3], Michael Spyer[2], Alexander V. Gourine[2], Sergey Kasparov[3], Mark F. Lythgoe[1]
[1]Centre for Advanced Biomedical Imaging, University College London, London, United Kingdom; [2]Neuroscience, Physiology & Pharmacology, University College London, London, United Kingdom; [3]Physiology & Pharmacology, University of Bristol, Bristol, United Kingdom

The relative contribution of the neuronal and glial activation to the BOLD signals is not fully established. Optogenetic techniques, in which particular brain cells are engineered to express light-sensitive ion channels, offer minimally invasive and temporally precise control of the activities of distinct cellular populations.
In this study we performed simultaneous optogenetic activation of cortical astrocytes with high field fMRI . Astrocytes in the cortex of the anaesthetised rat brain were stimulated during continuous imaging using gradient echo EPI at 9.4T. Here we present our preliminary data.

11:06 ***707***. **Mapping the Circuit of Fear with Pharmacogenetic Silencing and FMRI**

Alessandro Gozzi[1], Apar Jain[2], Valerio Crestan[1], Adam J. Schwarz[1,3], Theodoros Tsetsenis[2], Graham Sheridan[4], Cornelius T. Gross[4], Angelo Bifone[1]

[1]Neuroscience CEDD, GlaxoSmithKline, Verona, Verona, Italy, Italy; [2]Mouse Biology Unit,, EMBL, , Monterotondo, , Italy, Italy; [3] Translational Imaging , Eli Lilly , Indianapolis, IN, United States; [4]Mouse Biology Unit,, EMBL,, Monterotondo,, Italy, Italy

Functional MRI methods have been widely applied to map regional changes in brain activity elicited by somatosensory stimuli, complex cognitive or emotional tasks, and pharmacological challenges. Here we describe and demonstrate the use of fMRI to map the functional effects of rapid and reversible pharmacogenetic silencing of selected neuronal populations focally expressed in specific regions of the mouse brain. In combination with behavioural observations, this novel approach provides a powerful means to assess the functional role of these neurons, to resolve the brain circuitry they are elements of, and to establish their implication in behavioural control

11:18 ***708***. **Pharmacological MRI and Resting-State FMRI of Functional Brain Organization in the Serotonin Transporter Knock-Out Rat**

Kajo van der Marel[1], Judith R. Homberg[2], Willem M. Otte[1], Rick M. Dijkhuizen[1]

[1]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands; [2]Donders Centre for Neuroscience, UMC St. Radboud, Nijmegen, Netherlands

Genetic variation in the serotonin transporter gene (5-HTTLPR) has been linked to various neuropsychiatric disorders, including depression and drug addiction. In this study we combined resting-state fMRI (rs-fMRI) with pharmacological fMRI (phMRI) in the serotonin transporter knock-out rat, to study the effects of disrupted serotonin homeostasis on functional organization during baseline and psychoactive stimulation. With rs-fMRI we observed positive functional connectivity among ROIs within the limbic system, but no difference with controls. With phMRI we found stronger activation responses to cocaine in knock-outs in specific limbic areas, which is in agreement with previously reported cocaine supersensitivity.

11:30 ***709***. **Differential Effects of Chronic Fluoxetine Use in Young Vs. Adult Rats: A PhMRI Study**

Anne Klomp[1], Jordi L. Tremoleda[2], Aart J. Nederveen[1], Marzena Wylezinska[2], Willy Gsell[2], Liesbeth Reneman[1]

[1]Department of Radiology, Academical Medical Center, Amsterdam, Netherlands; [2]Biological Imaging Centre, Imaging Science Department, MRC Clinical Sciences Centre, Hammersmith Hospital, Imperial College London, London, United Kingdom

The effects of chronic fluoxetine treatment (the only SSRI registered for use in children) on the developing brain are not well studied. Here we investigate the effect of chronic fluoxetine exposure on the serotonergic system in adult and peri-adolescent rats using phMRI. Chronic treatment with fluoxetine elicits a reduction of overall brain activation in adult rats but not in young rats. Previous data from our group showed an increase of serotonin transporters after chronic treatment in peri-adolescent rats but not in adult rats, suggesting a compensation mechanism occurring in the developing brain which could explain our phMRI findings.

11:42 ***710***. **Endogenous Opioid-Dopamine Neurotransmission Evokes Sustained Negative CBV-Weighted FMRI Responses**

Yen-Yu Ian Shih[1,2], Yun-Chen Chiang[2,3], Yi-Hua Hsu[2], Fu-Shan Jaw[3], Jin-Chung Chen[4], Bai-Chuang Shyu[2], Timothy Q. Duong[1], Chen Chang[2]

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Dopamine and opioids have been implicated in various aspects of brain signaling. By employing CBV-weighted fMRI with pharmacological treatments, the present study reveals that endogenous stimulation of ?opioid receptors underlies negative CBV fMRI signals via the activation of dopamine D2/D3 receptors. The interpretation of fMRI data involving opioid–dopamine interactions requires careful consideration.

11:54 ***711***. **Differential Effect of Adrenoceptor on Functional Activation and Connectivity**

Fatima Ali Nasrallah[1], Jolena Tan, Nora Hennies, Kai-Hsiang Chuang

[1]Lab of Molecular Imaging, Singapore Bioimaging Consortium, Singapore , Singapore

In this work we clearly demonstrate the modulation of resting state functional connectivity by the á2-adrenergic receptor agonist, medetomidine. We determined the functional activation response induced by forepaw stimulation under 0.1, 0.2, and 0.3 mg/kg/hr infusion of medetomidine and the corresponding resting state functional connectivity as well. While BOLD signal change was unchanged across dosages, medetomidine had a profound effect on the synchronicity of interacting regions in the brain

12:06 ***712***. **Anaesthetic Interactions in the PhMRI Response to Acute Ketamine Challenge**

Duncan Jack Hodkinson[1], Carmen de Groote[2], Shane McKie[3], John-Francis William Deakin[3], Steve R. Williams[1]

[1]Imaging Science and Biomedical Engineering, University of Manchester, Manchester, United Kingdom; [2]Neuroscience and Biomedical Systems, University of Glasgow, Glasgow, United Kingdom; [3]Neuroscience and Psychiatry Unit, University of Manchester, Manchester, United Kingdom

Pharmacological-challenge MRI (phMRI) is an exciting new tool enabling researchers to examine underlying circuitry of the brain in response to neuroactive drugs. To avoid head movements pre-clinical phMRI studies are often conducted under general anaesthesia. However, interactions between the drug of interest and the anaesthetic may be a confounding factor. Here we assessed the effect of α-chloralose and isoflurane anesthesia on the phMRI response to ketamine challenge. The positive BOLD signal changes observed with α-chloralose showed areas of activation similar to neuroimaging studies in humans. A drug-anaesthetic interaction between isoflurane and ketamine compromised the phMRI response.

12:18 ***713***. **Simultaneous FMRI and Local Field Potential Measurements of Epileptic Seizures in Medetomidine Sedated and Awake Rats**

Antti Markku Airaksinen[1], Shahryar Khan Hekmatyar[2], Neil Jerome[2], Juha-Pekka Niskanen[1,3], Asla Pitkanen[4,5], Risto A. Kauppinen[2], Olli Grohn[1]

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Simultaneous LFP and fMRI measurements were performed during kainic acid (KA) induced seizures in awake and medetomidine anesthetized rats. The recurrent epileptic seizures were detected in the LFP signal after KA injection and robust BOLD responses were observed in the hippocampus both in awake and sedated animals. To determine basal CBF, ASL was performed showing the highest CBF values in isoflurane anesthetized rats and the lowest CBF under medetomidine sedation. We conclude that medetomidine sedation is suitable for studies of normal and abnormal brain activity, but lowered basal CBF level should be taken into account when interpreting the fMRI results.

Perfusion from Methods to Physiological Responses

Room A4 10:30-12:30 *Moderators:* Andrea Kassner and Esben Petersen

10:30 ***714***. **3D Real-Time Magnetic Particle Imaging of Cerebral Blood Flow in Living Mice**

Jürgen Rahmer[1], Bernhard Gleich[1], Jürgen Weizenecker[2], Jörn Borgert[1]

[1]Philips Technologie GmbH, Forschungslaboratorien, Hamburg, Germany; [2]University of Applied Sciences, Karlsruhe, Germany

The cerebral blood flow of living mice is imaged in real-time using magnetic particle imaging (MPI). This new medical imaging modality allows rapid imaging of 3D iron oxide nanoparticle distributions without anatomical background signal. For the experiments, an iron-oxide agent was bolus injected into the tail vein at clinically approved dosages.

10:42 ***715***. **Simultaneous Assessment of Perfusion with [^{15}O]water PET and Arterial Spin Labeling MR Using a Hybrid PET/MR Device**

Hans F. Wehrl[1], Martin S. Judenhofer[1], Florian C. Maier[1], Petros Martirosian[2], Gerald Reischl[3], Fritz Schick[2], Bernd J. Pichler[1]

[1]Laboratory for Preclinical Imaging of the Werner Siemens-Foundation, University of Tuebingen, Tuebingen, BW, Germany; [2]Section on Experimental Radiology, University of Tuebingen, Tuebingen, BW, Germany; [3]Radiopharmacy and PET-Center, University of Tuebingen, Tuebingen, BW, Germany

PET/MR imaging is an emerging technology. In this study, for the first time, PET as well as MR-ASL perfusion data were acquired simultaneously with a small animal PET/MR device, therefore minimizing confounding parameters such as physiological variations between the scans. Absolute [^{15}O]water PET and MR perfusion data were compared, and discussed in respect to blood-brain-barrier permeability issues. Permeability surface (PS) product values for different brain areas were determined. These experiment show an excellent application of PET/MR for cross-validation studies and pave the way for a wider range of multifunctional-imaging studies.

10:54 ***716***. **Estimation of CBF Based on the Metabolic $H_2{}^{17}O$ Decay Rate in $CMRO_2$ Measurement Using *In Vivo* ^{17}O MR Approach**

Xiao-Hong Zhu[1], Yi Zhang[1], Hannes Wiesner[2], Kamil Ugurbil[1], Wei Chen[1]

[1]Center for Magnetic Resonance Research, Department of Radiology,, Minneapolis, MN, United States; [2]High-Field Magnetic Resonance Center, Max Planck Institute for Biological Cybernetics, Tübingen, Germany

In vivo ^{17}O MRS imaging (MRSI) approach at high/ultrahigh field has been used to non-invasively mapping the cerebral metabolic rate of oxygen ($CMRO_2$) in small animals. However, imaging the cerebral blood flow (CBF) using the same ^{17}O MR approach requires invasive procedures for introducing the NMR-visible $H_2{}^{17}O$ as exogenous tracer. In the present study, we demonstrate that the decay rate of the metabolic $H_2{}^{17}O$ water following a brief $^{17}O_2$ gas inhalation in the $CMRO_2$ measurement, although does not directly reflect the CBF value, is closely related to brain perfusion. A linear relationship between CBF and corresponding metabolic $H_2{}^{17}O$ decay rate has been determined experimentally from combined CBF and $CMRO_2$ measurements in rat brains under varied physiological conditions. The outcomes of the study indicate that *in vivo* ^{17}O MRS/MRSI approach is a useful tool for noninvasively assessing not only $CMRO_2$ but also CBF simultaneously in the rat brain; and it provides new utilities for studying the cerebral oxygen metabolism and tissue perfusion associated with brain function and dysfunction.

11:06 ***717***. **Hippocampal Blood Flow and Vascular Reactivity in Normal Aging**

Henry Rusinek[1], Lidia Glodzik[2], Miroslaw Brys[3], Francois Haas[4], Kellyanne Mcgorty[1], Qun Chen[1], Mony J. de Leon[2]

[1]Radiology, New York University School of Medicine, New York, NY, United States; [2]Psychiatry, New York University School of Medicine, New York, NY, United States; [3]Neurology, New York University School of Medicine, New York, NY, United States; [4]Medicine, New York University School of Medicine, New York, NY, United States

Hippocampal blood flow and vascular reactivity were measured in 34 normal subjects aged 26-92 years using pulsed ASL with segmented TrueTFISP readout. Test-retest studies indicate reproducibility averaging 3.6 ml/100g/min (5.4%). Hippocampal flow averaged 61.2±9.0 ml/100g min, with no age effect. The cortical flow averaged 57.2±10.4 ml/100g min and there was a significant linear relationship with age. Mild hypercapnia resulted in a significant CBF increase in all brain tissue. The flow response was 18.0±12.2 in neocortex and 14.1±10.8 in the hippocampus. The cortical flow response among the women was significantly larger than in men, confirming numerous prior studies.

11:18 ***718***. **Sensitivity of CASL MRI to Quantitative Regional and Global Changes Associated with Pain**

Michael Froelich[1], Hrishikesh Deshpande[2], Tim J. Ness[1], Beverly Corbitt[2], Rajiv Menon[3], Jan den Hollander[4], Georg Deutsch[5]

[1]Anesthesiology, University of Alabama at Birmingham, Birmingham, AL, United States; [2]Radiology, University of Alabama at Birmingham, Birmingham, AL, United States; [3]Biomedical Engineering, University of Alabama at Birmingham, Birmingham, AL,

United States; [4]Vascular Cardiology, University of Alabama at Birmingham, Birmingham, AL, United States; [5]Radiology, University of Alabama at Birmingham, Birmingham, AL, United States

The imaging of cerebral activity associated with pain and painful states has important implications for the study of clinical pain syndromes, including potentially providing objective biomarkers in studies complicated by the ambiguities of subjective report. We present preliminary data showing quantitative rCBF changes using CASL based rCBF in normal subjects during three pain conditions involving heat, ischemic and cold presser pain conditions. Robust changes were recorded in thalamic and peri-rolandic as well as in mean hemispheric cortical rCBF during each condition, with the cold presser task inducing significantly greater absolute increases in thalamic and mean cortical activity.

11:30 ***719***. **Opioid-Induced Changes in Cerebral Blood Flow in the Human Brain During Controlled Breathing**

Richard G. Wise[1], Anna Jolly[2], C John Evans[1], Kevin Murphy[1], Fernando Zelaya[3], David Lythgoe[3], Kyle Pattinson[4], Judith E. Hall[2]
[1]CUBRIC, School of Psychology, Cardiff University, Cardiff, United Kingdom; [2]Department of Anaesthetics and Intensive Care Medicine, School of Medicine, Cardiff University, Cardiff, United Kingdom; [3]Centre for Neuroimaging Sciences, Institute of Psychiatry, King's College, London, United Kingdom; [4]Nuffield Department of Anaesthetics, Oxford University, Oxford, United Kingdom

We show that pulsed ASL is sensitive to opioid administration in the human brain. We measured the effects of a μ-opioid (remifentanil) on regional CBF. By training volunteers to maintain their breathing, we mitigated the global CBF increases arising from increased arterial carbon dioxide levels that result from opioid-induced respiratory depression. Significant localised opioid-induced CBF increases were observed in the thalamus and brainstem, whereas, decreases were observed in the putamen: all areas rich in opioid receptors. The regionally specific nature of the opioid's effect on CBF will be useful in interpreting opioid-related changes in task-related activity with FMRI.

11:42 ***720***. **ASL PhMRI After a Single Dose of Oral Citalopram**

Yufen Chen[1], Hong I. Wan[2], John P. O'Reardon[3], Marc Korczykowski[1], Ze wang[1], Jiongjiong Wang[1], John A. Detre[1]
[1]Center of Functional Neuroimaging, University of Pennsylvania, Philadelphia, PA, United States; [2]Clinical Translational Medicine, Pfizer Inc, Collegeville , PA, United States; [3]Department of Psychiatry, University of Pennsylvania, Philadelphia, PA, United States

Arterial spin labeling (ASL) is a favorable alternative to blood-oxygenation-level-dependent (BOLD)–based pharmacological MRI (phMRI) as it offers an easily interpreted, quantitative measurement of cerebral blood flow (CBF). We investigate the feasibility of ASL phMRI to detect the effects of a single orally administered dose of citalopram—a commonly used antidepressant—in healthy subjects. Our results reveal a significant drug-induced reduction in CBF within the amygdala. This result is in agreement with prior studies that show a correlation between amygdala function and depression, and indicates that ASL phMRI is a valuable tool for clinical trials.

11:54 ***721***. **Sustained Cerebral Hypoxia Increases Cerebral O2 Metabolism**

Erin Krizay[1], John S. Hunt Jr.[1], Ethan Li[1], Billy C. Hsu[1], David D. Shin[1], Zachary Smith[1], Richard B. Buxton[1], Miriam Scadeng[1], David J. Dubowitz[1]
[1]Radiology, University of California San Diego, La Jolla, CA, United States

Hypoxia results in decreased arterial oxygenation to the brain and increased cerebral blood flow. Previous studies suggest moderate global hypoxia does not influence resting cerebral oxygen metabolism (CMRO2), yet basal metabolic rate increases with sustained hypoxia. We examined the effects of 2 and 7 days of sustained global hypoxia on CMRO2 from measurements of venous T2 (using TRUST MRI), resting CBF (using ASL MRI), and SaO2 and Hb. Following 2 days hypoxia, CMRO2 increased by 59% to 2.5 mmol/g/min (+/- 0.9, $p<0.01$). Following 7 days hypoxia, CMRO2 increased 36% relative to normoxia, to 2.2 mmol/g/min (+/- 0.8, $p<0.05$).

12:06 ***722***. **Layer-Specific Blood-Flow and BOLD FMRI of the Mouse Retina Associated with Hypoxic Challenge**

Eric Raymond Muir[1,2], Qiang Shen[2], Timothy Q. Duong[2]
[1]Biomedical Engineering, Georgia Institute of Technology, Atlanta, GA, United States; [2]Research Imaging Institute, Ophthalmology/Radiology, UT Health Science Center San Antonio, San Antonio, TX, United States

The retina has two separate blood supplies, the retinal and choroidal vessels, located on either side of the retina. We recently showed that MRI at 42x42 μm can resolve layer-specific blood flow (BF) in both vascular layers, and the avascular layer in between in mice. In this study, we further developed this BF MRI technique to include inversion-recovery suppression of the vitreous and applied it to image layer-specific BF and BOLD changes during hypoxic challenge in mouse retinas. Basal BF and BF and BOLD responses to mild hypoxic challenge were markedly different between the retinal and choroidal vasculatures.

12:18 ***723***. **Effect of Hematocrit on MR Estimates of BVf, VSI and Local Blood Oxygen Saturation. an in Vivo Study.**

Thomas Christen[1], Benjamin Lemasson[1], Nicolas Pannetier[1], Regine Farion[1], Christoph Segebarth[1], Chantal Remy[1], Emmanuel Louis Barbier[1]
[1]INSERM U836, Grenoble, France

We have investigated the influence of the hematocrit on the MR estimates of Blood Volume fraction (BVf), Vessel Size Index (VSI) and local SO2 (lSO2). In healthy rats, the hematocrit was either decreased using isovolumic hemodilution or increased using an intermittent hypoxia preconditionning. Measurements obtained with MR were compared to quantitative histology and blood gas analysis. Our results showed variations of lSO2 (consistent with a stable tissue oxygenation level), variations of BVf and no changes in VSI between groups of animals. In all cases MRI and biology remains correlated suggesting a linear effect of hematocrit on the MR estimates.

Non-Proton MRI, Microscopy & ESR

Room A5 10:30-12:30 *Moderators:* Luisa Ciobanu and Richard A. Komoroski

10:30 ***724***. **In Vivo Oxygen-17 (17O) MRI at 7 Tesla**

Stefan Hoffmann[1], Paul Begovatz[1], Armin Nagel[1], Reiner Umathum[1], Michael Bock[1]
[1]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany

The detection of oxygen-17 (17O) provides a method to assess metabolic tissue information at ultra high fields. In this work direct 17O-MR imaging was carried out in vivo on a 7 Tesla MR system with a custom built head coil. Natural abundance imaging of the human head was performed and global relaxation parameters were measured. An inhalation experiment with enriched 17O gas was carried out using an inhalation-triggered oxygen delivery system. Imaging was performed prior to, during and after the inhalation showing an increase of signal intensity during ventilation with enriched oxygen-17 gas.

10:42 ***725***. **3D Regional Measurements of Alveolar Surface Area Using 90° Single Breath XTC**

Samuel Patz[1], Iga Muradyan[1], Mikayel Dabaghyan[1], Isabel Maria Dregely[2], Mirko I. Hrovat[3], Hiroto Hatabu[1], F William Hersman[4], Iulian C. Ruset[4], James P. Butler[5]
[1]Department of Radiology, Brigham and Women's Hospital, Boston, MA, United States; [2]Department of Physics, University of New Hampshire, Durham, NH, United States; [3]Mirtech, Inc, Brockton, MA, United States; [4]Xemed, LLC, Durham, NH, United States; [5]Department of Environmental Health, Harvard School of Public Health, Boston, MA, United States

Alveolar surface area is a key determinant of the severity of emphysema. Hence it is important to obtain regional maps of this parameter in order to evaluate disease heterogeneity. To accomplish this goal, we obtained 3D regional measurements of alveolar surface area per unit volume by measuring the septal uptake of hyperpolarized ^{129}Xe. Single Breath XTC was used but 90° RF pulses were used for the selective "tissue phase" pulses rather than the traditional 180° pulses.

10:54 ***726***. **Indirect ^{17}O MRI Using T1ρ at 11.7 T**

Hsiao-Ying Wey[1,2], Fang Du[1], Ai-Ling Lin[1], Yen-Yu I. Shih[1], Saaussan Madi[3], Peter T. Fox[1,2], Pradeep M. Gupte[4], Timothy Q. Duong[1,2]
[1]Research Imaging Institute, UT Health Science Center at San Antonio, San Antonio, TX, United States; [2]Radiology, UT Health Science Center at San Antonio, San Antonio, TX, United States; [3]Bruker Biospin MRI, Inc., Billerica, MA, United States; [4]Rockland Technimed Ltd., Airmont, NY, United States

Cerebral metabolic rate of oxygen ($CMRO_2$) is an important physiological parameter associated with normal brain and disease state. The unique characteristic of ^{17}oxygen makes ^{17}O MRI a valuable tool for $CMRO_2$ quantification. Direct ^{17}O measurement suffers from low spatiotemporal resolution and clinical practicability compared to indirect method, although the quantification is more straightforward. This study demonstrates the feasibility of indirect T1ρ-weighted ^{17}O detection with ^{17}O/PFC blood substitute injection in normal and physiologically modulated (hypothermia and ischemic stroke) rats at ultra-high field.

11:06 ***727***. **Separation of Sodium Compartments for Characterization of Tumor Tissue by ^{23}Na-MRI**

Armin Michael Nagel[1], Michael Bock[1], Christian Matthies[1], Marc-André Weber[2], Stephanie Combs[3], Wolfhard Semmler[1], Armin Biller,[2]
[1]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany; [2]Department of Diagnostic and Interventional Radiology, University Hospital Heidelberg, Germany; [3]Department of Radiation Oncology, University Hospital Heidelberg, Germany

In this work brain-tumor patients were investigated with different ^{23}Na-image contrasts (spin-density, ^{23}Na-FLAIR) to gain information from which compartment the ^{23}Na-signal originates. Using a ^{23}Na-FLAIR sequence different ^{23}Na-compartments in many brain tumors can be suppressed, whereas other parts still exhibit a high ^{23}Na-FLAIR-signal. Our findings indicate that a combination of both ^{23}Na-sequences allows for separating different ^{23}Na compartments. Distinguishing these compartments might be important for the determination of potential tumor malignancy.

11:18 ***728***. ***In Utero* MRI of Cerebral Vascular Development in Mice**

Cesar Augusto Berrios-Otero[1], Brian J. Nieman[2], Daniel H. Turnbull[1,3]
[1]Kimmel Center for Biology and Medicine at the Skirball Institute of Biomolecular Medicine, New York University School of Medicine, New York, United States; [2]Mouse Imaging Centre, Hospital for Sick Children, Toronto, Ontario, Canada; [3]Department of Radiology, New York University School of Medicine, New York, United States

Vascular system development involves a complex, three-dimensional branching process that is critical for normal embryogenesis. In a previous study, we developed a contrast-enhanced perfusion method to selectively enhance the cerebral arteries in fixed mouse embryos and demonstrated that Gli2 mutant mice lack a basilar artery, a key arterial input to the posterior brain regions. However, imaging studies of Gli2 and many other mutant mice with vascular defects are limited because mice do not survive postnatally. Extending vascular imaging to an in utero setting with potential for longitudinal vascular development studies is an exciting possibility. However, in vivo MRI scans routinely result in undesirable image artifact due to subject motion. In this study we utilized an in utero imaging, which corrects for motion using an interleaved gating acquisition and serial comparison of rapidly acquired 3D images. We demonstrate the potential of this method by examining vascular development in utero in E17.5 wildtype and Gli2 mutant mice. We show that the in vivo methods produce high-quality images of the embryonic cerebral vasculature and are able to detect the basilar artery phenotype in Gli2 mutants.

11:30 ***729***. **Cardiac Purkinje Fiber Imaging: The First Instance of in Situ Visualization of the Conduction Path Using MR Microscopy**

Min Sig Hwang[1], Katja Odening[2], Ohad Ziv[2], Bum-Rak Choi[2], Gideon Koren[2], John R. Forder[1]
[1]McKnight Brain Institute, University of Florida, Gainesville, FL, United States; [2]Cardiovascular Research Center, Rhode Island Hospital Alert Medical School of Brown University, Providence, RI, United States

In this study, we performed high resolution MR imaging using a 17.6 T magnet to demonstrate the cadiac conduction pathways as well as anatomical details of isolated rabbit hearts. The volume rendered images from the original 3D MR data, achieving a 35 ¥ìm in-plane resolution and generating an adequate T2*-weighted image constrast, made it possible to non-invasively and reproducibly trace the conduction paths in the left and right ventricles, as well as to describe the micro-anatomical make-up of the whole heart.

11:42 ***730***. **In Vivo Ultra High Field Magnetic Resonance Microimaging to Track the Development of Malignant Melanoma in Zebrafish**

A Alia[1], S Kabli[1], S He[2], E S. Jagalska[2], A Hurlstone[3], H P. Spaink[2], H J. M de Groot[1]
[1]Leiden Institute of Chemistry, Leiden University, Leiden, Netherlands; [2]Institute of Biology, Leiden University, Leiden, Netherlands; [3]Faculty of Life Sciences, University of Manchester, Manchester, United Kingdom

Zebrafish cancer models are fast gaining ground in cancer research. Most tumors in zebrafish develop late in life, when fish are no longer transparent, limiting in vivo optical imaging methods. Thus, non-invasive imaging to track tumors in adult zebrafish remains challenging. In this study tumors were visualized in transgenic zebrafish using µMRI at 9.4T. Furthermore, live imaging of tumors at ultra-high field (17.6T) revealed significant tumor heterogeneity. This study demonstrating the application of µMRI to detect the locations, invasion status and characteristics of internal melanomas in zebrafish and pave the way for tracking tumor development and real-time assessment of therapeutic effects in zebrafish tumor models.

11:54 ***731***. **Phase Contrast Based MR Microscopy of Glial Tumor Cells Using Microcoils**

Nicoleta Baxan[1], Ulf Kahlert[2], Hans Weber[1], Mohammad Mohammadzadeh[1], Juergen Hennig[1], Dominik von Elverfeldt[1]
[1]Diagnostic Radiology, Medical Physics, University Hospital, Freiburg, Germany; [2]Stereotactic Neurosurgery, University Hospital , Freiburg, Germany

The contrast mechanism employed for differentiating structures in micron-scale samples is of great interest especially when is combined with high-resolution MRI and an adequate SNR. In this study, phase contrast together with the susceptibility weighted imaging (SWI) technique was performed for imaging living glial tumor cells. Our method combines the benefits of exploiting the phase MR signal for contrast enhancement and the sensitivity optimization by using MR microcoils. Biochemical spectroscopy investigations were performed as well within a timeframe not detrimental for preserving cells viability.

12:06 ***732***. **In Vivo Imaging of Redox State in Mice Using EPRI/MRI Coimaging**

George Laurentiu Caia[1], Ziqi Sun[1], Sergey Petryakov[1], David Johnson[1], Murugesan Velayutham[1], Alexander Samouilov[1], Jay Louis Zweier[1]
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Electron paramagnetic resonance imaging (EPRI) using nitroxide spin probes is a sensitive technique for in vivo measurement of redox state. 1D and 2D EPR imaging has been previously used to map and monitor the change in redox status of various organs in animal models. However, 3D EPR imaging of the change in redox status in vivo with anatomic registration is essential to understand organ specific pathology and disease. In the present work, the nitroxide 3-carbamoyl-2,2,5,5-tetramethyl-1-pyrrolidinyl-N-oxyl (3CP) was used to map and monitor the redox state of various organs in living mice using the new EPR/NMR coimaging instrumentation [1]. With rapid scan projection acquisition, we performed 3D mapping of 3CP in living mice every 8 minutes. The NMR coimaging allowed precise slice by slice measurement of the radical reduction and mapping of this metabolism in major organs such as the heart, lungs, liver, bladder and kidneys.

12:18 ***733***. **Assessment of Melanoma Extent and Melanoma Metastases Invasion Using Electron Paramagnetic Resonance and Bioluminescence Imaging**

Quentin Godechal[1], Florence Defresne[2], Philippe Leveque[1], Jean-François Baurain[3], Olivier Feron[2], Bernard Gallez[1]
[1]Biomedical Magnetic Resonance Unit, Université Catholique de Louvain, Bruxelles, Belgium; [2]Pharmacotherapy Unit, Université Catholique de Louvain, Bruxelles, Belgium; [3]Medical Oncology Unit, Université Catholique de Louvain, Bruxelles, Belgium

Malignant melanoma is a skin tumor characterized by the uncontrolled proliferation of melanocytes, which can lead to metastasis mainly in lungs. The incidence of melanoma is rising each year. For this reason, it is essential to develop new effective methods able to detect melanoma. The purpose of the present study is to assess the ability of EPR to detect and measure the colonization of lungs by melanoma metastases. Results will be compared to results obtained with bioluminescence imaging in order to validate the EPR method.

Perinatal Brain

Room A6 10:30-12:30 *Moderators:* Nadine S. Girard and Patricia E. Grant

10:30 ***734***. **Study the Cerebral Wall of the Fetal Brain with DTI and Histology**

Hao Huang[1], Linda J. Richards[2], Paul Yarowsky[3], Susumu Mori[4]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Queensland Brain Institute, University of Queensland, St. Lucia, Australia; [3]Department of Pharmacology and Experimental Therapeutics, University of Maryland, Baltimore, MD, United States; [4]Department of Radiology, Johns Hopkins University, Baltimore, MD, United States

The cerebral wall of the fetal brain contains multiple layers and undergoes active structural changes during fetal development. DTI imaging can clearly identify three layers in the cerebral wall, which are cortical plate, subplate and inner layer. In this study, we qualitatively and quantitatively characterized the inner layer with both DTI and histology and found that radial structure, rather than the tangential structure of fetal white matter, is dominant in the inner layer during second trimester. Fractional anisotropy values in the inner layer are higher than those in the suplate but lower than those in the cortical plate.

10:42 ***735***. **Developing Connectivity in Human Fetal Brains: Emerging Regional Variations**

Emi Takahashi[1], Rebecca D. Folkerth[2], Rudolph Pienaar[1], Albert M. Galaburda[3], P. Ellen Grant[1,4]
[1]Department of Medicine, Children's Hospital Boston, Harvard Medical School, Boston, MA, United States; [2]Department of Pathology, Childrens Hospital Boston, MA, United States; [3]Department of Neurology, Beth Israel Deaconess Hospital, Harvard Medical School, Boston, MA, United States; [4]Department of Radiology, Massachusetts General Hospital, Boston, MA, United States

Examination of the three-dimensional axonal pathways in the developing brain is key to understanding the formation of cerebral connectivity. Using high-angular resolution imaging (HARDI) tractography, we imaged developing cerebral fiber pathways in human fetal specimens ranged from 18 to 33 post-gestational weeks (W). We observed dominant radial pathways at 18-20W, and at later stages, emergence of short- and long-range cortico-cortical association pathways, subcortical U-fibers in specific brain regions. Although radial pathways still remained, they were less dominant at 33W. These results demonstrate that HARDI tractography can detect radial migration and emerging regional specification of connectivity during fetal development.

10:54 ***736***. **Cortical Folding Analysis for Normal Fetuses**

Jue Wu[1], Suyash P. Awate[2], Daniel Licht[3], Catherine Limperopoulos[4], James C. Gee[1]
[1]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Siemens Corporate Research, Princeton, NJ, United States; [3]Children's Hospital of Philadelphia, Philadelphia, PA, United States; [4]Mcgill University, Montreal, Quebec, Canada

Eight cortical folding measures were applied to T2w in vivo MRIs of 40 normal fetuses with varied gestational ages. Correlations of these measures with gestational age are reported and Gaussian curvature L2 norm and intrinsic curvature index are the two most correlated measures. These measures may be help in characterization of normal neurodevelopment and in detection of abnormal brain growth in fetuses.

11:06 ***737***. **3D Fetal Brain Volumetry in Intrauterine Growth Restriction**

Mellisa Damodaram[1,2], Lisa Story[1,2], Prachi Patkee[1], Abhilasha Patel[1,2], Amy McGuinness[1], Joanna Allsop[1], Sailesh Kumar,[2], Jo Hajnal[1], Mary Rutherford[1]
[1]Robert Steiner MRI Unit, Hammersmith Hospital, Imperial College London, London, United Kingdom; [2]Imperial College Healthcare Trust, London, United Kingdom

Fetal intrauterine growth restriction is a significant problem that often results in iatrogenic premature delivery of the fetus. These children may have neurodevelopmental delay and exhibit problems that cannot be explained by the complications of prematurity alone. Little is known about the exact neurostructural deficiencies that arise as a result of intrauterine growth restriction, and MR studies have been limited by difficulties overcoming the inherent problem of fetal motion. We describe a technique to conduct 3D reconstruction of the fetal brain that enables volumetric analysis of the whole brain and cerebellum in both normally grown and growth restricted fetuses.

11:18 ***738***. **Development of Multi-Contrast Human Neonatal Brain Atlas**

Kenichi Oishi[1], Pamela Donahue[2], Lynn Anderson[3], Steven Buchthal[3], Thomas Ernst[3], Andreia Faria[1], Hangyi Jiang[1,4], Xin Li[4], Michael Miller[5], Peter van Zijl[1,4], Susumu Mori[1,4], Linda Chang[3]
[1]Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Department of Pediatrics, Johns Hopkins University School of Medicine; [3]Neuroscience and Magnetic Resonance Research Program, John A. Burns School of Medicine, University; [4]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute; [5]Department of Biomedical Engineering, Johns Hopkins University

We have developed neonatal brain atlases with detailed anatomic information derived from DTI and co-registered anatomical MRI. Combined with a highly elastic non-linear transformation, we attempted to normalize neonatal brain images to the atlas space and three-dimensionally parcellate the images into 122 brain structures. The accuracy level of the normalization was measured by the agreement with manual segmentation. This method was applied to 33 healthy term infants, ranging from 37 to 53 weeks of age since conception, to characterize developmental changes. The future applications for this atlas include investigations of the effect of prenatal events and the determination of imaging biomarkers.

11:30 ***739***. **Comparison of Cortical Folding Measures for Evaluation of Developing Cortex**

Joshua S. Shimony[1], Jason Hill[1], John Harwell[1], Tim Coalson[1], Dierker Donna[1], Terrie Inder[1], David Van Essen[1], Jeff J. Neil[1]
[1]Washington University in St. Louis, St. Louis, MO, United States

A variety of measures have been proposed to evaluate cortical folding, many of which are based on the mathematical quantity of curvature. We obtained MRI data from premature infants at <27, 30-31, 34-35, and 38-39 wks postmenstrual age (PMA). We evaluated how 17 cortical folding measures change with increasing PMA. There was considerable disparity in the sensitivity of the measures to cortical maturation, though a subset increased in a monotonic and predictable fashion, making them suitable for evaluation of brain development.

11:42 ***740***. **Quantification of Tissues' Maturation in the Infant Brain with Multi-Parametric MRI**

Jessica Dubois[1,2], Cyril Poupon[3,4], François Leroy[1,4], Giovanna Santoro[1], Jean-François Mangin[3,4], Lucie Hertz-Pannier[2,5], Ghislaine Dehaene-Lambertz[1,4]
[1]U562, Inserm, Gif-sur-Yvette, France; [2]LBIOM, CEA, Gif-sur-Yvette, France; [3]LNAO, CEA, Gif-sur-Yvette, France; [4]IFR49, Paris, France; [5]U663, Inserm, Paris, France

Brain development proceeds with a specific spatio-temporal pattern across regions during early infancy and childhood. MRI has recently enabled to study this process non-invasively, but the functional significance of MRI indices is still controversial. Here we used multi-parametric quantitative MRI to investigate this issue in the developing brain of 10 healthy infants (age: 6 to 18weeks). Diffusion Tensor Imaging and T1-T2 mappings were performed over the whole brain in a short acquisition time with EPI sequences. The indices quantification highlighted variable age-related changes across different regions of grey and white matter, and specific relationships between indices according to maturational processes.

11:54 ***741***. **Gestational Age at Birth Influences Brain White Matter Development**

L. Tugan Muftuler[1], Claudia Buss[2], Orhan Nalcioglu[1], Curt A. Sandman[2], Elysia Poggi Davis[2]
[1]Center for Functional Onco-Imaging, University of California, Irvine, CA, United States; [2]Psychiatry & Human Behavior, University of California, Orange, CA, United States

In the fetal brain, there is minimal myelinated WM at 29 weeks and a dramatic increase is seen after the 36th week. Therefore, this is a period when the brain development is highly vulnerable to insults caused by premature birth. Prior studies have investigated the mean differences between preterm and term children. But the fetal brain development is a continuous process and gestational age at birth will disrupt the process in different phases. Therefore, we studied the persisting effects of GAB on the WM of children. The results show that major WM pathways are strongly influenced by the GAB.

12:06 ***742***. **Differences in Biochemical Maturation in Term and Preterm Newborns**

Ashok Panigrahy[1,2], Marvin D. Nelson[1], Floyd H. Gilles[3], Lisa Paquette[4], Istvan Seri[4], Stefan Bluml[1,5]
[1]Department of Radiology, Childrens Hospital Los Angeles, Los Angeles, CA, United States; [2]Department of Radiology, Children's Hospital of Pittsburgh of UPMC, Pittsburgh, PA, United States; [3]Department of Neuropathology, Childrens Hospital Los Angeles, Los Angeles, CA, United States; [4]Division of Neonatology, Childrens Hospital Los Angeles, Los Angeles, CA, United States; [5]Rudi Schulte Research Institute, Santa Barbara, CA, United States

In this study, we compare age-dependent changes of metabolites using quantitative MR spectroscopy in white and grey matter of premature neonates without brain injury with normal biochemical maturation in age-matched term neonates. There are subtle but significant differences in the biochemical maturation of white matter in premature infants with normal conventional MR imaging when compared to control term infants. The observations suggest accelerated white matter development in the premature brain possibly from increased sensory-motor stimulation in the extra-uterine environment or possibly a reparative response to subtle brain injury (i.e. possibly related to sepsis induced white matter injury).

12:18 ***743***. **The Functional-Structural Interplay During First Two Years' Brain Development**

Wei Gao[1], Pew-Thian Yap[2], Hongtu Zhu[3], Kelly Giovanello[4], Keith Smith[2], John Gilmore[5], Weili Lin[6]
[1]Biomedical Engineering, UNC-Chapel Hill, Chapel Hill, NC, United States; [2]Radiology, University of North Carolina-Chapel Hill, Chapel Hill, NC, United States; [3]Biostatistics and Biomedical Research Imaging Center, University of North Carolina-Chapel Hill, Chapel Hill, NC, United States; [4]Psychology and Biomedical Research Imaging Center, University of North Carolina-Chapel Hill, Chapel Hill, NC, United States; [5]Psychiatry, University of North Carolina-Chapel Hill, Chapel Hill, NC, United States; [6]Radiology and Biomedical Research Imaging Center, University of North Carolina-Chapel Hill, Chapel Hill, NC, United States

In this study, normal and healthy pediatric subjects aged between 2wk to 2 yrs were studied so as to directly compare the temporal evolution of brain functional and structural connectivity. In so doing, we aim to determine the temporal correlation between functional and structural connectivity during the first two years of life and to reveal whether or not maturation of structural connectivity is needed for functional connectivity.

Body Metabolism: More to Life than Fat

Room A7 10:30-12:30 *Moderators:* Claude B. Sirlin and Kristen L. Zakian

10:30 ***744***. **Evaluation of Liver Regeneration in Human After Portal Vein Embolization and Partial Hepatectomy Using in Vivo ^{1}H Decoupled - ^{31}P Magnetic Resonance Spectroscopy Imaging**

Jing Qi[1], Amita Shukla-Dave, Yuman Fong[2], Mithat Gönen[3], Lawrence H. Schwartz[4], William M. Jarnagin[2], Jason A. Koutcher, Kristen L. Zakian[1]
[1]Medical Physics, Memorial Sloan-Kettering Cancer Center, New York, NY, United States; [2]Surgery, Memorial Sloan-Kettering Cancer Center, New York, NY, United States; [3]Epidemiology and Biostatistics, Memorial Sloan-Kettering Cancer Center, New York, NY, United States; [4]Radiology, Memorial Sloan-Kettering Cancer Center, New York, NY, United States

To compare the metabolic feature of hepatic regeneration stimulated by portal vein embolization (PVE) and partial hepatectomy (PH), liver 1H-decoupled 31P-MRSI data acquired from 8 healthy subjects, 6 patients at 48 hours following PVE and 4 patients at 48 hours following PH were analyzed. PH showed similar PME/NTP value as PVE, but significantly higher than control group. PH had significantly elevated PME/PDE, PE/NTP and PE/PC ratios but lower PC/NTP ratio compared to PVE and control subjects. The biochemical difference at 48 hours following PH and PVE indicated that hepatic regeneration process after PVE is not as strong as PH.

10:42 ***745***. **In Vivo Hepatic Localized Proton Magnetic Resonance Spectroscopy at 7T in a Glycogen Storage Disease Mouse Model**

Nirilanto Ramamonjisoa[1], Hélène Ratiney[1], Fabienne Rajas[2], Elodie Mutel[2], Frank Pilleul[1,3], Olivier Beuf[1], Sophie Cavassila[1]
[1]Université de Lyon, CREATIS-LRMN; CNRS UMR 5220; Inserm U630; INSA-Lyon; Université Lyon 1, Villeurbanne, France; [2]Inserm U855; Université Lyon1, Faculté de Médecine Laennec, Lyon, France; [3]Imagerie Digestive - CHU, Hospices Civils de Lyon, Lyon, France

In vivo 1H magnetic resonance spectroscopy (MRS) was used to evaluate the hepatic steatosis in a mouse model of GSD1a under two different diets, a standard- and a high fat diet. Accumulation of hepatic fat and fat composition within the liver were assessed. The estimated MRS profiles for both groups (Figure 2) showed significant differences for the lipid methyl resonances at 0.9ppm. Both estimated levels of the methylene resonances (1.3ppm) were significantly higher than the estimates obtained for control mice fed on standard diet. Based on MR imaging observations, 90% of the mice fed on high-fat diet exhibited adenomas in the liver while none fed on standard diet. These measurements will give insight into the understanding of the onset and progression of adenomas in a mouse model of GSD1a under different diets

10:54 ***746***. **Regional Variability in Triglyceride Composition of Adipose Tissue Measured by ^{1}H MRS**

Gavin Hamilton[1], Michael S. Middleton[1], Takeshi Yokoo[1], Mark Bydder[1], Michael E. Schroeder[1], Claude B. Sirlin[1]
[1]Department of Radiology, University of California, San Diego, San Diego, CA, United States

The multi-peak structure of the fat ^{1}H MR spectrum allows non-invasive estimation of the triglyceride composition of adipose tissue. The study compares variability in triglyceride composition of two locations in subcutaneous adipose tissue to the variability seen between subcutaneous and visceral adipose tissue. We see agreement in triglyceride composition in different locations in subcutaneous adipose tissue, but triglyceride composition of visceral tissue varies compared to that of subcutaneous tissue.

11:06 ***747***. **Liver Fat Is More Saturated Than Adipose Fat as Determined by Long TE ^{1}H-MRS**

Jesper Lundbom[1], Antti Hakkarainen[1], Sanni Söderlund[2], Jukka Westerbacka[2], Nina Lundbom[1], Marja-Riitta Taskinen[2]
[1]HUS Medical Imaging Centre, University of Helsinki, Helsinki, Finland; [2]Department of Medicine, University of Helsinki, Finland

We used long TE 1H-MRS to show that liver fat is more saturated than subcutaneous and intra-abdominal adipose tissue.

11:18 ***748***. **In Vivo Identification of a Molecular Marker for Brown Adipose Tissue in NMR Spectra of Large Volumes**

Rosa Tamara Branca[1], Warren Sloan Warren[2]
[1]Chemistry, Duke University, Durham, NC, United States; [2]Chemistry , Duke University, Durham, NC, United States

A molecular signature of brown adipose tissue is found in the iZQC spectrum of mice. More specifically the iZQC resonance frequency line between methylene protons (-CH2-) at 1.3ppm and water, at cellular length scales, seems to be characteristic of the only BAT tissue. This method is applied in vivo to screen normal and obesity mouse models, and to track the BAT response to adrenergic stimulation and cold exposure.

11:30 ***749***. **Characterization of Brown Adipose Tissue in Mice with IDEAL Fat-Water MRI**

Houchun Harry Hu[1], Daniel Larry Smith, Jr. [2], Michael I. Goran[3], Tim R. Nagy[2], Krishna S. Nayak[1]
[1]Electrical Engineering, University of Southern California, Los Angeles, CA, United States; [2]Nutrition Sciences, University of Alabama at Birmingham, Birmingham, AL, United States; [3]Preventive Medicine, Pediatrics, Physiology & Biophysics, University of Southern California, Los Angeles, CA, United States

The fat fraction from IDEAL-MRI is used to non-invasively characterize brown adipose tissue (BAT) in mice. We first demonstrate the ability to identify various BAT depots with IDEAL. We then demonstrate with IDEAL differences in BAT between mice that were housed at 19°C and 25.5°C for three consecutive weeks. The interscapular BAT fat fractions in the colder animals were (35.2–48.6%), in contrast to the warmer animals (48.4–60.9%), $p<0.01$. The two groups exhibited *similar* gains in body weight, despite a significant 29% *greater* food intake by the 19°C animals. These findings support BAT's involvement in thermogenesis and lipid metabolism.

11:42 ***750***. **Pancreatic and Hepatic Fat and Associated Metabolic Complications in Overweight Youth**

Catriona A. Syme[1], Greg D. Wells[1,2], Garry Detzler[1], Hai-Ling Margaret Cheng[1,2], Mike D. Noseworthy[3,4], Timo Schirmer[5], Brian W. McCrindle,[2,6], Jill Hamilton,[27]
[1]Physiology & Experimental Medicine, The Hospital for Sick Children, Toronto, ON, Canada; [2]University of Toronto, Toronto, ON, Canada; [3]Electrical and Computer Engineering, McMaster University, Hamilton, ON, Canada; [4]Brain-Body Institute, St. Joseph's Healthcare, Hamilton, ON, Canada; [5]Applied Science Laboratory, GE Healthcare, Munich, Germany; [6]Cardiology, The Hospital for Sick Children, Toronto, ON, Canada; [7]Endocrinology, The Hospital for Sick Children, Toronto, ON, Canada

In overweight youth, pancreatic and hepatic fat (PF and HF) were estimated from in- and out-of-phase MRI, and associations with metabolic parameters were assessed. Both showed positive correlations with triglycerides and insulin resistance and secretion. HF did not correlate with liver enzymes, suggesting its early accumulation may influence glucose metabolism before elevation of hepatic transaminases. Lack of associations between intra-abdominal fat or body mass index z-score and these metabolic parameters highlight the importance of fat distribution rather than fat quantity alone. The current study reveals the potential to index simultaneously ectopic fat in two organs important for glucose and lipid metabolism.

11:54 ***751***. **Fat Contents of Human Liver, Pancreas and Kidney**

Paul E. Sijens[1], Mireille A. Edens[1], Stephan J.L. Bakker[1], Ronald P. Stolk[1]
[1]UMCG, Groningen, Netherlands

Multivoxel MR spectroscopy and a previously validated gradient echo MRI adaptation of Dixon's two-point technique were used to quantify kidney, liver, and pancreas fat contents in volunteers with diverse body weights, and to assess inter-organ relationships. Respective fat contents of liver, pancreas and kidney were 4.4%, 4.0% and 0.8%. The amount of subcutaneous fat correlated with liver fat content and pancreas fat content (r=0.45 and r=0.44,

respectively; P<0.01). Kidney fat content correlated with none of the other parameters, indicating that renal lipid accumulation, unlike the coupled accumulations of fat in liver and pancreas (r=0.43;P<0.01), is not observed in obese subjects.

12:06 ***752***. **Use of MRI for Longitudinal in Vivo Phenotyping of Obese Mouse Models Following a Dietary Intervention**

Abdel Wahad Bidar[1], Karolina Ploj[2], Christopher Lelliott[2], Karin Nelander[3], Leonard Storlien[2], Paul Hockings[1]
[1]DECS Imaging, AstraZeneca R&D, Mölndal, Sweden; [2]CVGI, Bioscience, AstraZeneca R&D, Sweden; [3]DECS Discovery Statistics, AstraZeneca R&D, Sweden

In preclinical drug discovery, experimental rodent models of obesity are used for the investigation of metabolic disorders. Repeated in vivo measurements of adipose tissue depots and intraorgan fat can provide longitudinal data with greatly reduced usage of experimental animals. The aim of the present study was threefold: (i) validate in vivo MRI/S determinations of brown adipose tissue, total, intra-abdominal and subcutaneous white adipose tissues as well as intrahepatocellular lipids against ex vivo measurement, (ii) address the 3R's mandate, by presenting a statistical power analysis; (iii) characterize the phenotypic and metabolic switch of the "cafeteria-diet" mouse model during a dietary intervention.

12:18 ***753***. **Real-Time Assessment of *in Vivo* Postprandial Lipid Storage in Rat Liver Using ^{1}H-[^{13}C] MRS**

Richard Jonkers[1], Tom Geraedts[1], Luc van Loon[2], Klaas Nicolay[1], Jeanine Prompers[1]
[1]Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands; [2]Department of Human Movement Sciences, Maastricht University Medical Centre+, Maastricht

Insulin resistance and type 2 diabetes are associated with elevated liver lipid content. It remains unknown whether this excessive accumulation of triglycerides is a result of increased lipid uptake or decreased lipid oxidation. In this study, we measured for the first time postprandial lipid storage in rat liver in vivo using localized ^{13}C-edited ^{1}H-observed MRS and ^{13}C labeled lipids as tracers. The ^{13}C enrichment of the liver lipid pool was 0.9 ± 0.7% at baseline and increased to 4.8 ± 0.9% 5h after ingestion of the tracer, showing that we can assess changes in ^{13}C enriched lipid content *in vivo*.

Cardiovascular Image Postprocessing

Room A8 10:30-12:30 *Moderators:* Sebastian Kozerke and Rob J. van der Geest

10:30 ***754***. **Importance of Different Correction Methods for Optimized 3D Visualization of 3-Directional MR Velocity Data**

Ramona Lorenz[1], Jelena Bock[1], Jan Korvink[2], Michael Markl[1]
[1]Dept. of Diagnostic Radiology, University Hospital, Freiburg, Germany; [2]Dept. of Microsystems Technology, IMTEK, Freiburg, Germany

3D visualization of time resolved 3D phase contrast data plays an important role for the analysis of flow characteristics inside the vessels of interest. However, phase offset errors due to gradient field distortions caused by three major effects including eddy currents, concomitant gradients, and gradient field non-linearities can severely distort the measured three-directional velocities. This results in distortion of streamlines and particle traces which might lead to incorrect flow pattern visualization. The application of correction methods for all three phase offset errors resulted in an improvement of 3D streamline visualisation.

10:42 ***755***. **Identification of Myocardial Infarction Using Fractional Anisotropy of 3D Strain Tensors**

Sahar Soleimanifard[1], Khaled Z. Abd-Elmoniem, [12], Harsh K. Agarwal[1], Miguel Santaularia-Tomas[3], Tetsuo Sasano[3], Evertjan Vonken[3], Amr Youssef[3], M. Roselle Abraham[3], Theodore P. Abraham[3], Jerry Ladd Prince[1]
[1]Department of Electrical and Computer Engineering, Johns Hopkins University, Baltimore, MD, United States; [2]National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, Bethesda, MD, United States; [3]Cardiology Division, Department of Medicine, Johns Hopkins University, Baltimore, MD, United States

Assessment of tissue viability is currently involved with injection of gadolinium for contrast-enhanced imaging. Strain profile of myocardium has been previously studied but requires comparison of tensors fields, which is usually difficult due to multivariate nature of tensors. It is desirable to describe tensors with scalar indices, which are more mathematically and statistically intuitive. In this work, fractional anisotropy (FA) of strain tensors in healthy and infarcted regions in a large animal model is computed and compared with conventional delayed-enhancement method. High correlation between both representations shows promise of FA in assessment of viability without negative effects of contrast agents.

10:54 ***756***. **An Extended Graphical Model for Analysis of Dynamic Contrast-Enhanced MRI**

Huijun Chen[1], Feiyu Li[1], Xihai Zhao[1], Chun Yuan[1], William S. Kerwin[1]
[1]Department of Radiology, University of Washington, Seattle, WA, United States

Kinetic modeling of DCE-MRI permits the measurement of physiological parameters, such as K^{trans}. The modified Kety/Tofts model may lead to fit failures when the data acquisition period is too short. The estimates of the Patlak model can be highly inaccurate due to the neglecting of contrast agent reflux. In this investigation, an extended graphical model is proposed. In the tests of simulation data and in vivo data of carotid artery, the proposed extended graphical model was shown to address the bias inherent in the Patlak model and produce more stable estimates than the modified Kety/Tofts model for short duration experiments.

11:06 ***757***. **Improved T2* Estimation Technique in Human Carotid Arteries**

Travis Patrick Sharkey-Toppen[1], Bradley Dean Clymer[1], Andrei Maiseyeu[1], Tam Tran[1], Georgeta Mihai[1], Subha V. Raman[1]
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Atherosclerosis is one of the leading causes of death worldwide. It has been shown that iron may play a significant role in the development of plaque. Quantification of iron via T2* is complicated in small vessels such as the carotids due to their limited size, motion and flow artifacts. Evaluation of a new T2* estimation technique which utilizes WLSE and outlier detection is shown to lower the effect of noise and increase reproducibility in small vessels.

11:18 ***758***. **Three-Dimensional Prolate Spheroidal Extrapolation for Sparse DTI of the In-Vivo Heart**

Nicolas Toussaint[1], Christian Stoeck[2], Maxime Sermesant,[1,3], Sebastian Kozerke,[1,2], Philip Batchelor[1]
[1]Imaging Sciences, King's College London, London, United Kingdom; [2]ETH Zurich, Zurich, Switzerland; [3]Asclepios Research Group, INRIA, Sophia Antipolis, France

We propose to extrapolate sparsely distributed cardiac DTI using prolate spheroid coordinate system. For this, a segmented shape of the left ventricle is mapped to the closest truncated prolate spheroid using a non-linear diffeomorphic registration algorithm. Thereby, the tensor components and spatial positions can be expressed in prolate spheroid coordinates. After extrapolation, dense tensors are mapped back using the symmetric transformation. Comparison with the classic Cartesian extrapolation shows better consistency of the tensor field at unknown positions. It is demonstrated that this shape-based extrapolation method gives robust estimation of the in-vivo fibre architecture of the left ventricle.

11:30 ***759***. **Fourier Analysis of STimulated Echoes (FAST) for Quantitative Analysis of Left Ventricular Torsion**

Meral Reyhan[1], Daniel B. Ennis[1], Yutaka Natsuaki[2]
[1]Radiological Sciences, University of California, Los Angeles, CA, United States; [2]Siemens Medical Solutions USA, Inc., Los Angeles, CA, United States

Left ventricular (LV) torsion is an important measure of LV performance. This study validates a novel quantitative method (Fourier Analysis of STimulated echoes - FAST) for the rapid quantification of LV torsion by comparison to a "gold standard" method (FindTags) and finds no statistical difference between the methods in six canine studies. The intraobserver coefficient of variation (CV) for each observer was 4.2% and 2.3%. The interobserver CV was 8.4% and 5.4%. FAST analysis of LV torsion in six healthy-subjects demonstrates quantitation of systolic torsion and early untwisting. FAST is a highly reproducible and rapid (<3 minutes-per-study) quantitative method.

11:42 ***760***. **Varied Sampling Patterns in Modified Look-Locker with Saturation Recovery for Flexible Cardiac T1 Mapping**

Ting Song[1,2], Vincent B. Ho[2,3], Glenn Slavin[1], Maureen N. Hood[2,3], Jeffrey A. Stainsby[4]
[1]GE Healthcare Applied Science Laboratory, Bethesda, MD, United States; [2]Radiology, Uniformed Services University of the Health Sciences, Bethesda, MD, United States; [3]Radiology, National Navy Medical Center, Bethesda, MD, United States; [4]GE Healthcare Applied Science Laboratory, Toronto, ON, Canada

A cardiac T1 mapping sequence using a modified Look-Locker with saturation recovery acquisition provides increased flexibility with respect to sampling of the signal recovery curve over more traditional inversion recovery T1 mapping methods. In this work we explore different sampling patterns on phantoms and human subjects. A sampling scheme requiring half the data samples and thus half the breath hold time is compared to previous methods. An SNR sensitivity analysis was performed to confirm the accuracy of the reduced data sampling method at clinically relevant SNR and tissue T1 values.

11:54 ***761***. **Fully Automated Generation of Arteriogram and Venogram Using Correlation and Pooled Covariance Matrix Analysis**

Jiang Du[1], Afshin Karami[1], Yijing Wu[2], Frank Korosec[2], Thomas Grist[2], Charles Mistretta[2]
[1]Radiology, University of California, San Diego, CA, United States; [2]Medical Physics and Radiology, University of Wisconsin, Madison, WI, United States

Time-resolved CE-MRA provides contrast dynamics in the vasculature, which can be further used to separate arteries from veins. However, most of the segmentation algorithms require operator intervention. Furthermore, the contrast dynamics pattern may vary significantly within a large coronal imaging FOV due to delayed or asymmetric filling, or slow blood flow in the tortuous vessels. Correlation with single arterial and/or venous reference curves may result in misclassification. Here we present a fully automated region-specific segmentation algorithm for effective separation of arteries from veins based on cross correlation and pooled covariance matrix analysis.

12:06 ***762***. **Stent Visualization by Susceptibility Field Mapping Using the Original Resolution**

Gopal Varma[1], Rachel Clough[1], Julien Senegas[2], Hannes Dahnke[2], Stephen Keevil[1,3], Tobias Schaeffter[1]
[1]Imaging Sciences, King's College London, London, United Kingdom; [2]Philips Research Europe, Hamburg, Germany; [3]Medical Physics, Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom

Visualization of stent-grafts allows guidance and deployment to be assessed. Detection by negative contrast can be confused with other sources of hypo-intensity. A modified version for SGM is presented for positive visualization without compromise in resolution. This and its application by post-processing allows the information from both contrasts to be used without registration.

12:18 ***763***. **Heart-Within-Heart Dynamic Systems Implicit in Myocardial Fiber Architecture Revealed by Diffusion Tensor Tractography**

Kuan-Liang Liu[1], Hsi-Yu Yu[2], V. J. Wedeen[3], Wen-Yih Isaac Tseng[1,4]
[1]Center for Optoelectronic Biomedicine, National Taiwan University, Taipei, Taiwan; [2]Departments of Surgery, National Taiwan University Hospital, Taiwan; [3]Department of Radiology, MGH Martinos Center for Biomedical Imaging, Harvard Medical School, Charlestown, MA, United States; [4]Department of Medical Imaging, National Taiwan University Hospital, Taiwan

It is long known that the myocardial architecture has its functional significance. However, up to now there are no models that can fully explain the relationship between myocardial fiber structure and the mechanism of cardiac motion. In this study, we proposed using diffusion tensor imaging and fiber tracking technique to perform virtual dissection of the myocardial fiber architecture. We found that the LV myocardial fibers can be classified into two systems; the inner heart system corresponds to the motion of torsion and longitudinal shortening and the outer heart system corresponds to radial contraction of the LV wall.

Tagging & Water/Fat

Room A9 10:30-12:30 *Moderators:* Diego Hernando and Scott B. Reeder

10:30 ***764***. **Super-Resolution MRI Using Microscopic Spatial Modulation of Magnetization (MicroSPAMM)**

Stefan Ropele[1], Gernot Reishofer[2]
[1]Department of Neurology, Medical University of Graz, Graz, Austria; [2]Department of Radiology, Medical University of Graz, Graz, Austria

A new super-resolution (SR) method for field of view (FOV) shifted MRI is presented. In contrast to previous attempts that are based on simple FOV shifts only, the new method additionally modulates the longitudinal magnetization within the imaging plane for each shift, thus allowing the acquisition of new and independent k-space data. First SR experiments in a geometric phantom and in brain tissue of two healthy volunteers clearly demonstrate the feasibility and advantages of the new method, which has the capability to break current resolution limits in MRI.

10:42 ***765***. **Experimental Validation of SPAMM Tagged Magnetic Resonance Imaging Based Measurement of Non-Uniform 3D Soft Tissue Deformation**

Kevin Mattheus Moerman[1,2], Ciaran Knut Simms[1], Andre M. J. Sprengers[2], J. Stoker[2], Aart J. Nederveen[2]
[1]Trinity Centre for Bioengineering, Trinity College Dublin, Dublin, Ireland; [2]Radiology, Academic Medical Centre, Amsterdam, Netherlands

Analysis of human soft tissue motion and deformation is vital in diverse applications from constitutive modelling in biomechanics to the study of bowel motility. Post-processing Magnetic Resonance Imaging (MRI) to derive soft tissue deformation challenging and requires validation. For this study a novel MRI sequence, based on SPAtial Modulation of the Magnetization (SPAMM) designed for real-time measurement of non-periodic movements was evaluated for its ability to measure 3D soft tissue deformation using marker tracking in a silicone gel phantom. The mean error of the SPAMM based non-invasive deformation measurement technique was found to be 0.75mm.

10:54 ***766***. **Radial Tagging of MR Images: A Continuous RF Excitation Approach**

Abbas Nasiraei Moghaddam[1,2], Yutaka Natsuaki[3], J. Paul Finn[1]
[1]Radiology, UCLA, Los Angeles, CA, United States; [2]Caltech, Pasadena, CA, United States; [3]Siemens Medical Solutions, Los Angeles, CA, United States

MRI tagging is a well established method for non-invasive measurement of deformation and strain. Radial tagging is a pattern of interest that facilitates the measurement of angular information reflected in shear and twist of the left ventricle. In this work we describe a continuous RF approach for radial tagging that acts on a rotating excitation plane. The sequence has been successfully tested on phantom and also used to acquire short axis images of the left ventricle. The spatial resolution and density of taglines are considerably higher in this approach compared to previous schemes of the radial tagging.

11:06 ***767***. **Single Coil PILS Imaging Using Phase-Scrambling Fourier Transform Technique**

Satoshi Ito[1], Yoshifumi Yamada[1]
[1]Research Division of Intelligence and Information Sciences, Utsunomiya University, Utsunomiya, Tochigi, Japan

Parallel image reconstruction using local sensitivities (PILS) accelerate MR scan time by using multiple receiver coil in parallel scan time. We propose a novel imaging technique which is based on the PILS, but uses only a single set of signals. The signal obtained in the phase-scrambling Fourier Transform imaging (PSFT) can be transformed into the signal described by the Fresnel transform of the objects, in which alias-less images can be obtained by optionally scaling the object images. The reconstructed alias-less image has lower resolution than the original image which has aliasing artifact since aliasing is avoided by shrinking the image to fit in the given data size. In this paper, we propose PILS like reconstruction method which can improve the resolution of images by using the up-scaling of alias-less reconstruction and signal band extrapolation technique of PSFT signal.

11:18 ***768***. **A Reliable, Efficient and Flexible Multi-Echo FSE Based Water-Fat Separation Method**

Huanzhou Yu[1], Ann Shimakawa[1], Sabina Prato[2], Scott B. Reeder[3], Charles A. McKenzie[4], Jean H. Brittain[5]
[1]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [2]GE Healthcare, Waukesha, WI, United States; [3]Departments of Radiology, Medical Physics, Biomedical Engineering and Medicine, University of Wisconsin, Madison, Madison, WI, United States; [4]Department of Medical Biophysics, University of Western Ontario, London, ON, Canada; [5]Applied Science Laboratory, GE Healthcare, Madison, WI, United States

Three-point IDEAL water-fat separation techniques have been applied to FSE sequences, however, minimum scan time is tripled. Therefore, it is desirable to collect all 3 echoes in one repetition, an approach that brings unique challenges. In this work, we present a multi-echo FSE-IDEAL implementation that offers superior noise performance, high quality water-fat separation and flexible echo shift choices. The bipolar acquisition with high order phase correction allows efficient acquisition and uniform water-fat separation. Echo shifts are adapted to the desired resolution with best tradeoff in SNR. The technique is demonstrated in volunteer scanning in a variety of anatomic regions.

11:30 ***769***. **Ultrafast Near-Isotropic Spatial Resolution 3D Balanced-SSFP Dixon Imaging in the Breast**

Manojkumar Saranathan[1], Ersin Bayram[2], Christine Lee[3]
[1]Applied Science Lab, GE Healthcare, Rochester, MN, United States; [2]MR Engineering, GE Healthcare, Waukesha, WI, United States; [3]Radiology, Mayo Clinic, Rochester, MN, United States

T2 imaging in the breast is most commonly performed using a 2D Fast Spin Echo (FSE) pulse sequence with a high in-plane spatial resolution and 3-4 mm slice thickness. Balanced steady-state free precession (b-SSFP) techniques yield high SNR images in short scan times with a T2-like image contrast. We investigated a new 3D technique that combines balanced steady-state free precession imaging with a two-point Dixon fat-water reconstruction algorithm [2] for robust fat-separated volumetric imaging of the breast with near isotropic spatial resolution in short scan times.

11:42 ***770***. **Dual-Echo Dixon Imaging with Unrestricted Choice of Echo Times**

Holger Eggers[1], Bernhard Brendel[1], Adri Duijndam[2], Gwenael Herigault[2]
[1]Philips Research, Hamburg, Germany; [2]Philips Healthcare, Best, Netherlands

Existing two-point Dixon methods require at least one echo time being in phase. Thus, they restrict flexibility in the selection of protocol parameters and compromise scan efficiency. In this work, a novel two-point Dixon method is outlined that removes restrictions on the echo times. It is characterized in terms of noise propagation, and it is demonstrated to enable shorter scan times, higher spatial resolution, and increased signal-to-noise ratio in abdominal imaging in single breathholds.

11:54 ***771***. **Exploiting the Spectral Complexity of Fat for Robust Multi-Point Water-Fat Separation**

Huanzhou Yu[1], Ann Shimakawa[1], Jean H. Brittain[2], Charles A. McKenzie[3], Scott B. Reeder[4]
[1]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [2]Applied Science Laboratory, GE Healthcare, Madison, WI, United States; [3]Department of Medical Biophysics, University of Western Ontario, London, ON, Canada; [4]Departments of Radiology, Medical Physics, Biomedical Engineering and Medicine, University of Wisconsin, Madison, Madison, WI, United States

Multi-point water-fat separation methods must address the challenge of water-fat ambiguity that arises from the signal behavior of water and fat which, when both modeled with a single spectral peak, may appear identical in the presence of Bo off-resonance. Water-fat ambiguity is typically removed by enforcing field- or phase-map smoothness using region growing based algorithms. However, the fat spectrum actually has multiple spectral peaks. In this work, a novel algorithm to identify water and fat for multi-point acquisitions is introduced by exploiting the spectral differences between water and fat. New opportunities arise to design algorithms for highly robust water-fat separation.

12:06 ***772***. **Extending Performance of Fat-Water Separated Alternating TR SSFP: Ultra-High 0.29 Mm Isotropic Resolution**

Jessica Leigh Klaers[1], Ethan K. Brodsky[1,2], Richard Kijowski[2], Walter F. Block[1,3]
[1]Medical Physics, University of Wisconsin - Madison, Madison, WI, United States; [2]Radiology, University of Wisconsin - Madison, Madison, WI, United States; [3]Biomedical Engineering, University of Wisconsin - Madison, Madison, WI, United States

The alternating TR (ATR) balanced SSFP technique has proven to be useful for suppression of unwanted species while extending the TR interval available for increased spatial resolution. Ultra-high 0.29 mm isotropic resolution has been achieved by extending the performance of the multi-acquisition fat-water separation ATR SSFP sequence through the implementation of a 3D radial trajectory. Applications in cartilage assessment and vasculature imaging are demonstrated in the knee joint.

12:18 ***773***. **Three-Point Dixon Method for Whole-Body Water/fat Imaging**

Johan Berglund[1], Lars Johansson[1], Håkan Ahlström[1], Joel Kullberg[1]
[1]Department of Radiology, Uppsala University, Uppsala, Sweden

A three-point Dixon method applicable for water/fat separation of whole-body datasets is presented. In each voxel, two alternative error phasors are found analytically. The correct error phasor is identified by imposing spatial smoothness in a 3D multi-seed region growing scheme with a dynamic path. After removing the phase errors, water and fat signal components are found in each voxel by least squares fitting. Whole-body water and fat images were reconstructed from 39 volunteer subjects, and the images were subjectively graded by two radiologists. The method was found to achieve fast and accurate whole-body water/fat separation.

MR Safety

Room K2 10:30-12:30 *Moderators:* Blaine A. Chronik and Daniel J. Schaefer

10:30 ***774***. **Experimental and Theoretical Analysis of the Induced Voltage Along Implant Leads Due to Gradient Fields**

Esra Abaci Turk[1], Emre Kopanoglu[1], Yigitcan Eryaman[1], Vakur Behcet Erturk[1], Ergin Atalar[1]
[1]Bilkent University, Ankara, Turkey

With the help of the simplified electric field expressions for x, y and z gradient coils, approximate voltage values to occur on the lead are derived analytically and these values are compared with the values obtained from realistic experiments. This comparison shows that, if the path of the implant lead is known, induced voltage on the lead can be determined analytically and with the obtained result the risk of the stimulation can be examined for patients with implants prior to MRI.

10:42 ***775***. **Safely Detecting Device Coupling Using Reversed RF Polarization and Pre-Spoiled EPI**

William Overall[1], Pascal Stang[1], John Pauly[1], Greig Scott[1]
[1]Electrical Engineering, Stanford University, Stanford, CA, United States

The degree of coupling present in long-wire implants can be quantified by reversing the RF receiver polarization. To assess device coupling in patients with potentially dangerous implants, a four-shot projection EPI sequence may be used safely given reasonable assumptions. Image quality and reliability can be improved by adding a small pre-spoiler gradient to suppress imperfections due to electrodynamic effects.

10:54 ***776***. **Towards MRI-Safe Implanted Leads: A Comparative Evaluation of Four Designs**

Paul A. Bottomley[1], William A. Edelstein[1], Ananda Kumar[1], Justin M. Allen[1], Perry Karmarkar[1]
[1]Suite B307, 1101 E 33rd Street, SurgiVision Inc, Baltimore, MD, United States

Implanted leads and devices are a contraindication for MRI, denying many patients its potential benefits. Here, the MRI safety of four passive implantable lead designs that minimize the hazards of induced currents and heating, is investigated as a function of geometry. Continuously coiled leads, leads incorporating RF traps, and single and multi-layer “billabong” leads with reversed sections wherein the current opposes the induced RF, are compared in a

model phantom at 1.5T and 4W/kg exposure. In coil and trap designs factors that maximize impedance limited heating below 1-2°C, but folded lead configurations can be problematic. The billabong designs heated <1°C.

11:06 ***777*. Controlling Induced Currents in Guidewires Using Parallel Transmit**

Maryam Etezadi-Amoli[1], Pascal Stang[1], Marta G. Zanchi[1], John M. Pauly[1], Greig C. Scott[1], Adam B. Kerr[1]
[1]Electrical Engineering, Stanford University, Stanford, CA, United States

RF transmit fields during MRI can induce currents and unsafe heating in conductive structures such as guidewires and implanted device leads. In this work, we used parallel transmit to control the level of current induced in a guidewire. We found experimentally that only one transmit mode from a four-channel array induced any appreciable current in a guidewire, while the remaining three modes induced no significant current, yet still provided adequate visualization of the volume. A parallel transmit approach thus offers a safe way of imaging in the presence of implanted conductive structures.

11:18 ***778*. MR Safety Measurements of Intracranial Fixation Devices at 7T**

Jaane Rauschenberg[1], Jens Groebner[1], Armin Michael Nagel[1], Armin Biller[2,3], Wolfhard Semmler[1], Michael Bock[1]
[1]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany; [2]Division of Radiology, German Cancer Research Center, Heidelberg, Germany; [3]Neuroradiology, University Hospital, Heidelberg, Germany

So far, the widely used cranial bone fixation system CranioFix® has been evaluated to be MR-safe up to field strengths of 3T. In this work we performed ASTM measurements of the implants at 7T MRI. As the magnetic force is much less than the gravitational force, no torque could be detected, and the temperature rise was less than 1°C during 16 min the implants can be considered as MR safe for the hardware used. Further¬more, artifact width is acceptable. This result enables MR imaging studies after brain surgery to be performed at field strengths up to 7 Tesla.

11:30 ***779*. Systemic in Vivo Radio-Frequency Heating in Porcine Models with a 12.5'' Diameter, 8 Channel, 7 T (296 MHz) Head Coil**

Devashish Shrivastava[1], Timothy Hanson, Jeramy Kulesa, Jinfeng Tian[2], Gregor Adriany, John Thomas Vaughan
[1]CMRR, Radiology, University of Minnesota, Minneapolis, MN, United States; [2]Univeristy of Minnesota, Minneapolis, MN, United States

In vivo radio-frequency (RF) heating was measured due to a 7T head coil in four anesthetized porcine models (N = 4). Temperatures were measured using fluoroptic probes in the scalp; 5 mm, 10 mm, 15 mm, and 20 mm in the brain; and rectum. Continuous wave, 296 MHz, RF power was delivered for ~3 hours using the head coil. The whole head average SAR was maintained close to 3 W/kg. Systemic, uniform heating up to ~1.85 °C was produced. No RF heating induced adverse thermo-physiologic temperature response was detected as measured by the difference in post-RF and pre-RF temperature slopes.

11:42 ***780*. An Automated Method for Subject Specific Global SAR Prediction in Parallel Transmission**

Leeor Alon[1,2], Cem Murat Deniz[1,2], Riccardo Lattanzi[1], Graham Wiggins[1], Ryan Brown[1], Daniel K. Sodickson[1,2], Yudong Zhu[1]
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Current SAR measurement schemes are missing the capability to track and manage SAR under in-vivo conditions. Existing hardware schemes monitor forward and reflective power in real time only, but offer no prediction capability and tend to considerably overestimate SAR by assuming complete constructive interference of electric fields. In this study, we present, and demonstrate in vivo, a rapid and simple calibration method for the accurate prediction of subject specific global power deposition on an 8-channel transmit 7T MR system. This global SAR prediction capability is scalable to parallel transmit systems with any number of transmit channels.

11:54 ***781*. Real Time RF Monitoring in a 7T Parallel Transmit System**

Borjan Aleksandar Gagoski[1], Rene Gumbrecht[1,2], Michael Hamm[3], Kawin Setsompop[4,5], Boris Keil[4,5], Joonsung Lee[1], Khaldoun Makhoul[4,5], Azma Mareyam[4], Kyoko Fujimoto[4], Thomas Witzel[4,6], Ulrich Fontius[7], Josef Pfeuffer[3], Elfar Adalsteinsson[1,6], Lawrence L. Wald[4,6]
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Current challenges to high-field applications of parallel RF transmission (pTx) in vivo include the monitoring and management of local SAR. We developed and tested real-time RF monitoring system for MAGNETOM 7T (Siemens Healthcare, Erlangen, Germany) with an 8-channel prototype pTx system that limits local SAR based on numerical simulation of E fields and power deposition in a segmented head model, and tracks and compares RF waveforms on each channel to the expected digital pulse waveform and shuts down the scan in the event of a mismatch due to spurious sources of pTx RF errors.

12:06 ***782*. Effects of a High Static Magnetic Field on (Higher) Cognitive Functions**

Jöran Lepsien[1], Karsten Müller[1], D. Yves von Cramon[1,2], Harald E. Möller[1]
[1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; [2]Max Planck Institute for Neurological Research, Cologne, Germany

The possibility of exposure to high static magnetic fields altering cognitive performance in human volunteers was tested in a strictly controlled fashion. 24 participants conducted 6 different well-established paradigms covering a variety of cognitive processes. Sessions took place inside a 3T magnet with the main magnetic field being switched on and off. The analysis of reaction time and accuracy revealed no significant effect of the magnetic field in any of the 6 tasks related to the static field. The results indicate that exposure to a 3T field does not alter performance in cognitive tasks.

12:18 ***783***. **Effects of 7 Tesla MRI on Postural Stability with and Without RF, Gradient Switching, or B0 Exposure**

Jens M. Theysohn[1,2], Oliver Kraff[1,2], Stefan Maderwald[1,2], Marcus Gerwig[3], Dagmar Timmann[3], Franz Schmitt[4], Lena Schaefer[1,2], Sebastian Blex[1,2], Elke R. Gizewski[1,2], Michael Forsting[1,2], Mark E. Ladd[1,2], Susanne C. Ladd[1,2], Andreas K. Bitz[1,2]
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Ultra-high-field MRI (7 Tesla and above) generates more temporary side-effects compared to 1.5T and 3T, e.g. dizziness. In this study, postural stability was quantitatively measured before and after exposure to magnetic and electromagnetic fields of a 7 Tesla MR system. Forty-nine volunteers underwent Romberg's tests. Stability shortly after MRI exposure was significantly reduced; when no RF was applied, the effect showed a similar trend but did not achieve significance. The results show that exposure to 7 Tesla causes only a temporary dysfunction of the vestibular system which does not appear to be related to the RF field.