Ke Dai

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Current Affiliation: Department of Biomedical Engineering, Shanghai Jiao Tong University, China

Research Interests: MR Sequences; Spatiotemporal Encoding; Low-field MRI; Motion correction; MRSI.

EDUCATION

09/2020 - Present **Ph. D. Candidate in Biomedical Engineering** (Advisor: Zhiyong Zhang, Ph.D.)
Department of Biomedical Engineering, Shanghai Jiao Tong University, China

01/2022 - 06/2023 **Visiting Student** (Advisor: Lucio Frydman, Ph.D.)
Department of Chemical and Biological Physics, Weizmann Institute of Science, Israel

09/2018 - 07/2020 **Minor in Computer Science and Technology**
Huazhong University of Science and Technology, China

09/2016 - 07/2020 **B.Eng. in Biomedical Engineering**
Huazhong University of Science and Technology, China

RESEARCH EXPERIENCE

QxSPEN Super-Resolution Imaging 01/2022 – Present

- Proposed and implemented a quadratic-phase-modulated xSPEN (QxSPEN) sequence that augments xSPEN's intrinsic hyperbolic phase with an additional quadratic term, breaking its sinc-limited point-spread function and enabling true super-resolution deconvolution;
- Validated feasibility via synthetic simulations, phantom experiments, and human brain scans at Siemens 3T system; ongoing work is evaluating distortion robustness on a low-field scanner.

High-Acceleration PE-xSPEN Parallel Imaging 06/2024 – 10/2025

- Derived the theoretical connection between PE-xSPEN's hyperbolic phase modulation and its per-kz localized signal supports, altering the aliasing structure from global folding to localized overlap;
- Designed and implemented a per-kz adaptive GRAPPA pipeline leveraging PE-xSPEN-induced local support to achieve better-conditioned kernel estimation and lower noise amplification at high acceleration;
- Validated the proposed method on phantom and in vivo brain data, showing significantly reduced reconstruction artifacts up to subsampling factors of approximately 5 and 7, respectively.

Fast J-Decoupled/J-Resolved MRSI based on t_1-encoded xSPEN 09/2020 – 09/2025

- Developed a novel t_1-encoded xSPEN spectroscopic imaging sequence with a t_1-splitting evolution, enabling high-spectral-bandwidth MRSI with effective J-modulation for J-decoupled spectra;
- Integrated multiple xSPEN readouts between successive 180° pulses, enabling 2D J-resolved spectroscopy to separate chemical shifts and J-coupling patterns effectively;
- Demonstrated effective J-decoupling in GABA methylene peaks, yielding a well-resolved singlet (FWHM = 7.81 Hz) with clear elimination of J-coupling–induced splitting; also resolved 2D J-resolved spectra of ethanol methylene groups, exhibiting slanted/ straight J-coupling patterns with/without J-decoupled evolution.

Diffusion Tensor Imaging at Low-field **09/2023 – 06/2024**

- Performed multi-directional DWI/DTI experiments on a 110 mT portable low-field MRI system based on field-probe eddy current correction, acquiring 64-direction diffusion data with optimized averaging strategies to achieve sufficient SNR in ultra-low-field conditions.

Echo Planar Time Imaging – Sequence Development **12/2023 – 05/2024**

- Implemented core sequence modules and acquisition blocks for the EPTI framework, supporting the group's implementation of distortion-free, multi-contrast MRI.

Prospective Motion Corrected Diffusion MRI **01/2021 – 09/2022**

- Developed a prospective motion correction (PMC) framework for multi-shot diffusion MRI by implementing synchronous coordinate system updates before excitation/refocusing pulses, enabling slice position, FOV, and gradient directions to track head motion during acquisition using a 6-DOF;
- Implemented a processing pipeline including spatial-angular local low-rank (SPA-LLR) constrained reconstruction with nonlinear magnitude-phase optimization for inter-shot phase correction, followed by FSL-based eddy correction, and diffusion tensor fitting;
- Validated the approach on healthy volunteers at UIH 3T system across different motion patterns, demonstrating substantially reduced ghosting and phase inconsistencies, as well as stable DTI metrics (FA/MD) compared with non-PMC acquisitions.

AWARDS AND HONORS

- Educational Stipend for the Annual Meeting of the International Society for Magnetic Resonance in Medicine (ISMRM). (2022, 2023 & 2024).
- The Planning and Budgeting Committee Fellowship, Israel. (2022)
- First Prize of National Academic Scholarship, Ministry of Education, China. (2021)
- Outstanding Graduate Award, Huazhong University of Science and Technology, China. (2020)
- The Tuoren Scholarship, Tuoren Medical, China. (2019)
- Merit Student, Huazhong University of Science and Technology, China. (2018)
- National Encouragement Scholarship, Ministry of Education, China. (2017)
- Freshman Scholarship, Huazhong University of Science and Technology, China. (2016)

PUBLICATIONS

1. **K. Dai**, E. Solomon, P. K. Lee, G. Tao, Y. Qiu, H. Chen, L. Frydman, Z. Zhang. High-accelerated parallel imaging with the inherent local feature in PE-xSPEN MRI[J]. Magnetic Resonance in Medicine, 2025. https://doi.org/10.1002/mrm.70146.
2. **K. Dai**, X. Liu, Y. Liu, G. Tao, H. Chen, L. Frydman, Z. Zhang. Fast chemical shift encoded and J-Decoupled/J-Resolved MRSI based on cross-term spatiotemporal encoding[J]. NMR in Biomedicine, 2025, 38(10): e70146. https://doi.org/10.1002/nbm.70146.
3. H. Chen[#], **K. Dai**[#], S. Zhong, J. Zheng, X. Zhang, S. Yang, T. Cao, C. Wang, E. Karasan, L. Frydman, Z. Zhang. High-resolution multi-shot diffusion-weighted MRI combining markerless prospective motion correction and locally low-rank constrained reconstruction[J]. Magnetic Resonance in Medicine, 2023, 89(2): 605-619. https://doi.org/10.1002/mrm.29468.
4. Y. Qiu, **K. Dai**, S. Zhong, S. Chen, C. Wang, H. Chen, L. Frydman, Z. Zhang. Spatiotemporal encoding

MRI in a portable low-field system[J]. Magnetic Resonance in Medicine, 2024, 92(3): 1011-1021. https://doi.org/10.1002/mrm.30104.

5. H. Chen, **K. Dai**, J. Bao, S. Zhong, C. Hu, Y. Liu, Z. Zhang. Pseudo multishot echo-planar imaging for geometric distortion improvement [J]. NMR in Biomedicine, 2023, 36(5): e4885. https://doi.org/10.1002/nbm.4885.
6. H. Bai, **K. Dai**, Z. Li, E. Solomon, H. Wei, H. Chen, Z. Zhang. Rapid Quantitative Susceptibility Mapping using Single-shot Echo Planar Time-resolved Imaging[J]. Physics in Medicine and Biology, 2025. https://doi.org/10.1088/1361-6560/ae273d.
7. S. Zhong, M. Chen, X. Wei, **K. Dai**, H. Chen, L. Frydman, Z. Zhang. Understanding aliasing effects and their removal in SPEN MRI: A k-space perspective[J]. Magnetic Resonance in Medicine, 2023, 90(1): 166-176. https://doi.org/10.1002/mrm.29638.
8. Y. Qiu, S. Chen, E. Solomon, C. Wang, S. Zhong, **K. Dai**, H. Chen, L. Frydman, Z. Zhang. A new approach for multislice spatiotemporal encoding MRI in a portable low-field system[J]. Magnetic Resonance in Medicine, 2025, 93(2): 709-717. https://doi.org/10.1002/mrm.30300.

PRESENTATIONS

1. **K. Dai**, Y. Qiu, S. Chen, H. Chen, Z. Zhang. Diffusion tensor imaging in portable low-field MRI[C]. In Proceedings of the 32nd Annual Meeting of ISMRM. Singapore, 2024. (Digital Poster)
2. **K. Dai**, Z. Zhang, L. Frydman. Quadratic phase-modulated xSPEN (QxSPEN): A new route to high resolution single-shot imaging[C]. In Proceedings of the 31st Annual Meeting of ISMRM. Toronto, Canada, 2023. (Digital Poster)
3. **K. Dai**, H. Chen, S. Zhong, H. Bai, J. Zheng, X. Zhang, S. Yang, T. Cao, L. Frydman, C. Wang, Z. Zhang. High-resolution diffusion-weighted MRI combining markerless prospective motion correction and locally low-rank constrained reconstruction[C]. In Proceedings of the 30th Annual Meeting of ISMRM. London, UK, 2022. (Power Pitch)
4. **K. Dai**, Q. Bao, H. Chen, Y. Liu, Z. Zhang. Fast 2D J-resolved MRSI combining echo planar imaging acquisition and turbo spin echo train evolution[C]. In Proceedings of the 29th Annual Meeting of ISMRM. Virtual meeting, 2021. (Oral Presentation)
5. **K. Dai**, H. Chen, H. Shao, J. Liu, Z. Zhang. xSPEN spectroscopy: a self-navigated fast chemical shift encoded echo planar imaging acquisition[C]. In Proceedings of the 29th Annual Meeting of ISMRM. Virtual meeting, 2021. (Oral Presentation)
6. Y. Qiu, P. K. Lee, **K. Dai**, S. Zhong, S. Chen, C. Wang, H. Chen, L. Frydman, Z. Zhang. Spatiotemporal Encoding MRI in a Portable Low-Field System[C]. In Proceedings of the 33rd Annual Meeting of ISMRM. Honolulu, HI, USA, 2025. (Oral Presentation)
7. Y. Qiu, **K. Dai**, S. Zhong, H. Chen, L. Frydman, Z. Zhang. Spatiotemporal encoding MRI at a portable low field system without parallel imaging[C]. In Proceedings of the 32nd Annual Meeting of ISMRM. Singapore, 2024. (Oral Presentation)
8. H. Bai, Y. Qiu, **K. Dai**, H. Chen, Z. Zhang. Ultrafast multi-parametric quantitative MRI using Multi-TR echo-planar time-resolved imaging (Multi-TR-EPTI)[C]. In Proceedings of the 31st Annual Meeting of ISMRM. Toronto, Canada, 2023. (Oral Presentation)

SKILLS

Siemens IDEA, UIH ADEPT, Feite at low-field, Bruker Paravision, MATLAB, C++, FSL, VDI(MRS), LaTeX.