Mohammadreza Soltany Sadrabadi

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Summary

- **Postdoctoral Fellow** at Barrow Neuro Center Innovations (BNCI), specializing in advanced **MRI processing**, **software development**, **imaging analytics**, as well as **machine learning** and **deep learning** applications in clinical research.
- **Extensive background** in computational mechanics (7+ years) and **software development**, with specialized expertise in **cardiovascular biomechanics** and disease modeling.
- **Skilled in machine learning and deep learning** (including **physics-informed neural networks**) to tackle both clinical imaging pipelines (MRI, CBCT) and simulation-based biomechanics problems.
- **Proficient in software development**: Python, MATLAB, R, and C, with hands-on experience in designing open-source tools and real-time imaging pipelines for **clinical environments**.

Education

2022-Present	**Postdoc Fellow** **Barrow Neurological Institute**, Phoenix, AZ. **"MRI Processing and Analysis in Neurological Disorders"**
2018-2022	**PhD in Bioengineering** **Mechanical Engineering Department, Northern Arizona University**, Flagstaff, AZ. **Thesis: "Mechanobiology of the aortic valve: a multiscale approach"**
2014-2017	**MSc in Aerospace Engineering** **Faculty of New Sciences and Technologies, The University of Tehran**, Tehran,Iran Thesis: "FSI solution of Blood Flow in Circle of Willis in Alternative Gravity Conditions"
2007-2012	**BSc in Mechanical Engineering** **School of Mechanical Engineering, The University of Shiraz**, Shiraz, Iran Dissertation: *"Data analysis of fluid flow in the combined cycle power plant of Fars"*

Publications

- Mohammadreza Soltany Sadrabadi, Seungik Baek, Mohammad R. K. Mofrad, Amirhossein Arzani, **"Benchmark problems for multiscale systems mechanobiology modeling of cardiovascular disease growth and remodeling."** Journal of Biomechanical Engineering, March 2025.
- Maryam Aliakbari, Mohammadreza Soltany Sadrabadi, Peter Vadasz, Amirhossein Arzani, **"Ensemble physics informed neural networks: A framework to improve inverse transport modeling in heterogeneous domains."** Journal of Physics of Fluids, August 2023.
- Mohammadreza Soltany Sadrabadi, Mona Eskandari, Heidi P Feigenbaum, Amirhossein Arzani, **"Local and global growth and remodeling in calcific aortic valve disease and aging"** Journal of Biomechanics, Sep 2021.
- Mohammadreza Soltany Sadrabadi, Mohammadali Hedayati, Iman Borazjani, Amirhossein Arzani, **"Fluid-structure coupled biotransport processes in aortic valve disease".** Journal of Biomechanics, Jan 2021.
- B. Peik, M. Zare Naghadehi, R. Battulwar, B. Abbasi, J. Sattarvand, M. Soltany Sadrabadi, B Azarfar, **"An Analytical Study of Rockfall Trajectory Simulation to Develop Hazard Maps for Open-Pit Mines".** 54th US Rock Mechanics/Geomechanics Symposium, Sep 2020.
- Mohammadreza Soltany Sadrabadi, Bahman Vahidi, Roozbeh Riazi, **"Blood flow analysis in the circle of Willis using computed tomography scan images and fluid-structure interactions method".** Journal of Modeling in Engineering, March 2019.

Conference Presentations

- Mohammadreza Soltany Sadrabadi, Richard Dortch, Ashley Stokes, **Test-Retest Reliability of DSC-MRI Perfusion Metrics in Multiple Sclerosis Patients and Healthy Controls**, ISMRM, 2025.
- Marjan Ghaffarinia, Mohammadreza Soltany Sadrabadi, Ashley Madern **Automatic Detection and Classification of Canal Morphology in Cone-Beam Computed Tomography Using Deep Learning** , AAOMR, 2024.
- Mohammadreza Soltany Sadrabadi, Richard Dortch, Ashley Stokes, **Advancing Clinical SIR Imaging for Myelin Quantification Through Nonlinear Anisotropic Filtering**, ISMRM, 2024.

- Mohammadreza Soltany Sadrabadi, Richard Dortch, Ashley Stokes, **Investigating the relationship between multi-scale perfusion and myelin content in MS**, ISMRM, 2024.
- Mohammadreza Soltany, Richard Dortch, Ashley Stokes, **Investigating Relationships Between Lesion Perfusion and Myelination in Multiple Sclerosis Using Advanced Quantitative Imaging**, ACTRIMS, 2024.
- Mohammadreza Soltany Sadrabadi, Richard Dortch, Ashley Stokes, **Enhanced Clinical SIR Scans for Myelin Quantification Using Anisotropic Filtering**, ACTRIMS, 2024.
- Ping Wang, Mohammadreza Soltany Sadrabadi, Richard Dortch, **Comparisons of SENSE and Compressed SENSE in the Acceleration of Whole-brain Myelin Imaging**, ISMRM, 2023.
- Mohammadreza Soltany Sadrabadi, Iman Borazjani, Amirhossein Arzani, **Coupled fluid-structure interaction and mass transport in aortic valves**, APS Division of Fluid Dynamics (Seattle), 2019.
- Mohammadreza Soltany Sadrabadi, Seungik Baek, Mohammadreza Mofrad, Amirhossein Arzani, **Cell signaling pathways coupled with growth and remodeling in tissue level**, SB3C, 2022.
- Mohammadreza Soltany Sadrabadi, Iman Borazjani, Amirhossein Arzani, **Fluid-structure interaction of aortic valve coupled with mass transport of biochemical materials**, 9th International Bio-Fluid Mechanics and Vascular Mechano-Biology Symposiums (Tucson), 2020.
- Mohammadreza Soltany Sadrabadi, Mona Eskandari, Amirhossein Arzani, **Aortic valve dynamics coupled with growth and remodeling due to aging and calcification**, Summer Biomechanics, Bioengineering and Biotransport Conference (SB3C virtual), 2021.

Experience

2022-Present: Research Fellow at Barrow Neurology Institute (BNI)

- **Advanced MRI Processing and Software Development for MS Research**
  - **Developing open-source MRI software**: Creating pipelines to enable real-time or near-real-time post-processing on Philips scanners, directly supporting clinicians diagnosing and monitoring Multiple Sclerosis (MS).
  - **MRI Perfusion and Myelin Quantification**: Implementing and evaluating advanced techniques (e.g., *Dynamic Susceptibility Contrast (DSC)-MRI*, *SIR imaging*, and *nonlinear anisotropic filtering*) to quantify myelin content in MS lesions and analyze lesion perfusion.
  - **Comparisons of SENSE and Compressed SENSE**: Investigating acceleration methods for whole-brain myelin imaging, refining scanning protocols for faster image acquisition without sacrificing quality.
  - **Test-Retest Reliability Studies**: Examining the consistency of DSC-MRI perfusion metrics in both MS patients and healthy controls, identifying robust imaging biomarkers for clinical assessments.
  - **Investigating Multi-Scale Perfusion and Myelin Content**: Integrating multi-scale imaging data to understand how perfusion at the vascular level correlates with local myelin integrity, bridging knowledge gaps in MS pathology.
  - **Lesion Perfusion-Myelination Relationship**: Using advanced quantitative imaging methods (including SIR) to correlate lesion blood flow dynamics with demyelination severity, improving insights into MS progression.

2024: Collaboration with Dental School at Midwestern University

- **Automatic Detection and Classification of Canal Morphology in Cone-Beam Computed Tomography (CBCT) Using Deep Learning**
  - Developed convolutional neural network (CNN) models to automate detection and classification of canal morphology according to Weine's classification.
  - Enhanced endodontic diagnostics by integrating robust feature-extraction techniques for CBCT data.
  - Refined data preprocessing pipelines to ensure consistently high-quality input data in a clinical environment.

2018-2022: Research Assistant at Northern Arizona University

- **Software Development for Growth and Remodeling Caused by Diseases**

- Created open-source software and codes (NSF-funded) using advanced math, continuum mechanics, and finite element methods to simulate tissue growth and remodeling.
- Modeled cardiovascular disease mechanisms, focusing on calcific aortic valve disease and other structural pathologies.
- **Tools**: Solidworks, STL, VTK, Simvascular, Python, FEniCS, Paraview, Git.

- **Physics-Informed Neural Networks (PINN) in Forward and Inverse Tissue Dynamic Problems**
  - Leveraged deep neural networks to approximate elastodynamics modeling, enabling surrogate-based simulations and inverse analysis of tissue properties.
  - Identified constitutive equations and material properties of moving tissues with machine learning approaches.
  - **Tools**: Python, FEniCS, Pytorch, Numpy, VTK, Paraview.
- **FSI Simulation of Mass Transport near Aortic Valves**
  - Modeled hemodynamics near aortic valves using fluid-structure interaction (FSI) methods.
  - Coupled FSI simulations with mass transport equations to investigate biochemical concentration profiles.
  - **Tools**: Spaceclaim, Ansys Workbench, Fluent, System-Coupling.
- **Developing Python Visualization Toolkit (VTK) Codes for Efficient Mesh Processing**
  - Automated pre- and post-processing steps for finite element mesh data, facilitating faster analysis cycles.
  - **Tools**: Simvascular, STL, Python, Meshmixer, VTK, Paraview.
- **Relations between Hemodynamics in Aneurysms and Wall Enhancement in MRI**
  - Collected MRI data from Mayo Clinic to investigate vessel wall enhancement in cerebral aneurysms.
  - Modeled CFD and near-wall mass transport in aneurysm geometries to link hemodynamics with imaging findings.
  - **Tools**: Horos, Simvascular, Python, FEniCS, Paraview.

2014-2017: Research Assistant, University of Tehran, Iran

- **Modeling Blood Flow Circulation in the Circle of Willis**
  - Constructed patient-specific tissue geometries from CT/MRI data.
  - Performed FSI simulations to capture realistic blood flow patterns in the circle of Willis.
  - **Tools**: Materialise Mimics, Solidworks, Altair Hyperworks, ADINA.

Technical Skills

- **Programming**
  - Python, MATLAB, R, and C
  - Packages: Numpy, Scipy, Matplotlib, VTK, STL, Dolfin, Pytorch, TensorFlow
  - Version control system: Git (Object-oriented developer)
- **Software**
  - Expert in ITK-SNAP, Ansys, FEniCS, Solidworks, Simvascular, Adina, Altair Hyperworks, Materialise Mimics, Meshmixer, Paraview, K3DSurf

References

- **Dr. Amirhossein Arzani, University of Utah, Salt Lake City, UT, US**
  Amir.Arzani@sci.utah.edu
- **Dr. Richard Dortch, BNI Department at St. Joseph Medical Center, Phoenix, AZ, US**
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- **Dr. Ashley Stokes, BNCI Department at St. Joseph Medical Center, Phoenix, AZ, US**
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