

Ehsan Rahimi

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Work Authorization: U.S. Permanent Resident (Green Card holder)

Summary:

Computational Scientist with over 12 years of expertise in high-fidelity modeling, Computational mechanics, computational fluid dynamics (laminar and turbulence), computational heat transfer (cht), finite element analysis (FEA), Multiphysics and AI-driven simulations. Specializing in developing and deploying advanced numerical and machine learning models to analyze complex systems, enhance predictive accuracy, and optimize performance. Proficient in leveraging AI and physics-based modeling to improve simulation efficiency and computational scalability. Experienced in cross-functional collaboration, integrating computational modeling with real-world engineering applications to drive innovation, streamline processes, and deliver high-impact solutions in data-driven engineering and technical infrastructure environments.

Education:

- **Ph.D. in Mechanical Engineering (CFD, FVM, FEA)** 2019- 2023
Purdue University, West Lafayette, IN, U.S.A (GPA: 3.63/4.0)
- **M.Sc. in Electronic Engineering (solid state physics)** 2014-2017
Iran University of Science and Technology, Tehran, Iran (GPA: 15.75/20.0)
- **M.Sc. in Civil Engineering (nonlinear FEA)** 2011-2013
Sharif University of Technology, Tehran, Iran (GPA: 17.73/20.0)
- **B.Sc. in Civil Engineering** 2007-2011
Sharif University of Technology, Tehran, Iran (GPA: 16.85/20.0)

Academic Work Experiences:

- **Post doctoral Research Associate** 2023-Now
Purdue University, West Lafayette, IN, U.S.A
 - ✓ **High-fidelity CFD modeling of spinal drug injection for Central Nervous System (CNS) delivery**
Postdoctoral researcher in the Eli Lilly – Purdue collaboration, developing high-fidelity CFD to study CNS drug transport after intrathecal injection, optimizing biotherapeutic delivery and absorption.
 - ✓ **Reduced order modeling of cerebrospinal flow**
Developing lumped parameter models for fluid flow in the central nervous system (CNS) and integrating them with the cardiovascular system to enhance physiological modeling
 - ✓ **Postprocessing particle tracking velocimetry (PTV) experiments of cerebrospinal flow (CSF)**
Developing physics informed radial basis functions (RBFs) to postprocess PTV experiments to quantify fluid dynamics
 - ✓ **Multi fidelity CFD modeling of Intrathecal drug injection:**
Developed high fidelity CFD and low-fidelity mechanistic computational modeling of intrathecal injection with the goal of understanding the efficiency of drug transport fat tissue
 - ✓ **Machine learning surrogate of Biomechanical model of the tissue:**
Developed Neural network and Gaussian process based surrogate model of the high-fidelity biomechanical model of subcutaneous injection
- **Doctoral Research Assistant** 2019- 2023
Purdue University, West Lafayette, IN, U.S.A
 - ✓ **High fidelity CFD and computational biomechanics modeling of Subcutaneous injection:**
PhD researcher in the strategic Eli Lilly – Purdue collaboration focusing on developing biomechanical poro-elastic and hyper-elastic modeling of the tissue. High-fidelity numerical simulations of drug injection and bio-transport into fat layer and tissue deformation to analyze the delivery of injectable medicines to enhance our understanding of the mechanics of self-injection using autoinjectors
 - ✓ **Multi fidelity CFD modeling of Subcutaneous drug delivery:**
Developed high-fidelity CFD and low-fidelity mechanistic models to optimize drug dosage design for subcutaneous (SC) injection, improving estimation of monoclonal antibody bioavailability.

- ✓ **Data assimilation and uncertainty quantification of Subcutaneous drug injection**
Performing data assimilation to evaluate uncertainty in injector device mechanics, delivery parameters and injection site
- ✓ **TA for Computational fracture mechanics**
Teaching and mentoring graduate students on computational fracture mechanics course using Abaqus
- **Research Assistant (first MS degree)** 2011- 2013
Sharif University of Technology,
Tehran, Iran
 - ✓ **Nonlinear structural mechanics (FEA):**
 - Developed Nonlinear Finite element algorithm to asses collapse of steel moment frames under extreme dynamic loads
 - Nonlinear time history dynamic analysis and computational structural dynamics
 - Software used: OpenSEES and MATLAB

Industry Work Experiences:

- **FEA structural analysis and design engineer** 2016-2018
Sazeh Consultants, Tehran, Iran
 - ✓ *Finite element analysis and design of industrial structures (Modal, static, dynamic, and thermal), prepared detailed design drawings using CAD software*
 - ✓ *Computational heat transfer analysis of petrochemical piperacks*
- **FEA structural analysis and design engineer** 2015-2016
RayAb Consultants, Tehran. Iran
 - ✓ *Finite element analysis and design of industrial structures (Modal, static, dynamic, and thermal), prepared detailed design drawings using CAD software*
- **Deputy Project Manager** 2013-2014
DenaDezh Sazan Shargh , Tehran, Iran
 - ✓ Assistant project manager of constructing two concrete tanks in Bafgh iron ore mine, Project planning, Quality and progress controller, Project quantity surveying and estimating

Teching and Mentorship Experiences:

- Mechanical Engineering Dep., **Purdue University** Spring 2023
T.A. for Computational Fracture Mechanics
- Structural Engineering Dep., **University at Buffalo** Spring 2019
T.A. for Mechanics of materials
- Structural Engineering Dep., **University at Buffalo** Fall 2018
T.A. for Engineering Statistics

High-fidelity computational modeling skills:

- **Computational modeling capabilities** Comp. *Fluid Dynamics (laminar, turbolance)*, Comp. *Solid Mechanics*, Comp. *Fracture Mechanics*, Comp. *Structural Mechanics*, Comp. *Structural Dynamics*, Comp. *Heat Transfer*, Comp. *Mass Transport*, Comp. *Fluid-Structure interaction*, *Modal analysis*
- **Computational methods** *Finite Element Method (FEM)*, *Nonlinear FEM*, *Finite Volume Method (FVM)*, *Finite Difference Method (FDM)*, *Discrete Element Method (DEM)*
- **High performance computing skills** *Cloud computing*, *Parallel computing*, *bash shell scripting*
- **HPC Software** *Ansys (Fluent, Mechanical)*, *Abaqus*, *OpenFoam (C++ library)*, *LIGGGHTS (DEM)*

Programming, AI and other software:

- **Languages:** Python, R, C++, C#, MATLAB, Excel VBA
- **ML/AI** DNN, CNN, GAN, Encoders, ML surrogate, Gaussian process
- **Major Python libraries** TensorFlow, Jax, Scikit-learn, SciPy, NumPy, Pandas, Matplotlib, Pyomo
- **Drawing, sketch, animation, visualization:** AutoCAD, SolidWorks, Sketchbook, Paraview, Blender
- **General Applications:** Microsoft Office

Selected Publications:

- **E. Rahimi**, W.Holt, R. Dekate, X. Zhong, X. Zhang, G.Shi, I. Billionis, A. M.Ardekani. “Developing a multi-fidelity CFD and PBPK model of subcutaneous administration of monoclonal antibodies”, (*under internal review*)
- Reza B. Galangashi, Abhishek Singh, **Ehsan Rahimi**, P. Vlachos “In-Vitro Tomographic Particle Tracking Velocimetry (PTV) Analysis of the Impact of Spinal Cord and Nerve Roots on Cerebrospinal Fluid (CSF) Flow Dynamics” (*under internal review*)
- **E.Rahimi**, X. Zhong, C. Li, X. Zhang, G.H.Shi, A. M.Ardekani “A review on lymphatic uptake of biotherapeutics after subcutaneous injection” (*submitted for review*)
- C. Li, X. Zhong, **E. Rahimi**, A. M.Ardekani. “ A multi-scale numerical study of monoclonal antibodies uptake by initial lymphatics after subcutaneous injection”, (*International Journal of pharmaceutics*)
<https://doi.org/10.1016/j.ijpharm.2024.124419>
- **E. Rahimi**, Li, C., Zhong, X., Shi, G. H., & Ardekani, A. M. (2024). The role of initial lymphatics in the absorption of monoclonal antibodies after subcutaneous injection. (*Computers in Biology and Medicine*), 183, 109193.
<https://doi.org/10.1016/j.combiomed.2024.109193>
- D. Han, Z. Huang, **E. Rahimi**, A.M. Ardekani, (2023). Solute Transport across the Lymphatic Vasculature in a Soft Skin Tissue. *Biology*, 12(7), 942.
<https://www.mdpi.com/2079-7737/12/7/942/pdf>
- D. Han, C.Lee, S. Aramideh, V. Sree, **E. Rahimi**,AB. Tepole, A. M.Ardekani (2023). “Lymphatic uptake of biotherapeutics through a 3D hybrid discrete-continuum vessel network in the skin tissue”, *Journal of Controlled Release*. <https://doi.org/10.1016/j.jconrel.2022.12.045>
- **E. Rahimi**, H. Gomez, A. M.Ardekani (2022). “Transport and distribution of biotherapeutics in different tissue layers after subcutaneous injection”, *International Journal of pharmaceutics*.
(<https://doi.org/10.1016/j.ijpharm.2022.122125>)
- **E. Rahimi**, S. Aramideh, D. Han, H. Gomez, A. M.Ardekani (2022). “Transport and lymphatic uptake of monoclonal antibodies after subcutaneous injection”, *Microvascular Research*. (<https://doi.org/10.1016/j.mvr.2021.104228>)
- D. Han, **E. Rahimi**, S. Aramideh, A. M.Ardekani (2021). “Transport and lymphatic uptake of biotherapeutics through subcutaneous injection”, *Journal of Pharmaceutical Sciences*. <https://doi.org/10.1016/j.xphs.2021.09.045>
- **E. Rahimi** and H.E. Estekanchi (2015). “Collapse Assessment of Steel Moment Frames Using Endurance Time Method”. *Earthquake Engineering and Engineering Vibration*, Volume 14, Issue 2, pp 347-360 (<https://doi.org/10.1007/s11803-015-0027-0>)

Honors and Awards

- Winner of 2023 Postdoctoral Supplemental Travel Grant
- Honored as a “**Brilliant Talented Student**” in M.Sc. degree, Brilliant Talents Office, Sharif University of Technology **2011**
- **Ranked 3rd among more than 30** M.S students in Earthquake Engineering, Sharif University of Technology **2013**
- Honored as a “**Brilliant Talented Student**” in B.Sc. degree and admitted to M.Sc. Degree without taking the entrance exam, Brilliant Talents Office, Sharif University of Technology
- **Ranked among the top 10% of 100** B.Sc. students in Civil Engineering, Sharif University of Technology
- **Ranked 596 among more than 350,000** participants of the nation-wide university Entrance exam in Mathematics and Physics, National Organization of Educational Testing, Iran

Selectecd Conferences:

- D. Han, Z. Huang, **E. Rahimi**, H Gomez, A. M.Ardekani (2023). “Convective transport and absorption of drug solute in soft skin tissue”, (*Bulletin of the American Physical Society*)
- A Ardekani, **E Rahimi**, C Li, “Transport and lymphatic uptake of biotherapeutics after subcutaneous injection”, (*Bulletin of the American Physical Society*)