Maryam Hakimzadeh

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SUMMARY

I am a Postdoctoral Researcher specializing in Scientific Machine Learning (SciML) and Artificial Intelligence for Science (AI4Science), with a PhD in Computational Mechanics from Carnegie Mellon University. My research focuses on integrating machine learning and artificial intelligence with computational mechanics to accelerate numerical simulations and tackle complex computational challenges in engineering. My current research area focuses on developing neural operators and diffusion models for SciML tasks.

My PhD research centered on phase-field fracture modeling, computational mechanics, and numerical methods. I also applied machine learning and data science techniques to solve structural, heat transfer, and other mechanical problems.

EDUCATION

Carnegie Mellon University Pittsburgh, PA
Ph.D. in Computational Mechanics (Civil Engineering), GPA: 4.0/4.0 2020 - Sep 2024
· Thesis Title: Phase-Field Modeling of Fracture in Geo-and Environmental Mechanics
· Advisors: Kaushik Dayal, David Rounce
· Collaborators: Noel Walkington, Carlos Mora-Corral, Vaibhav Agrawal, George Gazonas
M.Sc. in Civil and Environmental Engineering , GPA: 4.0/4.0 2020 - 2022

Sharif University of Technology Tehran, Iran
M.Sc. in Civil and Environmental Engineering , GPA: 4.0/4.0 2016 - 2019
B.Sc. in Civil and Environmental Engineering , GPA: 3.81/4.0 2012 - 2016

EXPERIENCE

Johns Hopkins University, Postdoc Researcher Dec 2024 - Present, Baltimore, MD
· Developed a comprehensive dataset for phase-field fracture modeling, **selected for Nairr Pilot**.
· Implemented neural operators (Fourier Neural Operators, DeepONet, Latent DeepONet) for predictive modeling of fracture.
· Coupled FEM and Neural Operators with Domain Decomposition.
· Implementing Conditional Diffusion Model for PDEs.

Carnegie Mellon University, Staff Research Associate Sep 2024 - Dec 2024, Pittsburgh, PA
· Developed and validated a phase-field fracture model for complex loading conditions, benchmarking its performance against existing splitting approaches.

Carnegie Mellon University, Graduate Research Assistant Aug 2020 - Sep 2024, Pittsburgh, PA
Ph.D. Projects:
· Fracture Mechanics with an Effective Energy using Phase-Field Modeling (Contact Mechanics, Nonlinear FEA, Hyperelastic Nonlinear Material, FEniCS Simulations)
· Anisotropic Fracture Model under Compression and Confinement (Fracture Propagation in Anisotropic Material, High Performance Computing (HPC))
· Nucleation and Propagation Using a Modified Fracture Mechanics Model and it's Application in Glaciers (Dynamic FEA, Explicit and Implicit FEA)

Deep Learning Course Projects:
· Employing Transformers Deep Learning for Predicting the Dynamics of the Burgers' Equation
· SimCLR Model Supervised Model for Image Classification: From Training to Fine-Tuning
· Airfoil Generation via Variational Auto-Encoders (VAEs) and Generative Adversarial Networks (GANs)
· CIFAR-10 Classification via Convolutional Neural Networks (CNNs)
· Development and Analysis of a Diffusion Model for Image Generation Using the MNIST Dataset
· Implementing a Graph Neural Network for Predicting Aqueous Solubility

FEA Course Projects:
· FEA Analysis for Elasto-Plastic Material under Contact using Ansys

· Fatigue and Failure Assessment and Optimization under Diverse Loading Conditions
· Structural Design and Optimization of a Beam-Based Tower for Optimal Load Distribution and Safety
· Thermal Optimization of CPU Performance (Transient Analysis, Fluid Flow Simulation with Ansys Fluent)

University of Southern California, Graduate Research Assistant — Aug 2019 - Aug 2020, Los Angeles, CA
· Data-Driven Analysis of Biomass Burning Impact on Public Health in Metropolitan Area of Milan (Statistical Data Analysis and Data Visualization, Machine Learning)

Sharif University of Technology, Graduate Research Assistant — Sep 2016 - March 2019, Tehran, Iran
· Quantifying and Modifying Emission Sources Using Inverse Modeling: A Case Study in Tehran (**M.Sc Thesis**)
· Comprehensive Data Analysis of Greenhouse Gas Emissions and Environmental Impact in Iran
· Pollution Attenuation in Flume Outlets and Estuary Tidal Dispersion Study

TECHNICAL SKILLS

Programming	Python, MATLAB, Wolfram Mathematica , MPI
Machine Learning & Data Science	JAX, PyTorch, NumPy, scikit-learn, R, SPSS, SQL, PhysicsNeMo
FEA Simulation and Design	FEniCS, Ansys (Mechanical, Fluent, LS-DYNA), Abaqus, COMSOL
Design and Processing Softwares	CIVIL 3D, SolidWorks, Ansys Discovery, CAD, Gmsh, ParaView

PUBLICATIONS

Hakimzadeh, Maryam, Lori Graham-Brady, and Somdatta Goswami. "Fracture-Bench: A Comprehensive Evaluation of Neural Operators and ML Methods on Phase Field Fracture Datasets" Manuscript in Preparation

Wei Wang, **Hakimzadeh, Maryam**, Haihui Ruan and Somdatta Goswami. "Time-marching neural operator–FE coupling: AI-accelerated physics modeling"

Hakimzadeh, Maryam, Noel Walkington, Carlos Mora-Corral, George Gazonas, and Kaushik Dayal. "Crack face contact and sliding are essential to predict crack-parallel stresses" Journal of Applied Mechanics (2025): 1-11

Hakimzadeh, Maryam, Carlos Mora-Corral, Noel Walkington, Giuseppe Buscarnera, and Kaushik Dayal. "Phase-field modeling of fracture under compression and confinement in anisotropic geomaterials." International Journal for Numerical and Analytical Methods in Geomechanics 49.4 (2025): 1319-1335.

Hakimzadeh, Maryam, Vaibhav Agrawal, Kaushik Dayal, and Carlos Mora-Corral. "Phase-field finite deformation fracture with an effective energy for regularized crack face contact." Journal of the Mechanics and Physics of Solids 167 (2022): 104994.

Hakimzadeh, Maryam, Ehsan Soleimanian, Amirhosein Mousavi, Alessandro Borgini, Cinzia De Marco, Ario A. Ruprecht, and Constantinos Sioutas. "The impact of biomass burning on the oxidative potential of PM2. 5 in the metropolitan area of Milan." Atmospheric Environment 224 (2020): 117328.

HONORS AND AWARDS

Finalist for ASTM MR Mitchell Student Presentation Forum on Fatigue and Fracture Mechanics.	2023
Awarded Fenves Travel Grants, CMU CEE Department.	2023
Steinbrenner Institute Doctoral Fellowship for Environmental Education and Research.	2022
Invited participant at CMU Rising Stars Workshop.	2022
CMU CEE Department Fellowship.	2020

SELECTED CONFERENCE PRESENTATIONS

Accelerating Numerical Solvers with AI-based Surrogate Models
M. Hakimzadeh, W. Wang, H. Ruan, and Somdatta Goswami, The Mach Conference (**Mach2025**)

A Phase-Field Fracture Model for Anisotropic Materials Under Compressive Loading
M. Hakimzadeh, K. Dayal, and C. Mora-Corral, Society for Industrial and Applied Mathematics (**SIAM MS24**)

Simulating Crevasse Nucleation and Propagation Using a Modified Fracture Mechanics Model
M. Hakimzadeh, D. Rounce, and K. Dayal, American Geophysical Union (**AGU23**)

A Phase-Field Fracture Model for Complex Loadings in Space
M. Hakimzadeh, V.Agrawal, C. Mora-Corral, G. Gazonas, N. Walkington and K. Dayal, **ASTM 21st International Symposium on Fatigue and Fracture Mechanics**

A Phase-Field Fracture Model for Complex Loading Across the Crack Face
M. Hakimzadeh, V.Agrawal, C. Mora-Corral, and K. Dayal, Society of Engineering Science (**SES2022**)

TEACHING AND MENTORING

Carnegie Mellon University
Guest Lecturer: "Introduction to FEniCS" for Finite Element Methods course 2021-2024
Teaching Assistant: Courses: Finite Element Methods, Geology 2021-2024
Research Mentor: Keding Wang, M.Sc. Student - Phase-field Fracture Modeling June 2024-Sep 2024
Sharif University of Technology
Teaching Assistant: Courses: Solid Mechanics, Fluid Mechanics, Solid Mechanics Lab 2016-2019

RELATED GRADUATE COURSES

- Deep Learning for Physical Systems
- Deep Learning
- Machine Learning
- Finite Element Methods
- Numerical Methods
- Math Techniques (Solving PDEs)
- Continuum Mechanics
- Elasticity
- Environmental Hydrodynamics
- Applied FEA
- Continuum Mechanics & Multiscale Modeling

LICENSES & CERTIFICATIONS

Supervised Machine Learning: Regression and Classification July 2023, DeepLearning.AI
Advanced Learning Algorithms July 2023, DeepLearning.AI
Unsupervised Learning, Recommenders, Reinforcement Learning Jan 2024, DeepLearning.AI
What is Data Science? Jun 2024, IBM
Fundamentals of Deep Learning April 2025, NVIDIA
Gen AI Intensive Course April 2025, Google