Sina Jafari

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My personal webpage:
https://sina-jafari.github.io

PROFESSIONAL SUMMARY

PhD candidate in Engineering with strong expertise in quantitative research, and advanced programming (such as Python, MATLAB, C, C++). Over 5 years of experience in developing and implementing custom algorithms and models to solve complex problems and equations. Proven ability to conduct hands-on, high-impact research with real-world commercial applications.

EDUCATION

- **PH.D.** Mechanical Engineering, GPA: 3.9 — 2021 – Dec. 2025
  - University of Houston, TX, USA
- **M.SC.** Mechanical Engineering, GPA: 3.7 — 2016 – 2019
- **B.SC.** Mechanical Engineering, GPA: 3.8 — 2012 – 2016

QUANTITATIVE RESEARCH EXPERIENCE

RESEARCH ASSISTANT

University of Houston, Houston, TX, Sep. 2021-Present

- Developed a high-performance numerical solver for **complex partial differential equations (PDEs) using iterative root-finding algorithms and matrix algebra.** Achieved a **90% reduction** in computational time by optimizing algorithmic structure.
- Engineered an optimization algorithm integrating physical modeling with **statistical analysis** to enhance energy system performance. Improved solar thermophotovoltaic efficiency to **93.3%** by combining **analytical and numerical techniques.**
- Designed simulation tools and coding packages using **Monte Carlo methods** to model photon transport and **thermal diffusion**, enabling fast and accurate predictions of heat behavior—translating random sampling techniques into practical system optimization.
- Applied Finite-Difference Frequency-Domain (FDFD) methods **to solve PDEs** related to wave propagation and energy transfer, demonstrating strong command of **numerical solvers and grid-based discretization techniques.**
- Utilized Rigorous Coupled-Wave Analysis (RCWA) **and complex eigenvalue problem-solving** to model nanostructured systems—relying heavily on **linear algebra, matrix computation, and Fourier-space formulations.**
- Integrated machine learning techniques**,** including **Bayesian optimization,** to tune design parameters and optimize system performance, bridging the gap between simulation and experimental results.
- Conducted experimental validation using FTIR and UV-Vis spectroscopy**, complemented with statistical modeling** for data analysis, uncertainty quantification, and hypothesis testing**.**
- Programmed custom ray-tracing and physics-based solvers **in Python and MATLAB, building simulation platforms to support complex thermal system design—software development transferable to quantitative modeling environments.**
- Recognized with the **Best Presentation Award at ASME IMECE** for innovative application of applied mathematics, numerical modeling**,** and thermophysical analysis

CONFERENCES AND PRESENTATIONS

- **MRS Conference 2025** – Seattle, WA.
  Shared findings on machine learning–driven emitter optimization.
- **ASME IMECE 2024** – Portland, OR
  Presented research on numerical modeling and thermal system optimization.
- **ASME Summer Heat Transfer Conference (SHTC) 2024** – Anaheim, CA
  Delivered a talk on mathematical techniques in thermal rectification systems.
- **MIT Energy Conference 2024** – Boston, MA
  Supported conference organization and presented a rapid numerical approach for heat diffusion equations.
- **ASME SHTC 2023** – Washington, D.C.
  Presented advancements in PDE solvers for wave–matter interaction modeling.
- **MIT Energy and Climate Hack 2023** – Boston, MA
  Designed AI-driven solutions for global warming mitigation, resulting in a 30% cost reduction for green data centers.
- **Materials Research Society (MRS) Fall Meeting 2022** – Boston, MA
  Presented experimental and computational analysis on optical properties of nanomaterials.
- **Thermophotovoltaics (TPV) International Conference 2022** – Online
  Discussed numerical approaches to enhancing TPV system efficiency.

INTERNSHIP

R&D ENGINEER INTERN *(Helix Earth Technology LLC, Houston, Texas)* 2024-2025

- Contributed to data-driven scaling decisions by supporting system validation and prototype testing, aligning modeling outcomes with real-world performance metrics.
- Collaborated cross-functionally on design-to-manufacturing translation, applying problem-solving skills and quantitative analysis to support startup-level innovation.

TECHNICAL SKILLS

- Programming & Scripting:
  Python, MATLAB, R, SQL, Java, C, C++
  Applied in model development, data analysis, Monte Carlo simulation, and PDE solvers.
- Mathematical & Statistical Modeling:
  Bayesian optimization, statistical learning methods, Monte Carlo methods, differential equations, linear algebra, applied probability
- Software & Tools:
  COMSOL Multiphysics, ANSYS Fluent, CATIA, Power BI, Microsoft Excel
  Proficient in simulation, data visualization, and statistical reporting.
- Machine Learning & Advanced Computing:
  Bayesian inference, Random Forest, k-Nearest Neighbors (k-NN)
  Applied to parameter tuning, model validation, and performance prediction.

ADDITIONAL PROJECTS

ENTREPRENEUR LEAD OF NATIONAL SCIENCE FOUNDATION'S INNOVATION CORPS PROGRAM
Spring 2024

- Conducted 100+ interviews to understand challenges in the renewable energy industry, focusing on solar cells and wind turbines.

GREENTOWN LABS; THE MARTIN TRUST CENTER FOR MIT ENTREPRENEURSHIP **May 2023-Present**
TEX-E Fellow (Texas Entrepreneurship Exchange for Energy)

- Selected through a competitive process to facilitate partnerships between Texas universities, MIT, industry, and innovation centers to foster energy innovation.
- Work on cutting-edge research projects in climate change.
- Hold conferences related to clean energy and reaching Net Zero by 2050.

PUBLICATIONS AND PATENT

PUBLICATIONS

- **Jafari Ghalekohneh, S.**, Do, B., Adebiyi T., Zhao B., and Zhang R., "Automated design of nonreciprocal thermal emitters via Bayesian optimization", *Journal of Quantitative Spectroscopy and Radiative Transfer*,2024.
- **Jafari Ghalekohneh, S.**, Du, C., and Zhao, B., "Controlling the Contrast Between Absorptivity and Emissivity in Nonreciprocal Thermal Emitters", *Applied Physics Letters*, 2023. **[Editor's Pick] [Featured Article]**
- **Jafari Ghalekohneh, S.** and Zhao, B., "Nonreciprocal Solar Thermophotovoltaics", *Physical Review Applied*, 2022. **[World-Wide Media Reports]**
- **Jafari Ghalekohneh, S.**, Byung Nuh, et, al." Mode Conversion of Hyperbolic Phonon Polaritons in van der Waals terraces", *Nature Communication*, under review 2025.
- **Jafari Ghalekohneh, S.** and Zhao, B., "Perfect Heat Rectification and Circulation", under review 2025.
- **Jafari Ghalekohneh, S.** and Zhao, B., "Nonreciprocal Thermal Conductivity", under review 2025.
- **Jafari Ghalekohneh, S.** and Zhao, B., "Nonreciprocal Phonon Polariton", under review 2025.

PATENT

- U.S. Patent application 63/330,426, "Nonreciprocal Solar Thermophotovoltaics", April 13, 2022.
- U.S. Patent application. "Perfect Heat Rectification and Heat Circulation", Provisional submitted, 2025.