Pranav Rane

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Summary

Research assistant with over 4 years of experience in mechanical engineering, computing, and physics. Skills in data analysis, problem solving, and critical thinking. Interested in pursuing research at the intersection of mechanical/aerospace engineering, physics, and scientific computing.

Education

Haverford College   August 2021 – May 2025

B.S. Physics, B.S. Computer Science, minor: Applied Mathematics (3.9/4.0)   *Haverford, PA*

Experience

Research Assistant   July 2020 – Present

University of Utah, Department of Mechanical Engineering (advisor: Dr. Michael Czabaj)   *Salt Lake City, UT*
- Implemented a convolutional neural network with >90% accuracy to improve fiber segmentation of fiber-reinforced composites (FRCs) from X-ray tomographic images.
- Created a computer vision model to quantify measurement results for double cantilever beam tests.
- Implemented a multi-objective optimization algorithm to improve mechanical properties of FRCs.
- Created a novel method to provide an efficient fracture constraint for 2-D concave fiber cross sections.
- Presented in project meetings weekly and supervised graduate student work.

Research Assistant   May 2024 – August 2024

Georgia Institute of Technology, School of Physics (advisors: Dr. Phillip First, Dr. Zhigang Jiang)   *Atlanta, GA*
- Worked on NASA/NSF funded research to investigate the formation and distribution of lunar water.
- Implemented an instance segmentation algorithm to identify and segment damaged regions in lunar-relevant materials. Results presented at the Sandia Machine Learning Conference.
- Performed ion irradiation on lunar-relevant minerals with analysis using scanning electron microscopy
- Analysis of scanning transmission electron microscopy and atomic force microscopy data.
- Characterization of Apollo 17 lunar sample using energy dispersive X-ray spectroscopy and photoluminescence.

Electronics, Oscillations, and Advanced Quantum Laboratory   August 2021 – May 2022

Haverford College, Department of Physics and Astronomy   *Haverford, PA*
- Conducted electron spin resonance of DPPH to measure its g-factor and excited state lifetime.
- Performed atomic absorption spectroscopy on indium phosphide quantum dots.
- Conducted material characterization of a graphite specimen via electron diffraction.
- Analyzed the laser modes and gain profile of a helium-neon laser using optical equipment.
- Wrote scientific manuscripts for physics experiments in radioactivity, polarization, and optics.

Advanced Physics Laboratory   August 2023 – December 2023

Haverford College, Department of Physics and Astronomy   *Haverford, PA*
- Implemented several semiconductor and quantum analog experiments for future students.
- Ran optical experiments confirming the existence of photons and used SPDC to show nonlocality.

Scientific Computing and Data Structures Laboratory   January 2022 – December 2022

Haverford College, Department of Computer Science   *Haverford, PA*
- Implemented algorithms for numerical differentiation, integration, and solving systems of DEQs.
- Created an algorithm to optimize housing locations to maximize access to public transportation.
- Led a project using real-time data to optimize passenger costs and flight time for air travel.

Systems Programming Laboratory   January 2023 – May 2023

Bryn Mawr College, Department of Computer Science   *Bryn Mawr, PA*
- Enabled a 4x performance increase by designing multi-threaded code to analyze the Mandelbrot set.
- Implemented low-level algorithms and data structures while practicing memory allocation techniques.

Manuscripts

P. Rane, M. Czabaj. (2024). Genetic optimization of carbon fiber cross-section shape for tailorable compressive and transverse properties. *(manuscript in preparation)*.

P. Rane, S. Mathieson. (2025). Enhancing first-principle and cross-disciplinary learning through retrieval augmented generation. *(computer science senior thesis)*.

Patents

P. Rane, M. Czabaj. (2024). Three-lobed fiber for improved mechanical properties of fiber-reinforce composites. *(patent disclosure filed)*.

Talks/Presentations

Characterization of Ion-Induced Damage: Application of Convolutional Neural Networks, Sandia National Laboratory Machine and Deep Learning Conference (September 2024).

The Formation of Water on the Moon, Georgia Tech College of Sciences REU Program (July 2024).

Introduction to Neural Networks, Georgia Tech School of Physics (July 2024).

- Slides are now utilized by Dr. John Wise in 300-level computational physics course at Georgia Tech.

Lunar Water Formation Through Deuterium Ion Irradiation, Georgia Tech College of Sciences Poster Session (July 2024).

Artificial Intelligence Panel, Haverford College (November 2024).

Skills

Microscopy/Spectroscopy Techniques: SEM, SEM-CL, AFM, STEM, Confocal PL, NMR, AAS, Mass Spec, IR Spec
Physics Equipment: Oscilloscopes, Amplifiers, Thorlabs Optics, Labview, Signal Generators
Technical Skills: Matlab, Python, C, C++, Zotero, machine learning, optimization, visualization

Other Interests

DIY: Haverford Robotics Club, remote-controlled drones and scaled planes, 3D printing
Athletics: Haverford Varsity Baseball, Member of Haverford Athletics Action Plan Committee