Zain Shabeeb

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EDUCATION

Georgia Institute of Technology — Atlanta, GA
PhD Chemical and Biomolecular Engineering | Advisor: Dr. Vida Jamali — Aug 2022 – Present
Thesis: AI for Nanoscience | Minor: Data Science for the Chemical Industry — GPA: 3.86/4.00

The University of Manchester — Manchester, United Kingdom
MSc Advanced Process Integration and Design - Advisor: Dr. Nan Zhang — Sep 2018 – Sep 2019
Thesis: Modeling & Optimization of Electrodeionization process for water-treatment | Grade: Distinction

Newcastle University — Newcastle, United Kingdom
BS Chemical Engineering (transferred from NUST, Pakistan in 2016) | Grade: First Class Honors — Aug 2014 – June 2018

WORK EXPERIENCE

Georgia Institute of Technology — Atlanta, GA
Graduate Research Assistant, Jamali Lab — Sep 2022 – Present

- Developed a physics-informed deep learning model to learn and simulate nanoparticle motion in liquid-phase Electron Microscopy (LPEM) videos, achieving 95%+ accuracy on generated trajectories by training on collected experimental data *(Nature Communications)*
- Pioneered cryoSENSE, a compressive cryo-EM framework leveraging generative diffusion models to reconstruct high-resolution protein images from compressed measurements, enabling 2.5× throughput gains for microscopy (*arxiv preprint*) (*Website*)
- Designed SAM-EM, a fine-tuned version of Meta's Segment Anything Model (SAM2) for LPEM videos, achieving ~50× higher accuracy in LPEM video segmentation compared to current state-of-the-art (*AI4Mat NeurIPS 2025*)

Graduate Teaching Assistant — Sep 2022 – Present

- Structured 6 Jupyter assignments and guided AI projects, enhancing students' practical skills in "AI for Chemical Engineering" course
- Took initiative to lead first implementation of high-performance computing cluster in a ChemE course; trained 20 students to use it
- Communicated with faculty to design "AI for Chemical Engineering" course, curating content for department-wide data science training
- Collaborated with professors to structure final-year Capstone Design project for 30+ Chemical Engineering undergraduates

Fatima Group — Lahore, Pakistan
Supply Chain Management Trainee Officer — Sep 2021 – Aug 2022

- Created price forecasting tool in R to predict prices of commodities covering 90% of company spend
- Implemented PowerBI and OracleBI dashboards for data visualization and communicating insights to 5 cross-functional teams

PUBLICATIONS

- **Shabeeb, Z**; Goyal N; Nantogmah, P; Jamali, V; "Learning the Diffusion of Nanoparticles in Liquid Phase TEM via Physics-informed Generative AI", *Nature Communications* (2025)
- **Shabeeb, Z***; Saeedi, D*; Tsui, D*; Jamali, V; Aghazadeh, A; "cryoSENSE: Compressive Sensing Enables High-throughput Microscopy with Sparse and Generative Priors on the Protein Cryo-EM Image Manifold", *arxiv preprint, Website* (2025)
- **Shabeeb, Z**; Jamali, V; "LEONARDO: A Physics-Informed Generative Model for Stochastic Nanoparticle Dynamics in Liquid-Phase TEM", *NeurIPS 2025 AI for Science Workshop*
- Wang, A; Xu, M; Goel, R; **Shabeeb, Z**; Panicker, I; Jamali, V; "SAM-EM: Real-Time Segmentation for Automated Liquid Phase Transmission Electron Microscopy", *NeurIPS 2025 AI for Accelerated Materials Design Workshop*
- Goel, R; **Shabeeb, Z**; Panicker, I; Jamali, V; "Segment Anything Model for Zero-shot Single Particle Tracking in Liquid Phase Transmission Electron Microscopy", *arxiv 2501.03153* (2025)
- **Shabeeb, Z**; Goyal N; Nantogmah, P; Jamali, V; "Learning the Physics of Liquid Phase TEM Nanoparticle Trajectories Using Physics-informed Generative AI", *Microscopy and Microanalysis* (2024)

TALKS

- "AI-Assisted LPTEM: A Unified Framework for Nanoparticle Tracking and Physics-Informed Generative Modeling" — Nov 2025
  2025 AIChE Annual Meeting
- "Learning Diffusion of Nanoparticles in Liquid Phase TEM Using Generative AI" — Feb 2025
  37th ChBE Georgia Tech Annual Graduate Research Symposium
- "Learning Surface Diffusion of Nanoparticles in Liquid Phase TEM Using Physics-informed Generative AI" — Jun 2024
  98th ACS Colloids and Surface Science Symposium

AWARDS

- Eckert Graduate Fellowship (ChBE) - $5000 stipend awarded for potential for highly creative research by Georgia Tech (2025)
- Exemplary Academic Achievement (4.0 GPA) by Georgia Tech (2023)

SKILLS

Programming: Python, R, MATLAB
Deep Learning Frameworks: Pytorch, TensorFlow Keras, Scikit-Learn, CUDA
Microscopy & Image Processing: Electron microscopy of proteins, condensates, nanoparticles; image segmentation with deep learning
Structural Biology: Software: CryoSPARC, CryoDRGN, ModelAngelo; Protein Databases: EMDB, PDB, UniProt
Data Analysis & Visualization: NumPy, Pandas, Matplotlib, Seaborn, Statistical modeling, PowerBI, OracleBI