

Fin Amin

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Google Scholar

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US Citizen (Security Clearance in Progress)

RESEARCH INSTITUTIONS

- **Massachusetts Institute of Technology Lincoln Laboratory** Lincoln, MA
Graduate Research Scientist (CO-OP) in Human Health and Performance Systems Feb 2024 - Ongoing
 - Developing SOTA AI algorithms for brain mapping based on MRI data.
 - Working on the next generation of AI Guide, an AI-guided emergency surgical tool.
 - Investigating elastic and sheer mapping for soft tissue analysis.
 - Giving clinics to neuroscientists at Massachusetts General Hospital on using AI for axon centerline detection.
 - Investigating how to reduce energy consumption in mobile AI systems.
- **North Carolina State University** Raleigh, NC
PhD Student in Electrical Engineering advised by Prof. Paul D. Franzon Aug 2021 - Ongoing
 - Dissertation Topic: Reinforcement Learning for 3D Floorplanning in Elec. Design Automation
 - Research Interests: Neural Network {Model Calibration, Pruning, Knowledge Distillation}, Unsupervised Domain Adaptation, LLM Fine-Tuning and Graph Neural Networks.¹
 - GPA: 3.85/4.00
 - Junior advisor to four Ph.D students.
 - Funded the research of three other Ph.D students.
- **The University of Texas at Austin** Austin, TX
Bachelor of Science in Electrical Engineering Aug 2016-May 2021
 - Primary Interest: Data Science, Digital Image/Video Processing, Digital Signal Processing
 - Received Computational Science and Engineering Certificate
 - Terry Foundation Scholar (full tuition and housing)

EARNED RESEARCH FUNDING: \$313,900

- **CISCO Research** 08/16/2024
\$75,000 Rapid 3DIC Thermal Modeling
 - Proposed a novel machine learning approach for thermal modeling in 3DICs, focusing on addressing the challenges of heat dissipation across multiple stacked layers.
 - Introduced the concept of using a diffusion model to transform power maps into high-resolution heat maps, aiming to improve accuracy and efficiency over traditional methods.
 - Second author, written with Prof. Franzon and a labmate.
- **LAD Student Travel Grant** 06/28/2024
\$900 to present research at LLM-Aided Design
 - Presented research on a novel LLM adaptation technique to over 200 researchers, industry members and tech startups.
 - Released a benchmark for LLM adaptation on microelectronic reasoning.
- **CAEML Research Award** 04/28/2024
\$70,000 for the development of Natural Language Optimization Models for PCBs and Analog ICs
 - Motivated the development of LLMs for a query-based optimizer focused on packaging and on-chip interconnect problems.
 - Proposed support for multimodal inputs and outputs, including eye diagrams, waveform figures, and actual layouts.
 - Demonstrated proof of concept via retrieval augmented generation demo.
 - Co-first author with Prof. Franzon.
- **Qualcomm Innovation Fellow** 05/03/2023
\$100,000 for the development of Reinforcement Learning Agents for 3D Floorplanning in EDA
 - Proposed and developed proof of concepts of novel RL algorithms for floorplanning.
 - Motivated research by identifying critical drawbacks in the SOTA.
 - Presented and defended research over 3 rounds of interviews.
 - Co-first author with a lab mate. Supervised by Prof. Franzon and Prof. Xiaorui Liu.
- **CAEML Research Award** 04/11/2023
\$68,000 for the development of Siamese-Graph Neural Networks for Circuit Graph Isomorphism Detection
 - Proposed and developed a novel SGNN architecture to address the circuit graph isomorphism detection problem.
 - Demonstrated proof of feasibility and scalability for large graphs.
 - First author, supervised by Prof. Franzon.

¹In spring 2024, I was initially nominated for the NCSU Graduate Researcher of the Year Award. Due to moving to MIT-LL, I was considered ineligible. As for the research funding: I have worked on other successful grants but did not list them unless I had significant technical contribution.

PUBLICATIONS

- **Real-Time Vessel Segmentation for Ultra-Sound Guided Surgery** Feb 2024 - November 2024
Published as second author in High Performance Extreme Computing (HPEC '24). Supervised by MIT-LL
 - Investigated various pruning/quantization techniques for real-time image segmentation of human vessels.
 - Contributed to writing a custom application for evaluating performance on a mobile AI system.
 - Motivated the processing of tomographic segmentation algorithms from a discrete computer to a mobile AI system in the next generation of AI Guide.
- **Large Reasoning Models for 3D Floorplanning in EDA** Aug 2023 - Ongoing
*Under review, submitted as **first author**. Supervised by Qualcomm Fellowship and Prof. Franzon*
 - Developed an auto-regressive decision-making model to optimize 3D IC floorplanning.
 - Implemented an architecture that integrates sequence-to-sequence reinforcement learning algorithms, enhancing the model's ability to reason over large discrete action spaces.
 - Achieved notable improvements in sample efficiency and floorplan quality by training the model using non-expert trajectories..
 - Evaluated the model against the SOTA, demonstrating superior performance in reducing wirelength and reasoning over multiple objectives.
- **The Over-Certainty Phenomenon** Sept 2022 – Ongoing
*Under review, submitted as **first author**, supervised by Prof. Jung-Eun Kim*
 - Introduced a novel memory-efficient unsupervised domain adaptation algorithm (UDA) which improves calibration.
 - Identified key issues in state-of-the-art UDA algorithms which harm model calibration.
 - Retained comparable accuracy to SOTA.
- **Can Low-Rank Knowledge Distillation be Useful for Microelectronic Reasoning?** March 2024 - May 2024
*Published as **co-first author**, LLM-Aided Design (LAD '24)*
 - Presented empirical results on the feasibility of using offline LLMs in EDA.
 - Evaluated Llama-2-7B's performance as a microelectronics Q&A expert, focusing on its reasoning and problem-solving abilities.
 - Introduced a novel LLM adaptation technique, low-rank knowledge distillation (LoRA-KD).
 - Released an evaluation benchmark to support future research.
- **Optimal Brain Dissection** May 2022 – Aug 2023
*Published as **first author** in BioInspired Processing (BIP '23), supervised by Sozzani Lab and USDA*
 - **Won Best Paper award.**
 - Introduced a SOTA technique for feature-importance determination.
 - Developed the dense autoencoder, a new autoencoder architecture for reducing reconstruction error in -omics data.
 - Outperformed the *de facto* gene regulatory network with respect to explaining gene expressions.²
- **DepthGraphNet** Oct 2022 – July 2023
*Published as **first author** in Machine Learning for Computer Aided Design (MLCAD '23)*
 - Investigated the use of siamese-graph neural networks for circuit graph isomorphism (CGI) detection.
 - Showed logarithmic run-time complexity with respect to graph size.
 - Outperformed all other classical and neural methods in CGI detection accuracy.
 - Introduced theorems for the optimal architecture of GNNs for CGI detection.
- **Network Inference Approach for Phosphoproteomics** May 2022 – Nov 2022
Published as second author in Methods in Molecular Biology (MIMB vol. 2690), supervised by Sozzani Lab
 - Described methods to statistically analyze label-free phosphoproteomic data and infer post-transcriptional regulatory networks over time.
 - Used the Bayesian Dirichlet Equivalent Uniform to inference underlying latent relationships between variables.

RESEARCH TALKS AND CLINICS

- MLCAD talk on *Large Reasoning Models for 3D Hard Macro Placement*. 09/11/2024
- Qualcomm Innovation Fellowship invited talk on *Large Reasoning Models for 3D Floorplanning*. 07/30/2024
- LLM-Aided Design talk on *Low-Rank Knowledge Distillation for LLMs*. 06/29/2024
- MIT-LL clinic on *Axon centerline detection using 3D-UNets*. 05/18/2024
- BioInspired Processing talk on *Optimal Brain Dissection*. 11/29/2023
- MLCAD talk on *Siamese-Graph Neural Networks for Circuit Graph Isomorphism Detection*. 09/12/2023

²During my time at NC State, I wanted to enrich my knowledge beyond what I was learning in class and within Prof. Franzon's lab. To do this, I joined two additional labs: the low-resource computing lab under Prof. Jung-Eun Kim in the CS department and Sozzani lab under Prof. Ross Sozzani in the Microbial Biology department. I **concurrently** produced research for all three labs while balancing my responsibilities as a student, junior advisor, teaching assistant, and research/grant proposal writer. **I have manuscripts being prepared; contact me for details.**

TEACHING

- **ECE 220 Analytical Foundations of ECE** Raleigh, NC
Teaching Assistant for North Carolina State University Aug 2022 - May 2023
 - Taught a sophomore-level course on circuit theory, control, differential equations and communication systems.
 - Supervised weekly labs which introduced students to MATLAB.
 - Graded homework and exams.
 - Gave career advice to aspiring engineers.
- **ECE 301 Linear Systems and Signals** Raleigh, NC
Teaching Assistant for North Carolina State University Aug 2021 - May 2022
 - Taught a junior level course on linear systems and signals.
 - Wrote exams and lead recitation twice a week.
 - Taught students introductory machine learning in MATLAB.
 - Graded homework and exams.
 - Received outstanding feedback from my students.
- **Signal Processing and Data Science Tutor** Austin, TX
Varsity Tutors Feb 2021 - July 2021
 - Tutored undergraduates in data science, linear systems and signals
 - Taught introductory classes in Java and Python
 - 4.9/5.0 stars (top 10% of all tutors on platform)

TECHNICAL SKILLS

- Extremely experienced with PyTorch and TensorFlow machine learning frameworks.
- Expert in Python. Skilled with Java, MATLAB, C, and L^AT_EX.
- Highly familiar with libraries such as OpenCV, PIL, sci-kit-image, and Gym.
- Skilled at digital {tomography, image, video, voxel} processing. Also skilled with pattern recognition, detection and estimation theory. Strong background in reinforcement learning and Bayesian optimization.

PROFESSIONAL SERVICE

- Reviewer for Neurips 2024 Workshop FM4Science 2024.
- Contributor to *Machine Learning Systems: Principles and Practices of Engineering Artificially Intelligent Systems*, the textbook used for Harvard's CS249R (a course on TinyML).
- Contributor to Tensorflow Probability, SciKit Learn, and Deep Robust.
- Director of NC State Community Affairs for ECE Graduate Students Association (2021-2022).
- Organized NC State ECE Research Symposium January 28, 2022.
- Organized NC State TEDx Talk with Analog Devices, March 7, 2022.
- Member of UT Austin IEEE Robotics and Automation Society
- Director of Student Affairs for UT Austin Planet Longhorn (International Students Org)

UNDERGRADUATE PROJECTS

- **Deep Framerate Upscaling**
Undergraduate Computational Science and Engineering Research Certificate Project, under Prof. Al Bovik
 - Created a deep learning architecture to interpolate frames in videos to increase framerate.
 - Modified a Pix2Pix Conditional Generative Adversarial Network to predict a frame which would be present between two given frames.
 - Researched methods to reduce the smearing/ghosting artifacts traditionally associated with framerate upscaling.
 - Utilized extensive signal processing theory on the spatial and temporal attributes of videos to (unsuccessfully) create a better loss function.
- **Parallel Neural Networks in OpenMP and MPI**
Parallel Compute Final Project
 - Worked in a team of two to create a deep neural network to train on the MNIST handwritten digits dataset from scratch in C++ for serial execution for baseline performance metric.
 - Re-implemented the same network in Open Multi-Processing and Message Passing Interface to show speed up with various network sizes.

- Won Best Project Award.

- **EmotionNet: Autonomous Body Language Assessment**

Project manager for Honors Senior Design supervised by Prof. Al Bovik

- Created computer vision/image processing algorithms for dataset feature extraction such as blurry image detector, predominant face identifier, Haar Cascade Classifier, and MTCNN hyperparameter optimizer.
- Created a deep network based on VGG16 for facial emotion classification and encoding.
- Utilized ResNet18 to classify and encode body-posture and pose.
- Created a recurrent neural network decoder using LSTM to establish spatio-temporal relationships between facial emotions, pose, and posture with human body language.

EMPLOYMENT

- **Smith and Nephew**

Austin, TX

CO-OP: Real-Time FootSwitch Demultiplexer

May 2019 - Dec 2019

- Created a surgical device to demultiplex signals from a universal footswitch to numerous soft tissue ablation and coagulation systems.
- All signals (analog, digital, RS-485) sent and received are galvanically isolated to meet medical safety requirements.