# Fin Amin

Website: https://FinAminToastCrunch.github.io/Google Scholar

## **Research Institutions**

• Massachusetts Institute of Technology Lincoln Laboratory • Student Technical Staff in Human Health and Performance Systems	Lexington, MA Feb 2024 - Ongoing
<ul> <li>Developing computer-vision algorithms for brain mapping based on 3D confocal microscopy data</li> <li>Investigating how to reduce energy consumption in mobile image-segmentation systems to improceed and surgical tool</li> </ul>	a. ove the AI Guide, an
<ul> <li>Introducing meta-learning for self-supervised pre-training of tomography foundation models.</li> <li>Estimating the intents and behaviors of health-care professionals via control theoretic and inversional frameworks.</li> </ul>	se reinforcement learning
<ul> <li>North Carolina State University         <ul> <li>Ph.D Student in Electrical Engineering advised by Prof. Paul Franzon</li> <li>Aug 2021 - on sabbatical as of Jan 2024</li> <li>Dissertation Topic: Reinforcement Learning, Graphs and Language Models for Electronic Design Automation</li> <li>Research Interests: Neural Network {Model Calibration, Pruning, Knowledge Distillation, Unsupervised Domain Adaptation}, Language Model {Multimodality, Fine-tuning}, Diffusion Models and Graph Networks.</li> </ul> </li> </ul>	
<ul> <li>The University of Texas at Austin</li> <li>Bachelor of Science in Electrical Engineering         <ul> <li>Primary Interest: Data Science, Digital Image/Video Processing, Digital Signal Processing</li> </ul> </li> </ul>	Austin, TX <i>Aug 2016-May 2021</i>
• Computational Science and Engineering Research Program	

• Terry Foundation Scholar (full tuition and housing)

## Collaboration Timeline



My timeline of research collaborations across multiple institutions. At NCSU, concurrently I worked in three different labs in ECE, CS, and Microbiology, balancing research, mentoring, teaching, and grant writing. Later, while working at MIT Lincoln Laboratory, I again concurrently collaborated with researchers at MIT CSAIL and Harvard SEAS.

## RESEARCH FUNDING CONTRIBUTIONS: \$313,000

#### **CISCO** Research

- \$75,000 Rapid 3DIC Thermal Modeling
  - $\circ~^1$  Proposed a diffusion model for transforming power maps into high-resolution heat maps, improving accuracy over traditional methods.
  - $\circ~$  Co-wrote the proposal with Prof. Franzon and a lab mate.

#### CAEML Research Award

\$70,000 Natural Language Optimization Models for PCBs and Analog ICs

 $^{1}$ I had significant technical contribution to these grants/fellowships. They were earned with Prof. Franzon as the PI.

Page 1 of 4

08/16/2024

04/28/2024

Co-Lead Contributor

Co-Author

- $\circ$  Developed research vision and methodology for using LLMs in multi-modal query-based optimization.
- $\circ~$  Co-led proposal writing with Prof. Franzon; produced technical preview.

## Qualcomm Innovation Fellowship

- \$100,000 Reinforcement Learning for 3D Floorplanning in EDA
  - $\circ~$  Proposed and defended novel RL approaches for floor planning over three rounds of evaluation.
  - $\circ~$  Co-led proposal with a lab mate; supervised by Prof. Franzon and Prof. Xiaorui Liu.

#### CAEML Research Award

- \$68,000 Siamese-Graph Neural Networks for Circuit Graph Isomorphism Detection
  - Developed core SGNN architecture and research methodology.
  - $\circ~$  Wrote the proposal and developed a technical preview; supervised by Prof. Franzon.

## IN PREPARATION (FIRST-AUTHOR-LEVEL EFFORT)

#### Motivation-Guided Feature Generalization for Inverse Reinforcement Learning

Supervised by Prof. Bobu of MIT CSAIL's CLEAR Lab

 $\circ~$  Work involving language and human robot interaction.

#### [REDACTED]

- Supervised by MIT LL
  - $\circ~$  Work involving HRI, optimal control and estimation theory.

## PUBLICATIONS/UNDER REVIEW/PREPRINTS

#### The Over-Certainty Phenomenon

- Under review. First author. Supervised by Prof. Jung-Eun Kim
  - $\circ~$  Identified a concerning trend in the design of state-of-the-art TTA algorithms which harm model calibration.
  - Introduced a novel test-time adaptation algorithm (TTA) which improves calibration.
  - Retained comparable accuracy to SOTA.

#### Just Go With The (Optical) Flow!

- Published IEEE EMBC '25. First author. Supervised by MIT LL
  - Developed an optical flow-based approach to enhance axon centerline detection and tracing in 3D microscopy data.
  - Demonstrated that interpreting volumetric imaging data as sequential frames improves spatial feature extraction for neuron structure identification.

#### A Domain-Specific Q&A Dataset for Computer Architecture

- Published in IEEE CAL. Contributing author. Supervised by Harvard Edge Computing Lab
  - $\circ~$  Developed a Q&A dataset for benchmarking LLMs in computer architecture.
  - Assessed LLMs, identifying gaps in systems topics like memory and interconnects.
  - Proposed a roadmap to enhance LM reasoning and design capabilities.

#### Topology-Aware Deep Supervision for Axon Centerline Detection

- Published in IEEE ISBI '25. Co-first author. Supervised by MIT LL, MBF Bioscience, and Univ. Central Florida
  - Addressed the issue of limited annotations for axon centerline detection data in brain mapping.
  - $\circ~$  Improved performance over baseline despite using only 66% of the annotations.
  - Maintained performance for fully-annotated setting.

#### Mobile-Optimized Real-Time Vessel Segmentation for Ultra-Sound Guided Surgery

- Published in IEEE HPEC '24. Second author. Supervised by MIT LL
  - $\circ$  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.

#### Addressing Large Action Spaces in 3D Floorplanning via Spatial Generalization

Under review. First author. Supervised by Qualcomm Fellowship and Prof. Franzon

- $\circ~$  Investigated continuous action representations for 3D floor planning to improve scalability and spatial generalization.
- Developed a decision-transformer-based model that reasons over continuous placements and discretizes actions only at inference.
- Demonstrated that spatial inductive biases enable learning from non-expert and random trajectories.
- Can Low-Rank Knowledge Distillation be Useful for Microelectronic Reasoning?
- Published in IEEE/ACM LAD '24. Co-first author. Supervised by Prof. Franzon
  - Introduced a novel LLM adaptation technique, low-rank knowledge distillation (LoRA-KD).

05/03/2023Lead Contributor

04/11/2023 Lead Contributor

- Evaluated Llama-2-7B's performance as a microelectronics Q&A expert, focusing on its reasoning and problem-solving abilities.
- $\circ~$  Released an evaluation benchmark to support future research.

#### **Optimal Brain Dissection**

- Published in IEEE BIP '23. First author. Supervised by Sozzani Lab and USDA
  - Won Best Paper award.
  - Introduced a technique for feature-importance determination that exploits pruning algorithms.
  - Outperformed the *de facto* gene regulatory network with respect to explaining gene expressions.

#### DepthGraphNet

- Published in IEEE/ACM MLCAD '23. First author. Supervised by Prof. Franzon
  - Investigated the use of siamese-graph neural networks for circuit graph isomorphism (CGI) detection.
  - Empirically demonstrated logarithmic run-time complexity with respect to graph size.
  - $\circ~$  Outperformed all other classical and neural methods in CGI detection accuracy.

#### Network Inference Approach for Phosphoproteomics

- Published in Springer MIMB vol. 2690. Second author. 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 causal relationships between variables.

#### IN PREPARATION (CONTRIBUTER-LEVEL EFFORT OR SUPERVISION)

#### Is This Worth Asking?

Supervised by Prof. Bobu of MIT CLEAR Lab

 $\circ~$  Work involving understanding human effort answering questions.

## Large Language Optimization Model for Electronic Design

- Supervised by Prof. Franzon
  - Work involving the design of a multi-modal agent which interfaces with optimization algorithms.

#### Diffusion Models for Rapid 3DIC Thermal Modeling

#### Supervised by Prof. Franzon

• Work involving the design of a conditional diffusion model which estimates the thermal properties of 3DICs.

## 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

#### PROFESSIONAL SERVICE

- Mentor to four Ph.D students.
- Reviewer for Neurips Workshop on Foundation Models for Science (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 python libraries.
- 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.
- Each year, incoming ECE Ph.D. students at NCSU watch a video titled *How to Succeed Doing a Ph.D in ECE*. The presentation includes me as an example of a Ph.D. student navigating the program successfully.
- Director of Student Affairs for UT Austin Planet Longhorn (International Students Org) (2020-2021).

TEACHING	
ECE 220 Analytical Foundations of ECE	Raleigh, NC
• Teaching Assistant for North Carolina State University	Aug 2022 - May 2023
$\circ~$ 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

- Very experienced with PyTorch and TensorFlow.
- Daily usage of Python. Skilled with Java.
- Seasoned with libraries such as OpenCV, PIL, sci-kit-image, Gym and PyBullet.
- Skilled at digital {tomography, image, video, voxel} processing. Strong background in applied reinforcement learning, pattern recognition, detection/estimation theory, Bayesian optimization and large scale self-supervised learning.
- Growing experience in stochastic geometry, algebraic topology and inverse RL.