Fin Amin

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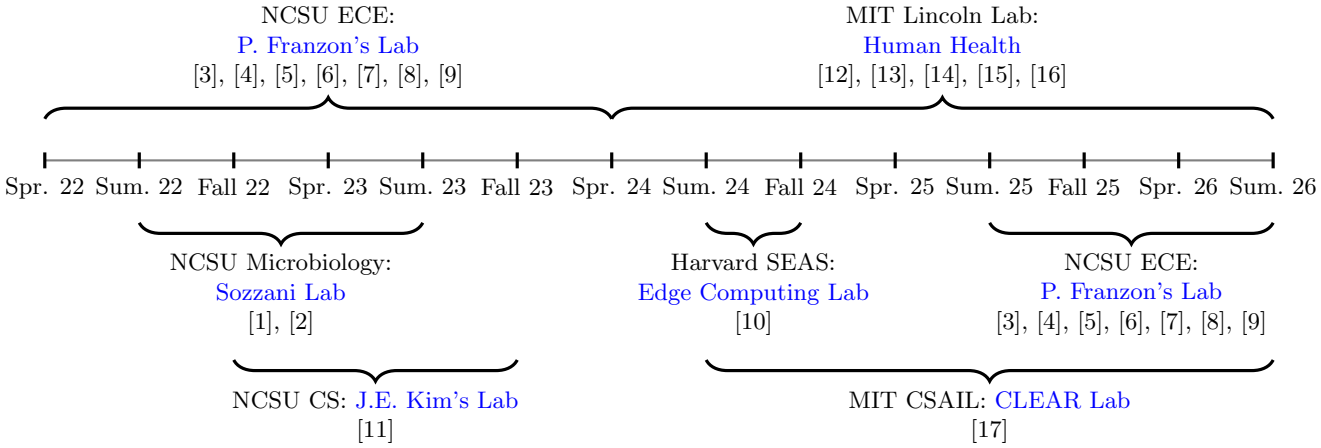
Last Updated: August 26, 2026
US Citizen with Secret Clearance

Research Institutions

- **Massachusetts Institute of Technology Lincoln Laboratory** — Lexington, MA
  CO-OP in Human Health and Performance Systems — *Feb 2024 - Aug 2026*
  - Developed computer-vision algorithms for brain mapping, as part of the NeuroTrALE project.
  - Investigated mobile image-segmentation systems to improve the AI Guide, an emergency surgical tool.
  - Evaluated meta-learning and self-supervised learning strategies for developing foundation models for 3D brain mapping.
  - Introduced a trajectory smoothing algorithm that significantly improved ultrasound reconstruction performance.
- **North Carolina State University** — Raleigh, NC
  Doctor of Philosophy in Electrical Engineering advised by Prof. Paul Franzon — *Aug 2021 - Aug 2026*
  - Dissertation Thesis: Resource-Aware Electronic Design Through Structured Ontologies
  - Research Interests: Statistical signal processing and estimation; learning and optimization under uncertainty; graph-structured representation learning; reward learning and sequential decision-making; reliable adaptation under distribution shift; and resource-aware machine learning for scientific and engineering systems.
- **The University of Texas at Austin** — Austin, TX
  Bachelor of Science in Electrical Engineering — *Aug 2016-May 2021*
  - Primary Interests: Data Science, Digital Image/Video Processing, Digital Signal Processing
  - Computational Science and Engineering Research Program advised by Prof. Al. Bovik.

Collaboration Timeline



My timeline of all the labs I have produced research with. At NCSU, I concurrently worked in labs in the ECE, CS, and Microbiology departments. While working at MIT Lincoln Laboratory, I collaborated with labs at MIT CSAIL and Harvard SEAS.

Awards and Honors

- MIT Lincoln Laboratory — Research featured on the Lincoln Lab Bulletin '26. As the first author of [15] and [16].
- IEEE CAL HPCA — Best Paper Award '25. As a contributing author of [10].
- IEEE BIP — Best Paper Award '23. As the first author of [2].
- Qualcomm Inc. — Qualcomm Innovation Fellow '23. To develop reinforcement learning algorithms for chip design.
- Terry Foundation — Terry Scholar '16 - '21 (full tuition and housing to attend UT Austin).

In Preparation

- **How Should AI Assist Chip Design? A Case Study on Floorplanning Algorithms**
  Advising a high school student's research project
  - Investigating the interplay between AI and classical floorplanning algorithms.
- **Is This Worth Asking?**
  Supervised by Prof. Bobu of MIT CLEAR Lab
  - Exploring the tradeoffs in understanding human effort and cognitive load vs. information gain.

Publications/Under Review/Under Revision

GIFT: Generalizing Intent for Flexible Test-Time Rewards

[17] *Published in the IEEE International Conference on Robotics and Automation (ICRA) '26.*
First author. Supervised by Prof. Bobu of MIT CSAIL

- First work to formulate test-time reward generalization from human intent.
- Introduced a framework that infers high-level human intent from demos to generalize unseen states to training states.
- Enabled reward reuse under distribution shift without retraining by conditioning similarity on inferred intent.
- Validated on 7-DoF Jaco (simulation) and Franka Panda (real-world) robots across tabletop manipulation tasks.

Smooth Like BUTTER: A Motion Restoration Framework for Trackerless Freehand 3D US

[16] *Under review at IEEE Transactions on Biomedical Engineering (TBME).*
First author. Supervised by MIT LL

- Formalized [15] into a framework for trackerless freehand 3D ultrasound reconstruction.
- Developed a motion restoration approach to correct pose drift and improve reconstruction consistency.

Boosting Framework for Trackerless Freehand 3D US Reconstruction Estimators

[15] *Published in the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP) '26.*
First author. Supervised by MIT LL

- Introduced a boosting-based correction framework for trackerless freehand 3D ultrasound reconstruction.
- Learned residual updates in Lie algebra, $\mathfrak{se}(3)$, to correct systematic drift and jitter in pose estimations.
- Demonstrated significant ($\approx 150\%$) improvement over oracle variants of prior art.

Just Go With The (Optical) Flow!

[14] *Published in the IEEE International Conference of the Engineering in Medicine and Biology Society (EMBC) '25.*
First author. Supervised by MIT LL, MBF Bioscience, and Univ. Central Florida

- Invited for an oral presentation.
- Developed an optical flow-based approach to enhance axon centerline detection and tracing in 3D microscopy data.
- Demonstrated that interpreting volumetric imaging data as videos extracts directional features for neuron structure identification.

Topology-Preserving Deep Supervision for Axon Centerline Detection

[13] *Published in the IEEE International Symposium on Biomedical Imaging (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.
- Improved performance over baseline despite using only 66% of the annotations.
- Maintained performance for fully-annotated setting.

Mobile-Optimized Real-Time Vessel Detection for Ultra-Sound Guided Surgery

[12] *Published in the IEEE High Performance Extreme Computing Conference (HPEC) '24.*
Second author. Supervised by MIT LL

- Implemented tomographic vessel detection algorithms on a smartphone platform.
- Adapted methods for deployment in the next-generation AI Guide mobile system.
- Explored pruning and quantization techniques for real-time segmentation.
- Developed a custom mobile app to benchmark performance.

The Over-Certainty Phenomenon of Modern Test-Time Adaptation Algorithms

[11] *Published in Transactions on Machine Learning Research (TMLR) (Aug. '25).*
First author. Supervised by Prof. J.E. Kim

- Identified a trend in the design of test-time adaptation algorithms (TTA) which harms model calibration.
- Introduced a novel TTA algorithm which improves calibration while maintaining accuracy uplifts.

A Question-Answering Dataset for AI Agents in Computer Architecture

[10] *Published in IEEE Computer Architecture Letters (CAL).*
Contributing author. Supervised by Harvard Edge Computing Lab

- Developed a Q&A dataset for benchmarking LMs in computer architecture.
- Proposed a road map to enhance LM reasoning and design capabilities.

Test-Time Analog Circuit Topology Representation Adaptation for Bayesian Optimization

[9] *Under review at IEEE Transactions on Computer-Aided Design (TCAD).*
First author. Supervised by Prof. Franzon

- Introduced online adaptation of the representations of analog circuit topologies to improve Bayesian optimization.
- Evaluated across 160 configurations using public circuit benchmarks, encoders, kernels, and acquisition functions.

Trident: A Distance-Based Graph Neural Model for Subgraph-Level LVS Verification

[8] *Under revision.*
Second author. Supervised by Prof. Franzon

- Extends [3] with a contrastive learning framework that estimates distances between target circuits and query subcircuits.
- Enables graded reasoning for LVS verification and validation instead of binary subgraph isomorphism.

Can an Actor-Critic Optimization Framework Improve Analog Design?

[7] *Presented at the NSF Workshop on Agents for Chip Design Automation (AI4EDA '26) Under review at the AI for Chip Design at NeurIPS 2026.*
Co-first author. Supervised by Prof. Franzon

- Proposed an actor-critic optimization framework for analog circuit sizing.
- Actor proposes candidate designs while the critic enforces constraints and redirects stalled search.
- Improved top-10 figure of merit by 38.9% and reduced regret by 24.7% over the strongest baseline.
- Compatible with standard simulator-based analog design workflows.

Addressing Large Action Spaces in 3D Floorplanning via Spatial Generalization

[6] *To appear at IEEE International Conference on Computer Design (ICCD) '26*
First author. Supervised by Qualcomm Fellowship and Prof. Franzon

- Investigated continuous action representations in RL for 3D floorplanning to improve scalability and spatial generalization.
- Developed a decision-transformer-based model that reasons over continuous placements and discretizes only at inference.
- Demonstrated that spatial inductive biases enable learning from non-expert and random trajectories.

A Conditional Diffusion Framework for Sample-Efficient Thermal Modeling in 3DICs

[5] *Published in the IEEE Conference on Electrical Performance of Electronic Packaging and Systems (EPEPS) '25.*
Second author. Supervised by Prof. Franzon. Funded by Cisco

- Invited for an oral presentation.
- Proposed HeatDiffUNet, a conditional diffusion model for static temperature prediction from power maps.
- Demonstrated sample-efficient thermal modeling.

Can Low-Rank Knowledge Distillation be Useful for Microelectronic Reasoning?

[4] *Published in the First IEEE International Workshop on LLM-Aided Design (LAD) '24.*
Co-first author. Supervised by Prof. Franzon

- Introduced a novel LLM adaptation technique, low-rank knowledge distillation (LoRA-KD).
- Released an evaluation microelectronics Q&A benchmark to support future research.

DepthGraphNet

[3] *Published in the ACM/IEEE International Symposium on Machine Learning for CAD (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.
- Outperformed all other classical and neural methods in CGI detection accuracy.

Optimal Brain Dissection

[2] *Published in the IEEE International Conference on BioInspired Processing (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.

Network Inference Approach for Phosphoproteomics

[1] *Published in the Methods in Molecular Biology series, vol. 2690 (MIMB).*
Co-first 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 infer underlying latent causal relationships between variables.

Invited Research Talks and Clinics

- Georgia Tech: *Reliable Learning Under Distribution Shift: Human Intent and Model Certainty at Test Time* Fall 2026
- EMBC '25: *How to Go With the Optical Flow* to improve axon tracing. 07/18/2025
- MLCAD '24: *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: *Low-Rank Knowledge Distillation for LLMs.* 06/29/2024
- Qualcomm Innovation Fellowship: Invited talk on *Challenges in Using RL for 3D Placement.* 05/29/2024
- MIT-LL: Invited clinic on *Axon Centerline Detection Using Large Spatial Models.* 05/18/2024
- BIP '23 Best Paper Award: *Optimal Brain Dissection.* 11/29/2023
- CAEML seminar on *Siamese-Graph Neural Networks for Circuit Graph Isomorphism Detection.* 05/12/2023

Research Funding Contributions: $392,300

- **Siemens–CAEML** 04/27/2026
  Amortized Estimation of Multivariate Normal CDFs *Lead Contributor* ***($77,300)***
  - Introduced amortized ML regression of high-dimensional MVNCDFs for semiconductor yield estimation, SSTA, reliability analysis, and EUVL stochastic modeling.
  - Proposed neural surrogate methodology to replace repeated Monte Carlo / importance-sampling evaluations by exploiting Large Deviations Theory.
  - Wrote the proposal and developed a technical preview; supervised by Prof. Franzon.
- **CISCO Research Grant** 08/16/2024
  Rapid 3DIC Thermal Modeling *Co-Lead Contributor* ***($77,000)***
  - Proposed a diffusion model for transforming power maps into high-resolution heat maps, improving sample efficiency over traditional methods.
  - Co-wrote the proposal with Prof. Franzon and a labmate.
- **Hewett Packard Enterprise–CAEML** 04/28/2024
  Natural Language Optimization Models for PCBs and Analog ICs *Co-Lead Contributor* ***($70,000)***
  - Developed research vision and methodology for using LLMs in multi-modal query-based optimization.
  - Co-led proposal writing with Prof. Franzon; produced technical preview.
- **Qualcomm Innovation Fellowship** 05/03/2023
  Reinforcement Learning for 3D Floorplanning in EDA *Lead Contributor* ***($100,000)***
  - Proposed and defended novel RL approaches for floorplanning over three rounds of evaluation.
  - Led proposal with a labmate; supervised by Prof. Franzon and Prof. Xiaorui Liu.
- **Siemens–CAEML** 04/11/2023
  Siamese-Graph Neural Networks for Circuit Graph Isomorphism Detection *Lead Contributor* ***($68,000)***
  - Developed core SGNN architecture and research methodology.
  - Wrote the proposal and developed a technical preview; supervised by Prof. Franzon.

Professional Service

- Reviewer for: IEEE Bioinspired Processing (BIP '26), IEEE International Conference on Robotics and Automation (ICRA '26), IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP '26), IEEE Software Journal (special edition '26), IEEE Body Sensor Networks (BSN '25, '26), Robotics: Science and Systems Workshop FM4RoboPlan (RSS FM4RoboPlan '26), and NeurIPS Workshop on Foundation Models for Science (Foundation Models for Science '24).
- Mentor to two Ph.D students.
- Contributor to Tensorflow Probability, SciKit Learn, and Deep Robust Python libraries. Contributor to *Machine Learning Systems*, the textbook used for Harvard's CS249R (a course on TinyML)
- 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 (2018-2021).
- Director of Student Affairs for UT Austin Planet Longhorn (International Students Org) (2020-2021).

[0] I had significant technical contributions to these grants/fellowships. They were earned with Prof. Franzon as the PI.

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 led recitation twice a week; taught 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

- Highly experienced with PyTorch and TensorFlow.
- Daily usage of Python. Skilled with Java.
- Seasoned with ML libraries such as OpenCV, PIL, sci-kit-learn, and Gym. Experienced with HPCs (SLURM and IBM LSF)
- Experience with robotics and physics simulation libraries such as PyBullet and Polymetis.
- Skilled at digital {tomography, image, video, voxel} processing. Strong background in applied reinforcement learning, pattern recognition, detection/estimation theory, Bayesian optimization, control theory and large-scale SSL.
- Growing experience in Lie algebra, convex optimization, online learning, statistical learning theory, complex analysis, finite-element techniques, inverse RL and spectral graph theory.

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.