Fin Amin

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Last Updated: September 28, 2025
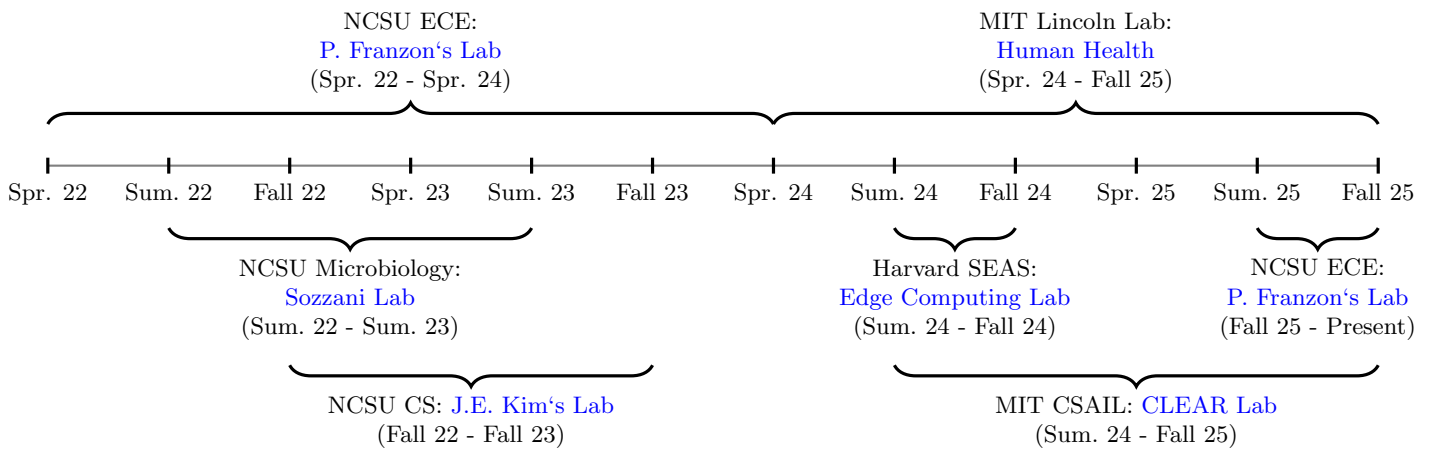US Citizen with Secret Clearance

RESEARCH INSTITUTIONS

- **Massachusetts Institute of Technology Lincoln Laboratory** — Lexington, MA
  Student Technical Staff in Human Health and Performance Systems — *Feb 2024 - Ongoing*
  - Developing computer-vision algorithms for brain mapping based on 3D confocal microscopy data.
  - Investigating how to reduce energy consumption in mobile image-segmentation systems to improve the AI Guide, an emergency surgical tool.
  - Quantifying the performance of SSL strategies for tomography.
  - Estimating the behaviors of health-care professionals via control theoretic and inverse RL frameworks.

- **North Carolina State University** — Raleigh, NC
  Ph.D. Student in Electrical Engineering advised by Prof. Paul Franzon — *Aug 2021 - part-time as of Jan 2024*
  - Dissertation Topic: Resource-Aware Deep Learning for Electronic Design Automation
  - Research Interests: Reinforcement Learning, Neural Network {Model Calibration, Pruning, Knowledge Distillation, Test-Time Adaptation}, Language Model {Multimodality, Fine-tuning}, Diffusion Models and Graph Networks.

- **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.
  - Terry Foundation Scholar (full tuition and housing)

COLLABORATION TIMELINE

NCSU ECE:
P. Franzon's Lab
(Spr. 22 - Spr. 24)

MIT Lincoln Lab:
Human Health
(Spr. 24 - Fall 25)

Spr. 22 | Sum. 22 | Fall 22 | Spr. 23 | Sum. 23 | Fall 23 | Spr. 24 | Sum. 24 | Fall 24 | Spr. 25 | Sum. 25 | Fall 25

NCSU Microbiology:
Sozzani Lab
(Sum. 22 - Sum. 23)

Harvard SEAS:
Edge Computing Lab
(Sum. 24 - Fall 24)

NCSU ECE:
P. Franzon's Lab
(Fall 25 - Present)

NCSU CS: J.E. Kim's Lab
(Fall 22 - Fall 23)

MIT CSAIL: CLEAR Lab
(Sum. 24 - Fall 25)

My timeline of all the labs I have produced research with. At NCSU, I concurrently worked in three labs in ECE, CS, and Microbiology, balancing research, mentoring, course work, teaching, and grant writing. While working at MIT Lincoln Laboratory, I again concurrently joined labs at MIT CSAIL and Harvard SEAS.

RESEARCH FUNDING CONTRIBUTIONS: $313,000

- **CISCO Research** — 08/16/2024
  $75,000 *Rapid 3DIC Thermal Modeling* — *Co-Lead Contributor*
  - 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.

- **CAEML Research Award** — 04/28/2024
  $70,000 *Natural Language Optimization Models for PCBs and Analog ICs* — *Co-Lead Contributor*
  - Developed research vision and methodology for using LLMs in multi-modal query-based optimization.
  - Co-led proposal writing with Prof. Franzon; produced technical preview.

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

- **Qualcomm Innovation Fellowship** 05/03/2023
  $100,000 Reinforcement Learning for 3D Floorplanning in EDA *Lead Contributor*
  - 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.
- **CAEML Research Award** 04/11/2023
  $68,000 Siamese-Graph Neural Networks for Circuit Graph Isomorphism Detection *Lead Contributor*
  - Developed core SGNN architecture and research methodology.
  - Wrote the proposal and developed a technical preview; supervised by Prof. Franzon.

PATENTS

- `[REDACTED]`
  Patent applied for by MIT LL. Contributing inventor.
  - Introduced `BUTTER`, the first framework to address pose correction in contemporary trackerless freehand 3D ultrasound.
  - Developed a boosting operator in $\mathfrak{se}(3)$ to correct systematic trajectory errors, improving drift reduction and robustness.

IN PREPARATION (FIRST-AUTHOR-LEVEL EFFORT)

- **Physics-Informed World Models for Thermal Estimation in ICs**
  Supervised by Prof. Franzon
  - Work involved instilling physics priors for generative networks in the context of thermal estimation.
- `[REDACTED]`
  Supervised by MIT LL
  - Work involving human-robot interaction, optimal estimation and control to understand the human musculoskeletal system.

PUBLICATIONS/UNDER REVIEW

[13] **GIFT: Generalizing Intent for Flexible Test-Time Rewards**
Under review at IEEE ICRA '26. First author. Supervised by 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.

[12] **Boosting Framework for Trackerless Freehand 3D US Reconstruction Estimators**
Under review at IEEE 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 improvements over oracle variants of prior art.

[11] **Addressing Large Action Spaces in 3D Floorplanning via Spatial Generalization**
Under review at IEEE/ACM ISQED '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.

[10] **The Over-Certainty Phenomenon**
Published in 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.

[9] **A Conditional Diffusion Framework for Sample-Efficient Thermal Modeling in 3DICs**
Published in IEEE EPEPS '25. Second author. Supervised by Prof. Franzon. Funded by Cisco
- Invited for oral presentation.
- Proposed HeatDiffUNet, a conditional diffusion model for static temperature prediction from power maps.
- Demonstrated sample-efficient thermal modeling, achieving high accuracy with as few as 200 training samples.

[8] **Just Go With The (Optical) Flow!**
Published IEEE EMBC '25. First author. Supervised by MIT LL
- Invited for 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.

[7] **A Domain-Specific Q&A Dataset for Computer Architecture**
Published in IEEE CAL. Contributing author. Supervised by Harvard Edge Computing Lab
- Developed a Q&A dataset for benchmarking LMs in computer architecture.
- Assessed LMs, identifying gaps in systems topics like memory and interconnects.
- Proposed a road map to enhance LM reasoning and design capabilities.

[6] **Topology-Preserving 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.
- Improved performance over baseline despite using only 66% of the annotations.
- Maintained performance for fully-annotated setting.

[5] **Mobile-Optimized Real-Time Vessel Detection for Ultra-Sound Guided Surgery**
Published in IEEE 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.

[4] **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).
- Released an evaluation microelectronics Q&A benchmark to support future research.

[3] **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.

[2] **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.
- Outperformed all other classical and neural methods in CGI detection accuracy.

[1] **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
  - 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.

INVITED RESEARCH TALKS AND CLINICS

- EMBC '25 talk on *How to Go With the Flow* to improve spatial reasoning for image segmentation.   07/18/2025
- 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
- Qualcomm Innovation Fellowship invited talk on *Challenges in Using RL for 3D Placement.*   05/29/2024
- MIT-LL clinic on *Axon Centerline Detection Using Large Spatial Models.*   05/18/2024
- BioInspired Processing Best Paper Award talk on *Optimal Brain Dissection.*   11/29/2023
- CAEML seminar on *Siamese-Graph Neural Networks for Circuit Graph Isomorphism Detection.*   05/12/2023

Professional Service

- Reviewer for IEEE Software Journal (special edition '26).

- Reviewer for IEEE Body Sensor Networks (BSN '25).

- Reviewer for Neurips Workshop on Foundation Models for Science (FM4Science '24).

- 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.

- Mentor to two Ph.D students.

- Contributor to *Machine Learning 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 (2018-2021).

- 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
  - 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

- Growing experience in causality (Pearl), abstract linear algebra, stochastic geometry, Lie algebra, convex optimization, online learning, statistical learning theory, complex analysis, finite-element techniques and inverse RL.

- Very experienced with PyTorch and TensorFlow.

- Daily usage of Python. Skilled with Java.

- Seasoned with ML libraries such as OpenCV, PIL, sci-kit-image, and Gym.

- 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.