

Darin Tsui

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Education

- Georgia Institute of Technology**, Ph.D. in Electrical and Computer Engineering Aug 2023 – May 2028
- Advisor: Amirali Aghazadeh.
- University of California San Diego**, B.S. in Bioengineering Sep 2019 – Jun 2023

Selected Publications

Darin Tsui, Kunal Talreja, Daniel Saeedi, and Amirali Aghazadeh. Protein circuit tracing via cross-layer transcoders. In *International Conference on Machine Learning (ICML)*, 2026.

Zain Shabeeb*, Daniel Saeedi*, **Darin Tsui***, Vida Jamali, and Amirali Aghazadeh. cryoSENSE: Compressive sensing enables high-throughput microscopy with sparse and generative priors on the protein cryo-EM image manifold. In *Conference on Computer Vision and Pattern Recognition (CVPR)*, 2026.

Darin Tsui, Aryan Musharaf, Justin S. Kang, Yigit E. Erginbas, and Amirali Aghazadeh. SHAP zero explains biological sequence models with near-zero marginal cost for future queries. In *Conference on Neural Information Processing Systems (NeurIPS)*, 2025.

Thomas A. Walton, **Darin Tsui**, Aryan Musharaf, and Amirali Aghazadeh. SpecMER: Fast protein generation with K-mer guided speculative decoding. In *NeurIPS (Spotlight)*, 2025.

Honors & Awards

- Steve W. Chaddick Fellowship**, Georgia Tech 2025
- Fellowship awarded for outstanding contributions in research.
- NSF Graduate Research Fellowship** 2024 – 2027
- Fellowship recognizing potential for significant research contributions (top 14% of applicants).
- Teaching Assistant's Choice Award (Mentor)**, UC San Diego 2024
- Award recognizing the top-performing capstone project team out of 100 teams. Submissions were evaluated on technical depth, innovation, and team dynamic.
- Course Enhancements & Improvement (CREATION) Award**, Georgia Tech 2023
- Award received for developing the course ECE 8803—*Generative and Geometric Deep Learning*.
- Graduate Student Conference Scholarship Award**, Conference on Information Storage and Processing Systems (ISPS) 2023
- Award received for outstanding paper submission and oral presentation.
- President's Fellowship**, Georgia Tech 2023
- Fellowship awarded to top 10% of Ph.D. applicants based on their research and scholarship.
- Anushka Michailova Memorial Bioengineering Award**, UC San Diego 2023
- Award received for best capstone project out of 100 teams. Submissions were evaluated on technical depth, innovation, and research dissemination.

Research and Work Experience

- Generate:Biomedicines**, Machine Learning Intern – Somerville, MA Jun 2026 – Aug 2026 (Exp)
- Advisors: Axel Levy and Max Baranov.
 - Research in protein structure and cryo-EM structure determination.
- AI ML and Information Research Group**, Georgia Tech – Atlanta, GA Jun 2023 – Present
- Advisor: Amirali Aghazadeh.
 - Leveraged *mechanistic interpretability* frameworks, such as cross-layer transcoders and sparse autoencoders, for

circuit discovery, protein design, and extracting biological mechanisms from protein language models.

- Extracted higher-order interactions in models 1000-fold quicker than state-of-the-art methods by developing algorithms at the intersection of *signal processing*, *coding theory*, and *combinatorics*.
- Developed principled *generative models* for high-throughput cryo-electron microscopy (cryo-EM), autoregressive protein generation, and variant effect prediction.

Surgalign, Data Engineering Intern – San Diego, CA

Jan 2023 – Aug 2023

- Manager: Weidong Luo.
- Interned at Surgalign, a medical device company focused on developing AI solutions in spinal surgery (now acquired by Xtant Medical and Augmetics).
- Automated MRI preprocessing pipelines and developed ground-truth spinal datasets for spinal surgery.

Integrated Systems Neuroengineering Lab, UC San Diego – San Diego, CA

Jun 2022 – Jun 2023

- Advisor: Gert Cauwenberghs. Mentored by Ph.D. candidates Akshay Paul, Tyler Bodily, and Min Lee.
- Developed a GFET-based COVID-19 diagnostic test using an ML pipeline for signal classification, achieving 98.5% accuracy in protein detection.

Talke Biomedical Device Lab, UC San Diego – San Diego, CA

Dec 2021 – Aug 2023

- Advisor: Frank E. Talke.
- Designed low-cost, sub-millimeter surgical vision systems with OpenCV and Kalman filtering.

Swartz Center for Computational Neuroscience, UC San Diego – San Diego, CA

Mar 2021 – Jun 2023

- Advisor: Tzzy-Ping Jung. Mentored by Ph.D. candidate Chiyuan Chang.
- Conducted ML analysis of EEG data in Python/MATLAB, improving stress-level classification by 42.1% in correlation with physiological features.

Paesani Research Group, UC San Diego – San Diego, CA

Jan 2020 – Sep 2021

- Advisor: Francesco Paesani. Mentored by postdoctoral scholar Vinícius Cruzeiro.
- Designed AMBER 20 molecular dynamics simulations on supercomputing clusters to model amino acid interactions via Python and Bash.

Publications

* Denotes equal contribution.

Darin Tsui, Kunal Talreja, Daniel Saeedi, and Amirali Aghazadeh. Protein circuit tracing via cross-layer transcoders. In *International Conference on Machine Learning (ICML)*, 2026.

Justin S. Kang, **Darin Tsui**, Yigit E. Erginbas, Landon Butler, Amirali Aghazadeh, and Kannan Ramchandran. Spectral sparsity: A unifying framework for scalable model interpretability using codes. *IEEE BITS the Information Theory Magazine (Accepted)*, 2026.

Zain Shabeeb*, Daniel Saeedi*, **Darin Tsui***, Vida Jamali, and Amirali Aghazadeh. cryoSENSE: Compressive sensing enables high-throughput microscopy with sparse and generative priors on the protein cryo-EM image manifold. In *Conference on Computer Vision and Pattern Recognition (CVPR)*, 2026.

Darin Tsui, Aryan Musharaf, Justin S. Kang, Yigit E. Erginbas, and Amirali Aghazadeh. SHAP zero explains biological sequence models with near-zero marginal cost for future queries. In *Conference on Neural Information Processing Systems (NeurIPS)*, 2025.

Thomas A. Walton, **Darin Tsui**, Aryan Musharaf, and Amirali Aghazadeh. SpecMER: Fast protein generation with K-mer guided speculative decoding. In *NeurIPS (Spotlight)*, 2025.

Darin Tsui, Kunal Talreja, and Amirali Aghazadeh. Sparse autoencoders for low- N protein function prediction and design. In *NeurIPS AI4Science Workshop*, 2025.

Thomas A. Walton, **Darin Tsui**, Lauren Fogel, Dustin J. E. Huard, Rafael S. Chagas, Raquel L. Lieberman, and Amirali Aghazadeh. GOLF: A generative AI framework for pathogenicity prediction of myocilin OLF variants. In *Machine Learning in Computational Biology*, 2025.

Darin Tsui^{*}, Kunal Talreja^{*}, and Amirali Aghazadeh. Efficient algorithm for sparse Fourier transform of generalized q -ary functions. In *IEEE Information Theory Workshop (ITW)*, 2025.

Darin Tsui, Kirsten Ramos, Capalina Melentyev, Ananya Rajan, Matthew Tam, Mitsuhiro Jo, Farshad Ahadian, and Frank E. Talke. A low-cost, open-source-based optical surgical navigation system using stereoscopic vision. *Microsystem Technologies*, 2025.

Darin Tsui and Amirali Aghazadeh. On recovering higher-order interactions from protein language models. In *International Conference on Learning Representations (ICLR) Generative and Experimental Perspectives for Biomolecular Design (GEM) Workshop*, 2024.

Chi-Yuan Chang, Chieh Hsu, Ying Choon Wu, Siwen Wang, **Darin Tsui** and Tzyy-Ping Jung. Online mental stress detection using frontal-channel EEG recordings in a classroom scenario. *arXiv preprint arXiv:2405.11394*, 2024.

Darin Tsui, Capalina Melentyev, Ananya Rajan, Rohan Kumar, and Frank E. Talke. An optical tracking approach to computer-assisted surgical navigation via stereoscopic vision. In *ISPS*, 2023.

Darin Tsui, Francisco Downey, Shreenithi Navaneethan, Akshay Paul, Tyler Bodily, Min Lee, Yuchen Xu, Ratnesh Lal, and Gert Cauwenberghs. A machine learning approach to COVID-19 detection via graphene field-effect-transistor (GFET). In *IEEE Engineering in Medicine and Biology Conference (EMBC)*, 2023.

Darin Tsui, Mitsuhiro Jo, Bryan Nguyen, Farshad Ahadian, and Frank E. Talke. Optical surgical navigation: a promising low-cost alternative. In *IEEE EMBC*, 2023.

Teaching Experience

Guest Lecturer, Georgia Tech – Atlanta, GA

Nov 2023 – Nov 2025

- Delivered undergraduate and graduate-level lectures for *Generative and Geometric Deep Learning* (ECE 8803) and *Intro to Signal Processing* (ECE 2026).
- **Topics:** Explainability and mechanistic interpretability in AI; Generative and geometric deep learning in computational biology; IIR filters and feedback.

Teaching Assistant, Georgia Tech – Atlanta, GA

Aug 2023 – Dec 2023

- Supported instruction for 300+ undergraduate and graduate students in *Advanced Programming Techniques* (ECE 4122/6122), focusing on C++ and parallel computing.
- Taught C++ development for lab assignments and mentored students through the completion of their final course projects. Held office hours for 10 hours a week.

Instructional Assistant, UC San Diego – San Diego, CA

Dec 2020 – Mar 2021

- Led two lab sections of 30 students each in *Introduction to Bioengineering* (BENG 1), providing guidance on lab procedures and techniques.
- Taught and facilitated hands-on experiments across various bioengineering domains, including noninvasive cardiovascular sensing, medical image spine segmentation, and biomechanical analysis. Held office hours and lab sections for 10 hours a week.

Presentations

Mechanistic Interpretation of AI-designed Proteins via Cross-layer Circuit Tracing, presented at the *Suddath Symposium*, Atlanta, GA, 2026.

SHAP zero explains biological sequence models with near-zero marginal cost for future queries, presented at the *ML Student Seminar*, Atlanta, GA, 2025.

Surgical site localization with non-invasive skin markers for pain management, *presented at the Center for Memory and Recording Research (CMRR) Research Review*, San Diego, CA, 2023.

Bioelectronic COVID-19 detection via graphene-field-effect-transistor (GFET), *presented at Bioengineering Day at UC San Diego*, San Diego, CA, 2023.

Design of a surgical navigation system via positional tracking of fiducial markers, *presented at the Conference on Micromechatronics for Information and Precision Equipment*, San Diego, CA, 2022.

Service

Reviewer: 2026 ICML, NeurIPS, CVPR, ECCV, ICLR GEM; 2025 NeurIPS AI4Science; 2024 ICLR GEM.

Bioengineering Day Chair, Georgia Tech – Atlanta, GA Jan 2025 – Present

- Co-organized Bioengineering Day, a symposium highlighting interdisciplinary research with over 100 attendees.
- Coordinated logistics, speaker outreach, and scheduling for faculty and alumni talks, award presentations, and a rapid-fire thesis competition.

Capstone Project Advisor, UC San Diego – San Diego, CA Jul 2023 – Jun 2024

- Capstone project advisor for a bioengineering capstone project with Dr. Frank E. Talke.
- Mentored two undergraduates toward the design and development of a surgical navigation system with 3D tracking and augmented reality.
- Capstone project team won the *Teaching Assistant's Choice Award* at Bioengineering Day.

Founding Member, IEEE EMBS at UC San Diego – San Diego, CA Apr 2023 – Jul 2023

- Co-founded the IEEE Engineering in Medicine and Biology Society (EMBS) at UC San Diego with Dr. Gert Cauwenberghs and other Ph.D. students to increase awareness of bioengineering topics and research.
- Recruited 5 graduate students to mentor undergraduate students interested in getting involved in research.

President, IEEE at UC San Diego – San Diego, CA May 2022 – May 2023

- Oversaw operations for a 300+ student body. Partnered with the San Diego Supercomputing Center (SDSC) to co-found IEEE's Supercomputing Team.
- Hosted lab recruiting talks and technical seminars targeted towards first and second-years looking to get into research. Topics included research in artificial intelligence, robotics, and wearable sensors.
- Awarded the Outstanding IEEE Large Student Branch award for maintaining strong project activities and company relations during tenure.

Outreach Chair, IEEE at UC San Diego – San Diego, CA May 2021 – May 2022

- Taught 60 elementary and middle school students programming basics at STEM Fair.
- Hosted a robotics workshop in collaboration with Robolink, a San Diego robotics company, where we invited 50 high school students from low-income communities to work with Robolink representatives on coding and designing their own aerial drones.

Project Team Lead, BMES at UC San Diego – San Diego, CA Oct 2021 – Jun 2022

- Led team of 20 undergraduates in designing a telesurgical prosthetic hand at UC San Diego's Biomedical Engineering Society (BMES). Hand designs were formulated and constructed based on biomechanics principles.
- Held workshops in CAD, Arduino, and circuit design. Implemented robotic motion in Arduino and interfaced linear actuators.

Committee Member, BMES at UC San Diego – San Diego, CA Sep 2019 – Jun 2023

- Helped organize Bioengineering Day, a day-long event celebrating all facets of bioengineering research and development, and Lab Expo, a research symposium aiming to get students involved in research and academia.

Mentoring

William Deinzer, CS Undergraduate, Georgia Institute of Technology 2026
Research Intern at Intel.

Rishi Manimaran, CS BS/MS, Georgia Institute of Technology 2025 – 2026

Kunal Talreja, ECE Undergraduate, Georgia Institute of Technology 2024 – 2026
Research Intern at GTRI; President's Undergraduate Research Award.

Aryan Musharaf, CS BS/MS, Georgia Institute of Technology 2024 – 2025

Matthew Tam, Bioengineering Undergraduate, UC San Diego 2023 – 2024
Engineer at Briohealth Solutions.

Kirsten Ramos, Bioengineering Undergraduate, UC San Diego 2023 – 2024
MEng Student at CSU Long Beach; Teaching Assistant's Choice Award.

Eric Lee, Bioengineering Undergraduate, UC San Diego <i>MD Student at Loma Linda; Teaching Assistant's Choice Award.</i>	2023 – 2024
Capalina Melentyev, Bioengineering Undergraduate, UC San Diego <i>MS Student at Stanford.</i>	2022 – 2024
Rohan Kumar, Bioengineering Undergraduate, UC San Diego	2022 – 2023