ALEC XU

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RESEARCH INTERESTS

My current research focuses on leveraging low-dimensional structure in deep learning to advance their theoretical foundations. I'm also broadly interested in efficiency of large models via model compression, as well as interpretability of large models through their internal representations.

EDUCATION

University of Michigan, Ann Arbor
PhD Electrical and Computer Engineering   Expected August 2027
Concentration: Signal & Image Processing and Machine Learning
Advisor: Dr. Qing Qu
GPA: 4.00/4.00

MSE Electrical and Computer Engineering   Dec. 2022
Concentration: Signal & Image Processing and Machine Learning
Advisor: Dr. Jeffrey Fessler
GPA: 4.00/4.00

BSE Electrical Engineering, Summa Cum Laude   Dec. 2021
GPA: 3.97/4.00

SELECTED PUBLICATIONS

* Denotes equal contribution

[6] **A. S. Xu**, C. Yaras, M. Asato, Q. Qu, L. Balzano. "Emergent Low-Rank Training Dynamics in MLPs with Smooth Activations," under review at *International Conference on Machine Learning (**ICML**)*, 2026.

[5] S. Kwon*, **A. S. Xu***, C. Yaras, L. Balzano, Q. Qu. "Out-of-Distribution Generalization of In-Context Learning: A Low-Dimensional Subspace Perspective", in *Conference on Artificial Intelligence and Statistics (**AISTATS**)*, 2026.

[4] **A. S. Xu**, C. Yaras, P. Wang, Q. Qu. "Understanding How Nonlinear Layers Create Linearly Separable Features for Low-Dimensional Data," in *Conference on Artificial Intelligence and Statistics (**AISTATS**)*, 2026.

[3] C. Yaras, **A. S. Xu**, P. Abillima, C. Lee, L. Balzano. "MonarchAttention: Zero-Shot Conversion to Fast, Hardware-Aware Structured Attention," in *Conference on Neural Information Processing Systems (**NeurIPS**)*, 2025 (Spotlight).

[2] **A. S. Xu**, N. I. Shamsi, L. A. Gjesteby, L. J. Brattain. "Self-Supervised Edge Detection Reconstruction for Topology-Oriented 3D Axon Segmentation and Centerline Detection," in *IEEE/CVF Winter Conference on Applications of Computer Vision (**WACV**)*, 2024.

[1] **A. S. Xu**, L. Balzano, J. A. Fessler, "HeMPPCAT: Mixtures of Probabilistic Principal Component Analysers for Data with Heteroscedastic Noise," in *IEEE International Conference on Acoustics, Speech, and Signal Processing (**ICASSP**)*, 2023.

INDUSTRY EXPERIENCE

MIT Lincoln Laboratory, Lexington, MA
Co-Op Research Student, Human Health & Performance Systems   Jan. 2023 - July 2023
- Developed novel edge detection reconstruction self-supervised learning (SSL) task for 3D axon segmentation. Proposed task on U-Nets achieved up to 5% higher downstream segmentation metrics (Dice score) on mouse brain data than previous SSL tasks.

Summer Research Intern, Satellite Communications   May 2022 - Aug. 2022
- Developed and implemented novel two-stage deep learning pipeline for multi-channel signal detection and modulation recognition using YOLO object detector and DeepSig's ResNet convolutional network [PyTorch].

Summer Research Intern, Satellite Communications   May 2021 - Aug. 2021
- Investigated probabilistic programming approach to simulate LEO satellite terminal geolocation via Time and Frequency Difference of Arrival [MATLAB, Stan]. Results were included in study on alternative position, navigation, and timing methods with U.S. Navy.

JHU Applied Physics Laboratory, Laurel, MD
Summer Intern, Wireless Cyber Capabilities   May 2020 - Aug. 2020
- Implemented preamble detection, carrier synchronization, and QAM modulation algorithms using FFTW and Boost libraries [C++]. Implementations were integrated into transmitter and receiver to test Eridan MIRACLE software-defined radio (SDR) API.

H3D, Inc., Ann Arbor, MI
Summer Intern   May 2019 - Aug. 2019
- Implemented I2C and UART data transfer between TI MSP430 LaunchPad, CPU board, and sensor board [C, Energia]. Implementations were handed off to aid development of radiation detector systems.

TEACHING

Graduate Student Instructor | University of Michigan
ECE 559: Optimization Methods for Signal Processing and Machine Learning   2026
ECE 551: Matrix Methods for Signal Processing & Machine Learning   2022, 2024

Undergraduate Instructional Aide | University of Michigan
EECS 455: Wireless Communication Systems   2021
EECS 398 / 498: Software Defined Radio   2021

AWARDS

ECE Department Fellowship | University of Michigan

EECS Scholar | University of Michigan

James B. Angell Scholar | University of Michigan

William J. Branstrom Freshman Prize | University of Michigan

Dean's List/University Honors | University of Michigan