Jiawei Sun

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Education

Northwestern Polytechnical University, Xi'an, China
B.Eng. in Information Engineering

University of Michigan, Ann Arbor, MI
M.S. in Electrical and Computer Engineering

Rensselaer Polytechnic Institute, Troy, NY
Ph.D. in Electrical, Computer, and Systems Engineering (in progress)

Publications

Sep 2025 **Contrastive Learning with Data Misalignment: Feature Purity, Training Dynamics and Theoretical Generalization Guarantees**

Neural Information Processing Systems, 2025

Jiawei Sun, Shuai Zhang, Hongkang Li, Meng Wang

June 2025 **Theoretical Learning Performance of Graph Networks: the Impact of Jumping Connections and Layer-wise Sparsification**

Transactions on Machine Learning Research, 2025

Jiawei Sun, Hongkang Li, Meng Wang

April 2022 **Modelling learning in C. elegans chemosensory and locomotive circuitry for T-maze navigation**

European Journal of Neuroscience, 2022

Bennet G. Sakelaris, Zongyu Li, Jiawei Sun, Shurjo Banerjee, Victoria Booth, Eleni Gourgou

Research Experiences

January 2025 –now **Theoretical Analysis of Diffusion Model with Curriculum Learning**,
Advisor: Professor Meng Wang

Theoretical analysis of feature learning dynamics in diffusion models with ReLU activation

- Characterized a distinct two-stage curriculum learning phenomenon where the model prioritizes learning major features before aligning with minor features
- Analyzed the training dynamics of neural networks under the diffusion objective, providing rigorous convergence guarantees
- Established the theoretical connection between the learned denoiser and the optimal score function, validating the model's capability to recover sparse data structures

January 2024 –January 2025 **Contrastive Learning with Data Misalignment in VLMs**,
Advisor: Professor Meng Wang

Theoretical analysis of VLM training with nonlinear activations

- Provided the first theoretical training dynamics and generalization analysis for nonlinear VLMs, capturing the joint learning behavior of dual encoders with ReLU activations
- Characterized the impact of misaligned image-text pairs, proving that spurious or missing features cause feature entanglement and degrade generalization performance
- Theoretically justified the efficacy of text recaptioning, demonstrating that reducing spurious correlations improves feature purity and enhances out-of-domain zero-shot classification

Sep 2021 – Sep 2023 **Theoretical Analysis of GCNs with Skip-connections and Sparsification**,
Advisor: Professor Meng Wang

Theoretical analysis on two-hidden-layer GCNs with skip-connections

- Provided the first learning dynamics and generalization analysis for two-hidden-layer GCNs combining jumping connections with graph sparsification
- Revealed that skip-connections enable deeper layers to tolerate more aggressive graph Sparsification than shallow layers
- Validated the theoretical findings through extensive experiments on deep GCNs across standard benchmark datasets

Sep 2019 – April 2020 **Image Processing to decipher C. elegans locomotion in mazes**,
Advisor: Research Scientist Eleni Gourgou

Working on finding the motion trails of the elegans

- Use the chan-vese active contour method and SVD to extract contours of the maze
- By the Procrustes Transformation method, a T-shape polygon is rotated and shifted to have maximal overlap with the extracted contour
- Apply the Frame Difference method to find motion trails of the elegans
- Use the the K-Nearest Neighbor (KNN) algorithm to smooth the motion trails

Jan 2020 – April 2020 **Deep Neural Network for Spectrum Unfolding**,
Advisor: Professor Alfred Hero

Working on Recurrent Neural Network (RNN) algorithm

- Propose the RNN architecture that mimics project gradient descent method from optimization theory
- Complete the Recurrent Neural Network code by Pytorch

March 2018 – June 2018 **Differential Microphones Arrays based on Differential Equation**,
Advisor: Professor Jie Chen and Professor Lijun Zhang

Worked on Differential Microphones Arrays based on Differential Equation

- Proved that the polynomial of sinusoidal function is the solution of a differential equation and the differential equation corresponding to LDMA and CDMA are same

May 2017 – October 2017 **Distributed PCA by the Primal-Dual Method of Multipliers (PDMM)**,
Advisor: Professor Jie Chen

Worked on Distributed Optimization Algorithm

- Distributed PCA method can be obtained by simply approximating the global correlation matrix via the Average Consensus Algorithm subroutine, so matrices are divided in columns
- Eigenvalue decomposition of the correlation matrix and reduced its dimension to p-dim by PDMM algorithm
- Programmed in Matlab to accomplish Distributed PCA

Selected Awards and Honors

November 2018 **Honorable Mention of the International Mathematical Contest in Modeling**

November 2017 **First Prize Scholarship**, Northwestern Polytechnical University
Top 15% in 200 students

November 2016 **National Scholarship**, Northwestern Polytechnical University
0.2% national wide)

Selected Course Projects

March 2018 **Communication System Design**
Achieved communication between two computers. Achieved source coding by ASIC code and adopted 2FSK modulation based on MATLAB

January 2018 **Development of Microphone Orientation System**
Accomplished acoustic localization by Conventional Beamforming method and Direction of Arrival (DOA) location method

Skills

Programming Languages: Matlab, Julia, Python, LaTeX, PyTorch