Weihan Li

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Education

Georgia Institute of Technology, PhD in Machine Learning — Sept 2023 – now

- **Ph.D. Advisor**: Prof. Anqi Wu

Zhejiang University, Master in Computer Science and Technology — Sept 2020 – May 2023

- **Advisor**: Prof. Gang Pan

Zhejiang University, Bachelor in Computer Science and Technology — Sept 2016 – June 2020

Research Summary

My research centers on developing advanced methodologies for modeling large-scale neural and behavioral data to address core questions in neuroscience.

Methodologies: State-space models, Multimodal Large Language Models, Reinforcement Learning, Diffusion Models, Probabilistic Generative Modeling, Probabilistic Inference

Applications: Neuroscience, Human or animal behaviors modeling.

Selected Research Projects

Foundation Models for Animal Behavior — July 2025 – Present

- Developing a multimodal foundation model that generates language descriptions of animal behavior, intent, and goals from video and optional text input.
- Leveraging self-supervised pretraining to utilize large-scale unlabeled behavioral data efficiently.
- Working toward evaluation benchmarks for the quality and consistency of output text descriptions.

Modeling Time-Varying Brain Communication Across Regions — Aug 2024 – May 2025

- Proposed a state-space formulation of Markovian Gaussian Processes to model dynamic brain interactions with time-varying structure and directionality.
- Discovered a general mapping between arbitrary Gaussian Process and equivalent state-space models, improving flexibility and biological interpretability.
- Applied parallel-scan–based inference, reducing complexity from $O(T^3)$ to $O(\log T)$, enabling scalable learning on long multi-region neural recordings.

Discovering Frequency-Specific Brain Communication Pathways — Sep 2023 – Jan 2024

- Developed a novel approximation of multi-output Gaussian Processes via state-space models to uncover latent neural interactions across brain regions.
- Introduced a theoretical bridge converting complex-valued spectral kernels into interpretable state-space dynamics, explicitly modeling phase delays and oscillatory coupling.
- Enabled linear-time inference while preserving frequency resolution, combining the strengths of structured GP priors with scalable temporal modeling.

Publications

A Revisit of Total Correlation in Disentangled Variational Auto-Encoder with Partial Disentanglement — Preprint [link]

Chengrui Li, Yunmiao Wang, Yule Wang, ***Weihan Li***, Dieter Jaeger, Anqi Wu

Learning Time-Varying Multi-Region Brain Communications via Scalable Markovian Gaussian Processes — **ICML 2025 Oral** [link]

Weihan Li, Yule Wang, Chengrui Li, Anqi Wu

Exploring Behavior-Relevant and Disentangled Neural Dynamics with Generative Diffusion Models **NeurIPS 2024** [link]
Yule Wang, Chengrui Li, ***Weihan Li***, Anqi Wu

Multi-Region Markovian Gaussian Process: An Efficient Method to Discover Directional Communications Across Multiple Brain Regions **ICML 2024** [link]
Weihan Li, Chengrui Li, Yule Wang, Anqi Wu

A Differentiable Partially Observable Generalized Linear Model with Forward-Backward Message Passing **ICML 2024** [link]
Chengrui Li, ***Weihan Li***, Yule Wang, Anqi Wu

Forward χ^2 Divergence Based Variational Importance Sampling **ICLR 2023 Spotlight** [link]
Chengrui Li, Yule Wang, ***Weihan Li***, Anqi Wu

Online Neural Sequence Detection with Hierarchical Dirichlet Point Process **NeurIPS 2022** [link]
Weihan Li, Yu Qi, Gang Pan

Efficient Point-Process Modeling of Spiking Neurons for Neuroprosthesis **EMBC 2021** [link]
Weihan Li, Cunle Qian, Yu Qi, Yiwen Wang, Yueming Wang, Gang Pan

Technical Skills

Languages: C++, Python

Technologies: PyTorch, JAX, Matlab, Latex

Teaching and Academic Services

Teaching Experience: TA for Gatech CSE-8803 Statistical machine learning models for neural and behavioral data analysis.

Conference Reviewer: NeurIPS 2023/2024/2025, ICML 2024/2025, ICLR 2024/2025.