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 develops advanced machine learning methods for modeling large-scale multimodal data, with applications in neuroscience and animal behavior understanding. I focus on state-space modeling, multimodal large language/vision models, and generative modeling (diffusion, probabilistic inference).

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

Applications: Neuroscience, Multimodal video understanding, Human and animal behavior modeling.

Selected Research Projects

Multimodal Foundation Models for Animal Behavior Understanding　　　　　July 2025 – Present
- Designing a large-scale multimodal foundation model that transforms videos of animal behavior, together with optional text input, into natural language descriptions of actions, intents, and goals.
- Leveraging LLM-driven agent workflows to efficiently annotate large-scale unlabeled video data.
- Developing benchmarks for animal behavior video datasets and establishing evaluation metrics based on downstream tasks such as pose estimation and behavior segmentation.

Modeling Time-Varying Brain Communication Across Regions　　　　　Aug 2024 – May 2025
- Proposed a State-space model to capture dynamic interactions across brain regions with time-varying structure and directionality.
- Established a general mapping between arbitrary Gaussian Process and equivalent state-space models, improving flexibility and biological interpretability.
- Developed parallel-scan–based inference reducing complexity from $O(T^3)$ to $O(\log T)$, supporting scalable training 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 Gaussian Process 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: Python, C++

Technologies: PyTorch, HuggingFace Transformers, multimodal LLM toolkits, 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.