KAI CHEN

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EDUCATION

SHANGHAI JIAO TONG UNIVERSITY *Ph.D of Applied Mathematics* 09/2020-Present

- **Relevant Courses**: *Scientific Computing, High performance Computing in ODEs and PDEs, Inverse Problems;*

SHANGHAI JIAO TONG UNIVERSITY *Master of Science of Physics* 09/2018-06/2020

- **GPA**: 3.57/4.0;
- **Relevant Courses**: *Advanced Statistical Physics, Biological Physics, Advanced Electrodynamics and Analytical Mechanics;*

SHANGHAI JIAO TONG UNIVERSITY *Bachelor of Science of Physics* 09/2013-06/2017

- **Rank**: 4/71; **GPA**: 3.78/4.0;
- **Scholarships**: National Scholarship; *Liuyuan* Scholarship of Shanghai Jiao Tong University;
- **Relevant Courses**: *Statistical Physics, Computational Physics, Biological Physics, Electrodynamics, Calculus, Linear Algebra, Partial Differential Equation, Complex Variables;*
- **Awards**: Champion in *Shanghai Undergraduate Physicists' Tournament*; Champion in *Shanghai Mathematical Contest in Modeling*; Second Prize in *National Mathematical Contest in Modeling*; Successful Participant in *COMAP's Mathematical Contest in Modeling*; Outstanding Graduates of Shanghai Jiao Tong University;

RESEARCH EXPERIENCE

Project: Effective Inference of Functional Connectivity from ECoG Data Using TDMI **SHANGHAI**

Shanghai Jiao Tong University *Supervisor: Prof. Li, Songting; Zhou, Douglas* 01/2021-Present

- Developed time-delayed mutual information(TDMI) analysis framework for analyzing neurophysiological data(ECoG).
- Showed that strong TDMI inferred signal highly consistent with anatomical connectivity(structure connectivity) with high positive prediction correct rate(PPV) for ECoG data.
- Demonstrated the merit of our TDMI inference framework by compared our inference performance based on conventional Granger causality(GC) and conditional GC.
- Developed banded inference framework for ECoG data.

Project: Modeling Attentional Modulated Spike Count Correlation(R_{sc}) in Macaque V1 **SHANGHAI**

Shanghai Jiao Tong University *Supervisor: Prof. Li Songting; Zhou, Douglas* 12/2019-Present

- Built neural rate model to simulate the effective dynamics in the delayed-color-change-detection experiments for macaque.
- Fitted the non-monotonic modulation for $\boldsymbol{R_{sc}}$ w.r.t. task difficulty in our model with electrophysiology data.
- Obtained a set of optimized parameter for the structure of model system with the help of *mean field theory* analysis.
- Revealed the role of inhibitory neurons in the attentional modulation.
- Built *spiking neuronal network*(SNN) model to verify prediction got from neural rate model.

Project: Causal Inference of Neuronal Data Based on Time-delayed Mutual Information **SHANGHAI**

Shanghai Jiao Tong University *Supervisor: Prof. Zhou, Douglas* 07/2017-12/2018

- Developed time-delayed mutual information (TDMI) analysis between spike trains and local field potentials (LFPs).
- Determined the relation between interacting strength and the value of mutual information for weakly interacted neurons.
- Reveal the difference between excitatory and inhibitory neurons by investigating TDMI between spike trains and LFP series.
- Measured the network dynamical regime in which TDMI analysis is applicable.

Project: Study of Network Dynamics Based on Integrate-and-Fire Neuron Model **SHANGHAI**

Shanghai Jiao Tong University *Supervisor: Prof. Zhou, Douglas; Cai, David* 02/2016-06/2017

- Built point neuronal network simulation program, with the implementation of conductance-based integrated-and-fire neuron model with 4th order global convergence (based on *Runge-Kutta* algorithm). Verified its numerical convergence.
- Simulated dynamics of 'small-world' networks with a few hundred neurons. Investigated their synchronizing and oscillating behaviors by using raster-plot and power spectrums as functions of initial Poisson inputs.
- Developed discussions of time-delayed mutual information (TDMI) analysis between Gaussian random variables.
- Measured the TDMI between spike train and local field potentials (LFPs) and confirmed its feasibility on causal inference between two types of neuronal signals.
- Optimized parameters in the calculation mutual information to achieve a better performance of TDMI.

Project: Coherent Diffraction Imaging (CDI) of Micro-Scale Samples **SHANGHAI**

Shanghai Jiao Tong University *Supervisor: Prof. Xiang, Dao* 09/2014 - 06/2015

CDI technique operates as a mode in ultra-high spatiotemporal resolution four-dimensional detection project. This project aimed to understand its algorithm and test it with specific samples.

- Developed *CDI* retrieval algorithm, and tested it with numerical samples;
- Designed and Constructed optical layout of 532nm laser-based CDI. Designed samples and recorded diffraction patterns.
- Optimized the performance of the system, and retrieved the structure of samples with ~2um spatial resolution;

Project: Femtosecond Pump-probe Spectroscopy (FPPS) of Protein Photosynthesis **DAVIS, CA, US**

University of California, Davis *Supervisor: Dr. Cramer, Stephen* 08/2016 - 09/2016

This project aims to study proteins with iron-sulfur clusters, such as nitrogenase and hydrogenase, with FPPS method.

- Adjusted optical layout of non-colinear optical parametric amplifiers (NOPAs). Generated laser pulses with central frequency ranging over visible spectrum from 800nm femtosecond seed laser.
- Built optical systems of FPPS. Ran FPPS study on putidaredoxin, a two iron-two sulfur protein that is involved in the electron transfer process of the P450cam system. Modified FPPS system by adapting lock-in amplifier.
- Reconstructed reaction modes based on global analysis simulations with sequential photosynthesis models.

PRESENTATIONS

Posters: *Modeling Attentional Modulated Spike Count Correlation in Macaque V1*, CCCN2021, online, Jun. 2021.

Conference Talks: *Modeling Attentional Modulated Spike Count Correlation in Macaque V1*, CCCN2021, online, Jun. 2021.

SKILLS AND SPECIALISTS

Programming: Python, C/C++, LaTeX, Shell, MATLAB/Octave

Hobbies: Chinese Calligraphy; Chinese Flute; Powerlifting;