Ruiqi Chen

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EDUCATION

B.S., School of Electronic Engineering and Computer Science, Peking University 2017.9 – 2021.7

- **Major:** Intelligence Science and Technology (Overall GPA: 3.59/4.0)
- **Minor:** Psychology (Minor GPA: 3.79/4.0)
- **Selected Coursework:** Abnormal Psychology (ongoing), Neuropsychology, Physiological Psychology, Experimental Psychology, Computational Neuroscience, Probability Theory and Statistics, Set Theory and Graph Theory, Signals and Systems, Introduction to Stochastic Processes, Introduction to Pattern Recognition, Machine Learning

Summer Program for Neural and Cognitive Science, Tsinghua University 2019.8

- Learnt about the principles, methodology and frontiers of neuroscience (Link)

RESEARCH EXPERIENCE

IDG/McGovern Institute for Brain Research, Peking University 2019.3 – 2020.10

Undergraduate Research Assistant
Advisor: Prof. Huan Luo
Funding: Peking University Undergraduate Research Grant (4000 RMB)

Project (Independent): Sequential Working Memory (Link)

- Simulated an auditory working memory cueing task with a Recurrent Neural Network (RNN)
  - Computed the tuning curves and representational similarity matrices for frequency and sequential position
  - Discovered that frequency and position were encoded jointly in network activity, but the dominance of frequency encoding increased as task difficulty increased
  - Proved that the representation of frequency, but not position, was preserved after an auditory perturbation
  - Both results being consistent with the lab's previous findings in human experiments
- Designed an EEG experiment to explore the neural mechanism underlying the manipulation of contents in auditory working memory and collected data from 16 subjects (Codes)
  - Performed ERP & time-frequency analysis; results being consistent with (Albouy et al., 2017)
  - Decoded the memory content with an LSTM network and conducted temporal generalization analysis
- Implemented an Inverted Encoding Model (IEM) based on an EEG visual working memory experiment (Codes)
  - Reconstructed the tuning curve for the orientation of two Gabor stimuli

Institute of Neurology, University College London 2020.7 – 2020.9

Summer Research Assistant (Remote)
Advisor: Prof. Sven Bestmann

Project (Independent): Simulation & Detection of Cortical Traveling Waves (Link)

- Simulated stable mesoscopic cortical traveling waves of different speeds, in different frequency bands under different levels of Signal-to-Noise-Ratio (SNR), with more than 300,000 trials in total
  - Quantified the precision of linear-regression-based estimation of wave orientation and speed
  - Illustrated that the estimation of orientation improved as SNR and spatial frequency increased, but there might be an optimal spatial frequency interval for the estimation of speed

  - Found that performing a single regression at each time point would be generally better than over the whole trial, and estimating by the median of speed distribution would be more accurate than the mean

- Simulated dynamic macroscopic spherical traveling wave with rapidly changing sources, and evaluated the performance of different traveling wave detection algorithms on the dataset (Link)
  - Revealed that neither the clustering method in (Alexander et. al., 2016) nor the PCA method in (Alexander et. al., 2019) could reliably classify the spatial structure of the traveling wave
  - Demonstrated that directly clustering the data samples at each time point provided satisfactory results and common phase offset removal might increase the sensitivity of the clustering algorithm

Department of Biomedical Engineering, Tsinghua University 2019.7 – 2020.2
Summer Research Assistant
Advisor: Prof. Bo Hong

Project (Leader): EEG Functional Connectivity Microstates (Link)

- Analyzed a large resting-state EEG dataset with functional connectivity microstates
  - Discovered the spatially hierarchical, temporally self-similar structure of functional connectivity microstates using different number of clusters and different sliding window length
  - Illustrated the consistency between functional-connectivity-based and voltage-distribution-based EEG microstates by their similarity in spatial topology and temporal dynamics
  - Examined the relationship between the proportion/stability/connectivity profile of a specific microstate and activity of the Default Mode Network (DMN) in different mental states
  - Explored the interaction between alpha oscillation and microstate dynamics
- Recorded EEG signals from subjects resting/listening to a story/listening to music, with eyes open or closed, and compared the microstate dynamics across different conditions (Link)
  - Analyzed the dynamics of voltage-based and connectivity-based microstates with dynamic Generalized Linear Model (GLM), Multidimensional Scaling (MDS), and unsupervised machine learning (Codes)

COURSE PROJECTS

Word Embedding Strategies & RNN Decoders for Sentiment Classification (Link) 2020.4

- Compared the performance of three word embedding strategies (Skip-gram, CBOW & Task-oriented) and three decoding networks (LSTM, GRU, simple RNN) on the IMDb dataset after controlling the number of parameters
- Found that LSTM generalized best while simple RNN was highly unstable; Task-oriented encoding is optimal

Visualization of NSFC Funding 2018 (Link) 2019.10

- Revealed the disparity in funding received among different academic institutions and regions in China vividly
- Acquired visualization skill to facilitate high-dimensional big data analysis

SKILLS

- **Programming**: *(Proficient)* MATLAB (EEGLAB, Fieldtrip, Psychtoolbox), Python (TensorFlow, OpenCV); *(Intermediate)* C/C++, HTML, CSS, JavaScript (d3.js), SVG; *(Basic)* R, SPSS
- **Signal Analysis**: EEG recording & preprocessing, ERP & time frequency analysis, MVPA, dynamic GLM, clustering & classification, decoding, connectivity, microstates, traveling wave
- **Modeling**: Bayesian modeling & MCMC, Inverted Encoding Model, Convolutional & Recurrent Neural Network
- **English:** GRE Verbal 168 (98%), Quantitative 170 (96%), Analytic Writing 4 (57%); TOEFL 112 (Speaking 23)