Ruiqi Chen

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EDUCATION

Division of Biology and Biomedical Sciences, Washington University in St. Louis 2021.8 - Present
- **Major:** Neurosciences PhD Program

B.S., School of Electronic Engineering and Computer Science, Peking University 2017.9 – 2021.7
- **Major:** Intelligence Science and Technology
- **Undergraduate Thesis:** *Spatiotemporal Information Processing with Reservoir Decision-making Networks*

RESEARCH EXPERIENCE

Institute of Neurology, University College London 2020.7 - Present
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
  - Discovered that performing a single regression at each time point would be generally better than over the whole trial, and estimation by the median of speed distribution would be more accurate than the mean
- Simulated dynamic macroscopic spherical traveling wave with rapidly changing sources (Link)
  - Generated signals with the power spectrum of real EEG data by iFFT, Hilbert Transform and phase perturbation
  - Revealed that the clustering method in (Alexander et. al., 2016) and PCA method in (Alexander et. al., 2019) could reliably classify the spatial structure of the traveling waves
  - 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 resting-state EEG dataset with functional connectivity microstates clustering and Markov Chain Process
  - Confirmed the within- and across-subject stability of functional connectivity microstate (FC state) topologies
  - Discovered the spatially hierarchical, temporally self-similar structure of FC states using different number of clusters and different sliding window length, extending current results on fMRI (Reinen et. al., 2018)
  - Figured out a specific FC state that may reflect the activity of the Default Mode Network (DMN) by the changes in its occurrence, duration, stability, and connectivity profile in different mental states

- Recorded EEG signals from subjects resting/listening to a story/listening to music, with eyes open or closed (Link)
  - Illustrated the consistency between functional-connectivity-based and traditional voltage-distribution-based EEG microstates by their similarity in spatial topology and temporal dynamics
  - Analyzed the microstate dynamics with statistical and machine learning methods (Codes)

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 sequential 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 jointly encoded in network activity, but the dominance of frequency representation increased as task difficulty increased, by comparison of the explained variance
  - Proved that the representation of frequency, but not position, was preserved after an auditory perturbation
  - Both results being consistent with the previous findings in human research with the same experiment paradigm
- Designed an auditory working memory EEG experiment with different kinds of mental manipulation during retention period 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

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)