KAIWEN SHENG

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EDUCATION

University College London   **London, UK**
MRes in Biosciences: Neuroscience (with Distinction, top 1)   Sept 2021 - Sept 2022
Peking University   **Beijing, CN**
BS in Computer Science (outstanding dissertation nomination, 27/360)   Sept 2016 - Jun 2020

AWARDS

Dean's List Nomination of University College London (top 5%)   Nov 2022

Best Overall Student Prize of University College London   Nov 2022

Outstanding Graduate of Peking University   Jul 2020

Robin Li Scholarship of Peking University   Sept 2019

Excellent Research of Peking University   Sept 2019

Ke Chuanglong Scholarship of Peking University   Sept 2018

Merited Student of Peking University   Sept 2018 & Sept 2017

May Fourth Scholarship of Peking University   Sept 2017

SELECTED RESEARCH PROJECTS

A theoretical framework to investigate the functional specificity of cortical neurons   **University College London**
Advised by Prof. Michael Häusser and Dr. Brendan Bicknell   Dec 2021 - Present
- Derived a general learning rule based on cable theory, Hodgkin-Huxley equations and synaptic kinetics with which detailed models of neurons, comprising 3D reconstructed morphologies and an array of active conductances, can be 'trained' to perform sophisticated computational tasks.
- Designed a battery of tasks with distinct processing requirements, including: nonlinear feature-binding computations, Boolean logic operations, and a regression task designed to test the limits of stimulus selectivity.
- Identified a diverse set of morphological and biophysical features to explain the computational performances of different neuron models.
- Constructed an efficient and flexible software package to support the training of neuronal models and analysis.

Inferring neural properties from neural data across scales   **Beijing Academy of Artificial Intelligence**
Advised by Prof. Kai Du (PKU) and Prof. Jun Ding (Stanford)   Jan 2020 - Present
- Proposed a general domain adaptive neural inference framework to infer biophysical properties and connectivity.
- Designed self-training and domain adaptation to avoid biased inference results caused by the out-of-distribution problem between synthetic data and experimental data.
- Accurately and efficiently inferred biophysical properties of 550 neurons across 14 brain regions of mice and those of the stomatogastric ganglion microcircuit of the *Cancer Borealis*.
- Achieved near-optimal accuracy in inferring monosynaptic connectivity of networks in the CA1 region of mice.

Geometric analysis of the influence of retina on cortical decision boundaries   **Peking University**
Advised by Dr. Kai Du   March 2022 - Present
- Approximated dynamics of retinal gap junction networks by a recurrent neural network based on derivations of conductance-based neuronal models.
- Drafted the manuscript and prepared the figures.

PUBLICATIONS

- **Sheng, K.**, Zhang, S., Beau, M., Qu, P., Yang, L., Liu, X., He, L., Ma, L., & Du, K. (2022). Domain Adaptive Neural Inference for Neurons, Microcircuits and Networks. *bioRxiv*.
- Yue, Y., Zhang, S., **Sheng, K.**, Zhang, S., Zhang, R., & Du, K. (2022). Retina Gap Junctions Support the Robust Perception by Warping Neural Representational Geometries along the Visual Hierarchy. (ready to submit to eLife)
- Shi, R., Wang, W., Li, Z., He, L., **Sheng, K.**, Ma, L., ... & Huang, T. (2022). U-RISC: an annotated ultra-high-resolution electron microscopy dataset challenging existing deep learning algorithms. *Frontiers in Computational Neuroscience*, *21*.

- Su, L.*, Wang, W.*, **Sheng, K.**, Liu, X., Du, K., Tian, Y., & Ma, L. (2022). Siamese Network-Based All-Purpose-Tracker, a Model-Free Deep Learning Tool for Animal Behavioral Tracking. *Frontiers in Behavioral Neuroscience, 48.* (* equally contributed)
- **Sheng, K.**, Qu, P., Yang, L., Liu, X., He, L., Ma, L., & Du, K. (2021). A General LSTM-based Deep Learning Method for Estimating Neuronal Models and Inferring Neural Circuitry. *bioRxiv.*
- Shi, R., Wang, W., Li, Z., He, L., **Sheng, K.**, Ma, L., ... & Huang, T. (2020). Human Perception-based Evaluation Criterion for Ultra-high Resolution Cell Membrane Segmentation. *arXiv preprint arXiv:2010.08209.*
- Zheng, S., Liang, Y., Wang, S., Chen, R., & **Sheng, K.**. (2020, March). FlexTensor: An Automatic Schedule Exploration and Optimization Framework for Tensor Computation on Heterogeneous System. In *Proceedings of the Twenty-Fifth International Conference on Architectural Support for Programming Languages and Operating Systems* (pp. 859-873).

POSTER PRESENTATIONS

- **Sheng, K.**, Bicknell, B.A., Häusser, M. Computational Specialization of Cortical Dendrites.
  Neuroscience 2022; Dec 2022; San Diego, United States.
- **Sheng, K.**, Bicknell, B.A., Häusser, M. Computational Specialization of Cortical Dendrites.
  UCL Neuroscience Symposium 2022; June 2022; London, United Kingdom.
- Bicknell, B.A., **Sheng, K.**, Häusser, M. Learning to Harness Dendritic Computations.
  Dendrites 2020: Dendritic anatomy, molecules and function; May 2022; Heraklion, Greece.
- **Sheng, K.**, Qu, P., Yang, L., Liu, X., He, L., Ma, L., & Du, K. A General LSTM-based Deep Learning Method for Estimating Neuronal Models and Inferring Neural Circuitry.
  Third Chinese Computational and Cognitive Neuroscience Conference; June 2021; Shenzhen, China.

WORKING EXPERIENCE

Research Assistant   **University College London**
Neural Computation Lab   Oct 2022 - Present
- Established a theoretical framework for investigating principles of single neuron computation.

Research Assistant   **International Brain Laboratory**
Neural Analysis Group   Oct 2022 - Present
- Facilitated the development of the electrophysiology atlas platform.

Leader of Application Research Team   **Beijing Academy of Artificial Intelligence**
Life Simulation Research Center   Jun 2021 - Sept 2021
- Organized research cooperation among researchers and interns.
- Scheduled and summarized weekly discussions on the progress of research projects of the group members.

Software Development Engineer   **Beijing Academy of Artificial Intelligence**
Life Simulation Research Center   Jun 2020 - Sept 2021
- Developed an automatic tool for parameter estimation and optimization for computational neural models.
- Published a preprint paper of the tool on bioRxiv.

TEACHING EXPERIENCE

Teaching Assistant   **Peking University**
Compiler Practice   Feb 2020 - Jun 2020
- Guided students to work through each stage of compiler design, including symbol table construction, type check, intermediate representation generation, register allocation.

Teaching Assistant   **Peking University**
Algorithm Design and Analysis Seminar   Feb 2019 - Jun 2019
- Reviewed and expanded lecture content based on *Introduction to Algorithms*.
- Designed exam papers and provided references on reinforcement learning.

ACADEMIC SERVICE

Reviewer of Bioscience Horizons   Nov 2021 - Present

LEADERSHIP EXPERIENCE

President and Captain   **Peking University**
Badminton Association and Team of Peking University   Sept 2019 - Jun 2020
- Organized badminton competitions at Peking University and scheduled friendly matches among colleges.
- Popularized badminton through social media at Peking University.

- Led weekly training and competitions.

SKILLS

Languages	Python, C/C++, MATLAB
Framework	NEURON, NEST, PyTorch