Zhuo-Cheng Xiao, Ph.D.

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Employment

2024/01 – **Assistant Professor in Mathematics and Neuroscience,**
Department of Mathematics & Department of Neuroscience,
NYU-ECNU Institute of Mathematical Sciences,
NYU-ECNU Institute of Brain and Cognitive Science,
New York University, Shanghai — Shanghai, China

2021 – 2023 **Courant Instructor/Assistant Professor,**

2020 – 2021 **Swartz Fellow,**
Courant Institute of Mathematical Sciences, New York University — New York, NY
Supervised by *Prof. Lai-Sang Young*.

Education

2016 – 2020 **Ph.D. in Applied Mathematics,** University of Arizona — Tucson, AZ
Co-Advised by *Prof. Kevin Lin* and *Prof. Jean-Marc Fellous*
Thesis - *Neuronal oscillations: In hippocampal functions and in simulations*

2012 – 2016 **Bachelor of Biological Sciences,**
Dual Degree of Mathematics, Peking University — Beijing, China
Advised by *Prof. Louis Tao*

Funding & Awards

Funding

2021 - 2024 **Courant Instructorship**, New York University.

2020-2021 **Swartz Fellowship**, Awarded by the Swartz Foundation.

Awards and Achievements

2020 **Travel Award**. SIAM Life Sciences.

2019 **Finalist of Michael Tabor's Graduate Scholarship**, University of Arizona.

Carter Award, University of Arizona.

2018-2019 **Don Wilson Travel Award**, University of Arizona.

2018 **Travel Award**, Computational Neuroscience Society.

2013-2016 **Undergraduate Research Honor Program**, Peking University.

2010 **Gold Medal (#5)**, Chinese Western Mathematical Olympiad.

Academic Services

Journal review:
eLife; Neural Computation; NPJ Schizophrenia; Science; PLoS One; Scientific Reports; Cognitive Neurodynamics.

Research Interests

I combine modern data-driven methods and conventional ideas of model reductions to understand how brain functions emerge from complex dynamics of neuronal populations. I am also interested in mathematical questions arising from simulations and analysis of spiking networks.

Specific Research Items

- Efficient computational models of the visual cortex.
- Model reductions for coherent, oscillatory cortical dynamics.
- Reliability of numerical simulations of spiking networks.

Publication List

Manuscripts

1. **Xiao**, **Z.-C.**, Lin, K. K., & Young, L.-S. (2024). Efficient models of cortical activity via local dynamic equilibria and coarse-grained interactions. *Under Review by Proceedings of the National Academy of Sciences*.
2. Zhang, R., Wang, Z., Wu, T., Cai, Y., Tao, L., **Xiao**, **Z.-C.**, & Li, Y. (2024). Learning spiking neuronal networks with artificial neural networks: Neural oscillations. *Journal of Mathematical Biology*, *88*(6), 65.
3. Dong, Y., Li, Y., Xiang, X., **Xiao**, **Z.-C.**, Hu, J., Li, Y., … Hu, H. (2023). Stress relief as a natural resilience mechanism against depression-like behaviors. *Neuron*, *111*(23), 3789–3801.
4. Wu, T., Cai, Y., Zhang, R., Wang, Z., Tao, L., & **Xiao**, **Z.-C.** (2023). Multi-band oscillations emerge from a simple spiking network. *Chaos: An Interdisciplinary Journal of Nonlinear Science*, *33*(4), 043121.
5. **Xiao**, **Z.-C.**, & Lin, K. K. (2022). Multilevel monte carlo for cortical circuit models. *Journal of Computational Neuroscience*, *50*(1), 9–15.
6. Cai, Y., Wu, T., Tao, L., & **Xiao**, **Z.-C.** (2021). Model reduction captures stochastic gamma oscillations on low-dimensional manifolds. *Frontiers in Computational Neuroscience*, 74.
7. **Xiao**, **Z.-C.**, Lin, K. K., & Young, L.-S. (2021). A data-informed mean-field approach to mapping of cortical parameter landscapes. *PLoS Computational Biology*, *17*(12), e1009718.
8. **Xiao**, **Z.-C.**, Lin, K., & Fellous, J.-M. (2020). Conjunctive reward–place coding properties of dorsal distal ca1 hippocampus cells. *Biological Cybernetics*, *114*(2), 285–301.
9. **Xiao**, **Z.-C.**, Wang, B., Sornborger, A. T., & Tao, L. (2018). Mutual information and information gating in synfire chains. *Entropy*, *20*(2), 102.
10. **Xiao**, **Z.-C.**, Zhang, J., Sornborger, A. T., & Tao, L. (2017). Cusps enable line attractors for neural computation. *Physical Review E*, *96*(5), 052308.
11. Wang, C., **Xiao**, **Z.-C.**, Wang, Z., Sornborger, A. T., & Tao, L. (2015). A fokker-planck approach to graded information propagation in pulse-gated feedforward neuronal networks. *arXiv preprint arXiv:1512.00520*.

Ongoing Work

1. Chang, J., Li, Z., Wang, Z., Tao, L., & **Xiao**, **Z.-C.** (2024). A markov framework relates spiking neural networks to ordinary differential equations with minimized information loss. In Preparation.
2. Wang, Z., Chang, J., Li, Z., Tao, L., & **Xiao**, **Z.-C.** (2024). A fast estimator of firing rates of spiking neural networks with synchrony. In Preparation.
3. Zou, T., & **Xiao**, **Z.-C.** (2024). Phase transition of local synchrony in spiking networks. In Preparation.

Supervision Experience

Graduate Students

Zhongyi Wang	2021-now	*PhD student in Mathematics, Courant Institute, NYU*
Jie Chang	2022-now	*PhD student in Life Sciences, PKU*
Zhuoran Li	2022-now	*PhD student in Life Sciences, PKU*

Undergraduate Students

Tim Zou	2023-now	*BS in Mathematics NYU 2025*

Alumni

Yuhang Cai	2020-2022	*MS in Statistics U Chicago 2021.* Yuhang is now a PhD student at University of California, Berkeley
Ruilin Zhang	2020-2022	*BS in Interdisciplinary Science PKU 2022.* Ruilin is now a PhD student at Peking University
Tianyi Wu	2020-2022	*BS in Mathematics PKU 2022.* Tianyi is now a PhD student at New York University
Athena Liu	2022	*BS in Mathematics NYU 2022.* Athena is now a PhD student at the University of Michigan
Emily Bunnapradist	2022	*BS in Mathematics, Stanford U 2023. Emily is now a Master's student at Stanford University*

Teaching

At New York University, Shanghai

2024 Spring — **Partial Differential Equations**,

At New York University

2023 Fall — **Theory of Probability**,
2023 Spring — **Ordinary Differential Equations**,
2022 Fall — **Theory of Probability**
2022 Spring — **Ordinary Differential Equations**
2021 Fall — **Discrete Mathematics**

At University of Arizona

2018 Fall – 2020 Spring — **Principles and Methods of Applied Mathematics**, as teaching assistant
2018 Summer — Leader of the review sessions for applied math PhD qualification exam.
2017 Fall – 2018 Fall — **Ordinary Differential Equations**, as teaching assistant
2016 Fall – 2017 Spring — **College Algebra**, as instructor.

Invited Talks

2024.05 — **Neuroscience Seminar Series**, New York University Shanghai *Shanghai, China*
Title: *Multiscale Cortical Modeling: Building Global Dynamics through Coarse-Grained Local Interactions*

2024.04 — **Seminar of Frontiers in Intelligence and Complex Systems**, Fudan University *Shanghai, China*
Title: *Relating Spiking Networks to Ordinary Differential Equations with Minimized Information Loss*

2024.03 — **Computational Neuroscience Seminar**, Shanghai Jiaotong University *Shanghai, China*
Title: *Efficient Cortical Models via Coarse-Grained Interactions and Local Response Functions*

2023.07 — **Society of Mathematical Biology**, Columbus, OH
Title: *Efficient Cortical Models via Coarse-Grained Interactions and Local Response Functions*

Invited Talks (continued)

2023.05 **SIAM Meeting in Dynamical Systems**, Portland, OR
Title: *Efficient Cortical Models via Coarse-Grained Interactions and Local Response Functions*

Mathematics in Imaging, Data and Optimization, Rensselaer Polytechnic Institute *virtual*
Title: *Modeling Neural Oscillations via Data-Driven Coarse-Graining Methods*

Computational Neuroscience Seminar, New York University New York, NY
Title: *Modeling Neural Oscillations via Data-Driven Coarse-Graining Methods*

2023.04 **Departmental Colloquial**, City University of Hong Kong *virtual*
Title: *Efficient Cortical Models via Coarse-Grained Interactions and Local Response Functions*

2023.03 **Mathematics Seminar**, New York University, Shanghai *virtual*
Title: *Efficient Cortical Models via Coarse-Grained Interactions and Local Response Functions*

2023.02 **Modeling and Simulation Group**, New York University New York, NY
Title: *Efficient Cortical Models via Coarse-Grained Interactions and Local Response Functions*

2022.10 **Mathematical Neuroscience Seminar**, University of Nottingham Nottingham, UK
Title: *Towards efficient cortical models retaining biological realism*

AMS Eastern Sectional Meeting Amherst, MA
Title: *A data-informed mean-field approach to mapping cortical landscapes*

2022.07 **SIAM Annual Meeting** Pittsburgh, PA
Title: *A data-informed mean-field approach to mapping cortical landscapes*

2021.06 **Society for Mathematical Biology** *virtual*
Title: *A data-informed mean-field approach to mapping cortical landscapes*

2021.04 **Modeling and Simulation Group**, New York University New York, NY
Title: *Model reduction of gamma oscillations*