

Yao Li

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Research Interests

Stochastic Dynamical Systems, Stochastic Processes, Stochastic differential equations
– Topics related to machine learning, mathematical physics, and neurosciences
Numerical Analysis and Scientific Computing

Employment

Associate Professor, Department of Mathematics and Statistics, 2021 – Present
Assistant Professor, Department of Mathematics and Statistics, University of Massachusetts Amherst, 2015 – 2021
Courant Instructor, Courant Institute of Mathematical Sciences, New York University, 2012 – 2015
Teaching Assistant, School of Mathematics, Georgia Institute of Technology, 2007–2012
Research Assistant, School of Mathematics, Georgia Institute of Technology, 2009 summer and 2012 summer

Academic Visiting

Research member, Mathematical Sciences Research Institute, 2015 fall
Research fellow, Institute for Computational and Experimental Research in Mathematics (ICERM), 2021 fall

Education

Ph.D in Mathematics, Georgia Institute of Technology, 2012
Advisor: **Yingfei Yi**
B.S. in Mathematics, Shanghai Jiao Tong University, China, 2007.

Grants

UMass Amherst HEG Faculty Research Grant, \$ 12,426, 2017-2018
UMass MSP Research Support Grant, \$ 1,000, 2017
Simons Collaboration Grant, \$ 42,000, 2018-2018 (terminated after having NSF grant)

NSF DMS-1813246, \$144,192, 2018-2021, PI

NSF DMS-1900397, \$23,600, 2019-2020, PI

NSF DMS-2108628, \$225,549, 2021-2024, PI

Publications and Preprints

1. A deep learning method for solving Fokker-Planck equations, (with Matthew Dobson and Jiayu Zhai) [Paper presentation], *MSML21: Mathematical and Scientific Machine Learning, Virtual Event, Aug 16-19, 2021* (arXiv: 2012.10696) [link](#)
2. Data-driven computation methods for quasi-stationary distribution and sensitivity analysis, (with Yaping Yuan), *Submitted*, (arXiv: 2103.01419) [link](#)
3. Unraveling the mechanisms of surround suppression in early visual processing, (with Lai-Sang Young), *PLoS Computational Biology* 17(4): e1008916, [link](#) ,
4. Stationary distributions of persistent ecological systems, (with Alexandru Hening), *Journal of Mathematical Biology* 82(64), 2021, [link](#)
5. Numerical computations of geometric ergodicity for stochastic dynamics, (with Shirou Wang), *Nonlinearity* 33(12), 6935, 2020, [link](#)
6. Using coupling methods to estimate sample quality for stochastic differential equations, (with Matthew Dobson and Jiayu Zhai), *SIAM/ASA J. Uncertainty Quantification*, 9(1), 135162, 2021, [link](#)
7. From deterministic dynamics to thermodynamic laws II: Fourier's law and mesoscopic limit equation, *submitted*, (arXiv: 1908.06219) [link](#)
8. Entropy, mutual information, and systematic measures of structured spiking neural networks, (with Wenjie Li) *Journal of Theoretical Biology*, 501(21), 110310, 2020 [link](#)
9. Stochastic stability of a cell cycle model with "silence period", (with Cesar Augusto Vargas Garcia and Abhyudai Singh) [Paper presentation], *2020 European Control Conference (ECC): 1820-1825* [link](#)
10. An efficient data-driven solver for Fokker-Planck equations: algorithm and analysis, (with Matthew Dobson and Jiayu Zhai), *submitted*, (arXiv: 1906.02600) [link](#)
11. Thermal conductivity and local thermodynamic equilibrium of stochastic energy exchange models, (with Wenbo Xie) *Journal of Statistical Mechanics: Theory and Experiment*, 043205, 2019 [link](#)
12. Stochastic neural field model: multiple firing events and correlations, (with Hui Xu) *Journal of Mathematical Biology*, 79, 11691204, 2019 [link](#)
13. A data-driven method for the steady state of randomly perturbed dynamics, *Communications on Mathematical Sciences*, 17(4), 1045-1059, 2019 [link](#)
14. From billiards to thermodynamic laws: stochastic energy exchange model, (with Lingchen Bu) *Chaos: An Interdisciplinary Journal of Nonlinear Science*, 28, 093105, 2018 [link](#)
15. How well do reduced models capture the dynamics in models of interacting neurons? (with Logan Chariker and Lai-Sang Young), *Journal of Mathematical Biology*, 78(1-2):83-115, 2019 [link](#)
16. On the polynomial convergence rate to nonequilibrium steady state, *The Annals of Applied Probability*, 28(6), 3765-3812, 2018 [link](#)

17. Numerical simulation of polynomial-speed convergence phenomenon (with Hui Xu), *Journal of Statistical Physics* 169(4), 697-729, 2017 [link](#)
18. Polynomial convergence to equilibrium for a system of interacting particles (with Lai-Sang Young), *The Annals of Applied Probability* 27(1), 65-90, 2017 [link](#)
19. Systematic measures of biological networks, part I: Invariant measures and entropy (with Yingfei Yi), *Communications on Pure and Applied Mathematics, Vol. LXIX, 1777-1811*, 2016 [link](#)
20. Systematic measures of biological networks, part II: Degeneracy, complexity and robustness. (with Yingfei Yi), *Communications on Pure and Applied Mathematics, Vol. LXIX, 19521983*, 2016 [link](#)
21. Local thermal equilibrium for certain stochastic models of heat transport (with Peter Nandori and Lai-Sang Young), *Journal of Statistical Physics* 163(1), 2016, 61-91 [link](#)
22. Convergence to global equilibrium for Fokker-Planck equations on a graph and talagrand-type inequalities (with Rui Che, Wen Huang and Prasad Tetali), *Journal of Differential Equations* 261, 2552-2583, 2016 [link](#)
23. A fast exact simulation algorithm for a class of Markov jump processes (with Lili Hu), *The Journal of Chemical Physics*, 143(18), 2015 [link](#)
24. On the stochastic modification of locally confined particle systems, *Chaos: An Interdisciplinary Journal of Nonlinear Science* 25, 073121, 2015 [link](#)
25. A limiting strategy for the back and forth error compensation and correction method for solving advection equations (with Lili Hu, Yingjie Liu), *Mathematics of Computation* 85, 2016, 1263 – 1280 [link](#)
26. Nonequilibrium steady states for a class of particle systems (with Lai-Sang Young), *Nonlinearity* 27(3), 607, 2014 [link](#)
27. Existence of nonequilibrium steady state for a simple model of heat conduction (with Lai-Sang Young), *Journal of Statistical Physics*, pp. 1170-1193, 2013 [link](#)
28. Quantification of degeneracy in biological systems for characterization of functional interactions between modules (with Gaurav Dwivedi, Wen Huang, Melissa L. Kemp and Yingfei Yi), *Journal of Theoretical Biology*, 302:2938, 2012 [link](#)
29. Fokker-Planck equation for a free energy functional or markov process on a graph (with Shui-Nee Chow, Wen Huang, Hao-min Zhou), *Archive for Rational Mechanics and Analysis, Volume 205*, pp. 969-1008, 2011 [link](#)
30. A free energy based mathematical study for molecular motors (with Shui-Nee Chow, Wen Huang, Hao-min Zhou), *Regular and Chaotic Dynamics, Volume 16, Issue 1-2*, pp. 117-127, 2011 [link](#)

Selected Presentations

2019 IMS-China International Conference on Probability and Statistics, July 7, 2019

The 6th International Conference on Random Dynamical Systems, Shanghai, China, July 1, 2019

PIMS-AMI Seminar, University of Alberta, Canada, August 24th, 2018

The International Congress of Mathematical Physics, Montreal, Canada, July 27th, 2018

Dynamical Systems seminar, University of Toronto, Canada, January 17th, 2018

PIMS Workshop on Nonlinear Stochastic Dynamics, University of Alberta, Canada, August 14th, 2017

Applied Math Seminar, University of Le Havre, France, June 22nd, 2017

2016 CMS Winter Meeting, December 4th, 2016

International Conference on Statistical Properties of Nonequilibrium Dynamical Systems, Shenzhen, China, August 1st, 2016

The 11th AIMS Conference on Dynamical Systems, Differential Equations and Applications, July 4th and 5th, 2016

Probability Seminar, Brown University, March 15, 2016

Interplay of Stochastic and Deterministic Dynamics in Networks, The Mathematical Biosciences Institute, February 23, 2016

SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, May 19th, 2015

The 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Madrid, Spain, Jul. 10th, 2014

111th Statistical Mechanics Conference, Rutgers University, May 13th, 2014

Dynamics Days, Georgia Tech, Jan. 5th, 2014

First International Conference on Dynamics of Differential Equations, Georgia Tech, Mar. 20, 2013

Workshop on Functional Inequalities and Discrete Spaces, Université Paris-Est Marne-la-Vallée, Jan. 14 2011

Supervisions

Mr. Caleb Meredith - Research Experiences for Undergraduates, *Deep Fokker-Planck solver*, Summer 2021

Ms. Zoe Duan - Research Experiences for Undergraduates, *Thermodynamics of billiards II*, Summer 2020

Ms. Yaping Yuan, current PhD student

Mr. Long Le - Research Experiences for Undergraduates, *Using artificial neural network to learn biological neuronal networks*, Summer 2019

Mr. Robin Armstrong - Research Experiences for Undergraduates, *Thermodynamics of billiards I*, Summer 2019

Dr. Jiayu Zhai, Visiting assistant professor (under joint supervision with Matthew Dobson)

Mr. Lingchen Bu, current PhD student.

Ms. Wenjie Li - Research Experiences for Undergraduates, *Information-theoretical measures of neural field models*, Summer 2018

Ms. Hui Xu - Honor Thesis, August 2017 to May 2018

Mr. Jimmy Hwang and Mr. Wenbo Xie - Research Experiences for Undergraduates, *Nonequilibrium steady state for an energy exchange model*, Summer 2017

Ms. Hui Xu and Mr. Jake Reiser - Research Experiences for Undergraduates, *The computation of speed of mixing for Markov jump processes*, Summer 2016

Ms. Huangyi Shi - Research Experiences for Undergraduates, *Finite time Monte Carlo method for invariant measures* May 2015 to October 2015

Mr. Haipeng Gao - Master's thesis: *A numerical investigation of some stochastic thermal conduction models*, Graduated in 2015

Mr. Ye Wang - Master's thesis: *A comparison of GARCH and stochastic volatility option pricing models*, Graduated in 2015

Teaching

2021 Spring: Mathematical Modeling, Stochastic Processes

2020 Spring: Stochastic Calculus

2019 Fall: Statistics I (two sections)

2019 Spring: Applied Mathematics and Mathematics Modeling,

2018 Fall: Ordinary Differential Equations (for graduates), Statistics I

2018 Spring: Intro to Scientific Computing, Statistics I

2017 Fall: Numerical Analysis I

2017 Spring: Probability Theory

2016 Fall: Ordinary Differential Equations

2016 Spring: Statistics I (two sections)

2015 Spring: Ordinary Differential Equations

2014 Fall: Analysis I

2014 Spring: Linear Algebra

2013 Fall: Calculus I

2013 Spring: Linear Algebra

2012 Fall: Discrete Mathematics

2011 Summer: Classical Mathematical Methods in Engineering

2010 Summer: Linear Algebra

Recitation Class TA : Calculus I-III, Differential Equations (2008 – 2012)

Programming Skills

Proficient in C/C++, Python, Matlab, Mathematica; Familiar with SAS, R

Proficient in high performance computing (MPI, OpenMP, CUDA .etc)

Last updated: May 2020

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