

Jiayu Zhai

Curriculum Vitae

Department of Mathematics and Statistics,
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Education

- 2018 **Ph.D. in Mathematics**, *Louisiana State University*.
Baton Rouge, LA, USA
- 2014 **M.S. in Mathematics**, *Louisiana State University*.
Baton Rouge, LA, USA
- 2012 **M.S. in Mathematics**, *Shanghai University*.
Shanghai, China
- 2009 **B.S. in Mathematics**, *Ludong University*.
Yantai, China

Work Experience

- Sep 2018 **Visiting Assistant Professor**, *University of Massachusetts Amherst*.
–Present Amherst, MA, USA
- Feb 2016 **Research Assistant**, *Louisiana State University*.
–May 2018 Baton Rouge, LA, USA
- May 2017 **NSF Mathematical Sciences Graduate Internship Program**,
–Jul 2017 *Pacific Northwest National Laboratory*.
Richland, WA, USA
- Aug 2012 **Teaching Assistant**, *Louisiana State University*.
–Feb 2016 Baton Rouge, LA, USA
- Sep 2011 **Teaching Assistant**, *Shanghai University*.
–Jan 2012 Shanghai, China

Research Interests

- Numerical Methods** Minimum action methods for large deviation principle
Numerical methods for invariant probability measures of stochastic dynamical systems
Machine learning methods and analysis
Numerical methods for stochastic differential equations and stochastic modeling
Uncertainty quantification
- Stochastic Analysis** Stochastic integration
White noise distribution theory
Stochastic differential equations

Funds, Awards and Honors

- 2021–2024 **NSF Funding, Co-PI.**
Analysis and Data-Driven Computation for Nonequilibrium Thermodynamic Models
(Award Number: 2108628, PI: Dr. Yao Li, NSF Organization: DMS, Total Award Amount: \$225,549.00)
- 2018–2021 **MSP Research Support Funds.**
University of Massachusetts Amherst
- 2013 **Pasquale Porcelli Graduate Student Academic Excellence Award.**
Louisiana State University
- 2012–2016 **Graduate School Enrichment.**
Louisiana State University
- 2011–2012 **Innovation Fund of Academic Research for Graduate Students.**
Shanghai University

Publications

Published and Accepted Papers

- 1 Jiayu Zhai, Matthew Dobson and Yao Li, *A deep learning method for solving Fokker–Planck partial differential equations*, Proceeding of Mathematical and Scientific Machine Learning (MSML21) (2021).
- 2 Xiaoliang Wan and Jiayu Zhai, *A minimum action method for dynamical systems with constant time delays*, SIAM Journal on Scientific Computing, (2021), **41**(1), A541–A565.
- 3 Matthew Dobson, Yao Li and Jiayu Zhai, *Using coupling methods to estimate sample quality for stochastic differential equations*, SIAM/ASA Journal on Uncertainty Quantification (2021), **9**(1), 135–162.
- 4 Matthew Dobson, Yao Li and Jiayu Zhai, *An efficient data-driven solver for Fokker–Planck equations: algorithm and analysis*, Accepted, Communications in Mathematical Sciences (2021), arXiv:1906.02600.
- 5 Xiaoliang Wan, Haijun Yu and Jiayu Zhai, *Convergence analysis of a finite element approximation of minimum action methods*, SIAM J. Numer. Anal., (2018), **56**(3), 1597–1620.
- 6 Hui-Hsiung Kuo, Sudip Sinha and Jiayu Zhai, *Stochastic Differential Equations with Anticipating Initial Conditions*, Communications on Stochastic Analysis **12**, no. 4 (2018) 473–485.
- 7 Chii-Ruey Hwang, Hui-Hsiung Kuo, Kimiaki Saitô and Jiayu Zhai, *Near-martingale property of anticipating stochastic integration*, Communications on Stochastic Analysis **11**, no. 4 (2017) 491–504.
- 8 Chii-Ruey Hwang, Hui-Hsiung Kuo, Kimiaki Saitô and Jiayu Zhai, *A general Itô formula for adapted and instantly independent stochastic processes*, Communications on Stochastic Analysis **10**, no. 3 (2016) 341–362.

- 9 Zhongrui Shi and Jiayu Zhai, λ point and λ property in generalized Orlicz spaces with Luxemburg norm, *Journal of East China Normal University (Natural Science)*, **1** (2012), 63–73.

Preprints and Works in Progress

- 10 Jiayu Zhai, *Quantify the dynamics from invariant distribution using GANs*, Work in progress.
- 11 Jiayu Zhai, Xiaoliang Wan and Yao Li *A flow-GANs for dynamics quantification via block-triangular mapping*, Work in progress.
- 12 Yao Li, Jiayu Zhai, Matthew Dobson and Yaping Yuan *A hybrid reinforcement method for injection measure in low density regions*, Work in progress.
- 13 Yulong Lu, Jiayu Zhai and Yao Li *Neural network representation of solutions to convection–diffusion equations in Barron Spaces*, Work in progress.
- 14 Jiayu Zhai and Liwen Ouyang, *A data-driven method for invariant probability measures of nonlinear dynamical systems driven by non-Gaussian Lévy processes*, Work in progress. **(REU program as a supervisor at UMass Amherst)**
- 15 Jiayu Zhai and Xiaoliang Wan, *A minimum action method by augmented Lagrangian method for delayed stochastic dynamical systems*, In preparation.
- 16 Jiayu Zhai Xiaoliang Wan and Bin Zheng, *Multigrid minimum action method*, In preparation.
- 17 Jiayu Zhai, Huan Lei and Xiaoliang Wan, *MAM for systems with degenerated noises*, In preparation.
- 18 Jiayu Zhai, Hui-Hsiung Kuo and Sudip Sinha, *A Black–Scholes model with anticipating initial conditions*, **Preprint to be submitted.**

Conferences

- Aug 16–19 **Mathematical and Scientific Machine Learning (MSML21)**,
2021 ***Presented Talk: A Deep Learning Method for Solving Fokker-Planck Equations***,
Zoom virtual conference.
- May 23–27 **SIAM Conference on Applications of Dynamical Systems (DS21)**,
2021 ***Presented Talk: A Neural Network Approximation for Invariant Measures in Stochastic Dynamical Systems***,
Zoom virtual conference.
- Nov 15–17 **The Second Northeast Conference on Dynamical Systems**,
2019 ***Presented Talk: A Data-Driven Solver for Steady State Distributions of Stochastic Dynamical Systems***,
University of Massachusetts Amherst, Amherst, MA.
- Feb 25– Mar 1 **SIAM Conference on Computational Science and Engineering (CSE18)**,
2019 ***Presented Talk: Transitions as Rare Events in Stochastic Delayed Systems***,
Spokane, WA.

- Apr 16–19 **SIAM Conference on Uncertainty Quantification (UQ18)**,
2018 *Presented Talk: Temporal Minimum Action Method for Delayed System*,
Orange County, CA.
- Feb 23–24 **The Finite Element Rodeo 2018**,
2018 Center for Computation and Technology, Louisiana State University, Baton Rouge,
LA.
- Feb 2–3 **Scientific Computing Around Louisiana (SCALA 2018)**,
2018 Center for Computation and Technology, Louisiana State University, Baton Rouge,
LA.
- Jan 10–13 **Joint Mathematics Meeting (JMM 2018)**,
2018 San Diego Convention Center, San Diego, CA.
- Oct 20–21 **The Finite Element Circus 2017**,
2017 *Presented Talk: Convergence Analysis of Finite Element Approximation of
Large Deviation Principle*,
College of Natural and Mathematical Sciences, UMBC, Baltimore, MD.
- Mar 17–18 **Scientific Computing Around Louisiana (SCALA 2017)**,
2017 *Presented Talk: Convergence Analysis of Finite Element Approximation of
Large Deviation Principle*,
Center for Computational Science, Tulane University, New Orleans, LA.
- Feb 12–13 **Scientific Computing Around Louisiana (SCALA 2016)**,
2016 Center for Computation and Technology, Louisiana State University, Baton Rouge,
LA.
- Aug 10–14 **The 8th International Congress on Industrial and Applied Mathematics
(ICIAM 2015)**,
2015 Beijing, China.
- Aug 8–12 **The 3rd International Conference on Analytic Mathematics and its Applica-
tion**,
2011 *Presented Talk: λ Point and λ Property in Generalized Orlicz Spaces*,
Xinyang, China.
- Jun 21–24, **International Conference on Convex Geometric Analysis, Integral Geometry
and Related Topics**,
2011 Shanghai University, Shanghai, China.

Invited Local Talks

- Nov 2021 **Deep Density Estimation via Invertible Block-Triangular Mappings**,
Seminar on Mathematics of Machine Learning, University of Massachusetts Amherst.
- May 2021 **A Neural Network Approximation for Invariant Measures in Stochastic Dy-
namical Systems**,
Nanjing University, Zoom presentation.
- Dec 2020 **Data-Driven Methods for Fokker–Planck Partial Differential Equations**,
CCMA Seminar on Mathematics of Data and Computation,
Pennsylvania State University and Peking University Jointly, Zoom presentation.

- Oct 2020 **Minimum Action Methods for Transitions in Stochastic Dynamical Systems**,
Applied Mathematics Seminar,
Northeast Normal University, Zoom presentation.
- Mar 2020 **Data-Driven Methods for Fokker–Planck Partial Differential Equations**,
Scientific Computing and Numerical Analysis Seminar,
Center for Computation and Technology, Louisiana State University, Cancelled due to COVID-19.
- Dec 2019 **A Data-Driven Solver for Steady State Distributions of Stochastic Dynamical Systems**,
Applied Mathematics Seminar,
Nanjing, China.
- Sep 2019 **A Data-Driven Solver for Steady State Distributions of Stochastic Dynamical Systems**,
Applied Mathematics and Computation Seminar,
University of Massachusetts Amherst.
- Nov 2018 **Convergence Analysis of a Finite Element Approximation of Minimum Action Methods**,
Numerical Methods Seminar,
Worcester Polytechnic Institute.
- Oct 2018 **Convergence Analysis of a Finite Element Approximation of Minimum Action Methods**,
Applied Mathematics and Computation Seminar,
University of Massachusetts Amherst.
- Fall 2018 **Markov Property (Series Talks)**,
Weekly Group Seminar,
University of Massachusetts Amherst.
- Oct 2017 **Multilevel Monte Carlo Methods for PDE**,
Weekly Computational Group Seminar,
Louisiana State University.
- Sep 2009 **Banach Spaces, Orlicz Spaces and Related Theories (Series Talks)**,
–May 2011 *Weekly Graduate Student Seminar on Functional Analysis*,
Shanghai University.
- Dec 2009 **Linear Topological Spaces**,
Graduate Student Seminar,
Shanghai University.
- Dec 2009 **Convex Bodies: The Brunn-Minkowski Theory**,
Graduate Student Seminar,
Shanghai University.

Supervision Experience

University of Massachusetts Amherst

- Liwen **Research Experiences for Undergraduates (REU)**, *Summer 2020*.
Ouyang Topic: A data-driven method for invariant probability measures of nonlinear dynamical systems driven by non-Gaussian Lévy processes (paper in preparation)
Long Le **Research Experiences for Undergraduates (REU)**, *Summer 2019*.
(unofficial co-supervision with Yao Li)

Teaching Experience

University of Massachusetts Amherst

- Fall 2021 MATH 645 **ODE and Dynamical Systems** (*Graduate Level*, Instructor)
STAT 515 **Statistics I** (Instructor)
Spring 2021 STAT 515 **Statistics I** (Instructor)
Fall 2020 MATH 131 **Calculus I** (Instructor)
Spring 2020 STAT 515 **Statistics I** (Instructor)
Fall 2019 STAT 515 **Statistics I** (Instructor)
Spring 2019 MATH 132 **Calculus II** (Instructor)
Fall 2018 MATH 131 **Calculus I** (Instructor)

Louisiana State University

- Fall 2015 MATH 1550 **Calculus I** (Instructor)
Spring 2015 MATH 4153 **Finite Dimensional Vector Spaces** (TA)
MATH 2085 **Linear Algebra** (TA)
MATH 1552 **Calculus II** (TA)
Fall 2014 MATH 7311 **Real Analysis I** (*Graduate Level*, TA)
MATH 3355 **Probability** (TA)
Spring 2014 MATH 7330 **Functional Analysis** (*Graduate Level*, TA)
MATH 1550 **Calculus I** (Recitation)
Fall 2013 MATH 7311 **Real Analysis I** (*Graduate Level*, TA)
MATH 4031 **Advanced Calculus** (TA)
Spring 2013 MATH 4036 **Complex Variables** (TA)
MATH 4032 **Advanced Calculus of Several Variables** (TA)
Fall 2012 MATH 4038 **Mathematical Methods in Engineering** (TA)
MATH 2085 **Linear Algebra** (TA)

Skills

- Computer Python, C, Matlab and LaTeX.
Language English, Chinese Mandarin, French (reading).

Academic Service

- Reviewer AMS Mathematical Reviews and many journals

References

- Xiaoliang Wan (Advisor), xlwan@math.lsu.edu
- Hui-Hsiung Kuo (Advisor), kuo@math.lsu.edu
- Yao Li (Postdoc Mentor), yaoli@math.umass.edu
- Matthew Dobson (Postdoc Mentor), dobson@math.umass.edu
- Huan Lei (Research), leihuan@msu.edu
- Jinguo Lian (Teaching), lian@math.umass.edu