# Bin Shi

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## Academic Appointments

06/2021–present **Associate Professor**
Academy of Mathematics and Systems Science
Chinese Academy of Sciences

01/2019–05/2021 **Postdoctoral Scholar (Hosted by Michael I. Jordan)**
Department of Electrical Engineering & Computer Science
University of California, Berkeley

## Education

2015–2018 **Ph.D in Computer Science**
Major: Theoretical Machine Learning
School of Computing and Information Sciences, Florida International University, FL

2013–2015 **M.S. in Physics**
Major: Theoretical Physics
Department of Physics, University of Massachusetts, Dartmouth, MA

2008–2011 **M.S. in Mathematics**
Major: Pure Mathematics
Thesis: Nekhoroshev Estimates for Infinite-Dimensional Reversible System with Chain Structure,
Advisor: Xiaoping Yuan
School of Mathematical Science, Fudan University, Shanghai, China

2002–2006 **B.S. in Mathematics**
Major: Pure and Applied Mathematics
School of Mathematical Science, Ocean University of China, Qingdao, China

## Research Interests

- Optimization for Machine Learning
- Numerical Analysis and Scientific Computing
- Nonlinear and Stochastic Sciences
- Fluid Dynamics (Turbulence, Geophysical and Astrophysical)

## Publications

- **The Sampling Method for Optimal Precursors of ENSO Events**
  **Bin Shi** and Junjie Ma
  To appear in Nonlinear Processes in Geophysics, 2024

- **On Learning Rates and Schrödinger Operators**
  **Bin Shi**, Weijie J. Su and Michael I. Jordan
  Journal of Machine Learning Research, 2023, 24(379):1-53

- **An adjoint-free algorithm for conditional nonlinear optimal perturbations (CNOPs) via sampling**
  **Bin Shi** and Guodong Sun
  Nonlinear Processes in Geophysics, 2023, 30(3):263–276

- **Understanding the Acceleration Phenomenon via High-Resolution Differential Equations**
  **Bin Shi**, Simon S. Du, Michael I. Jordan, and Weijie J. Su
  Mathematical Programming, Series A, 2022, 195(1):79-148

- **Conjugate and Cut Points in Ideal Fluid Motion**
  Theodore D. Drivas, Gerard Misiołek, **Bin Shi** and Tsuyoshi Yoneda
  Annales Mathématiques du Québec, 2022, 46(1):207-225

- **Acceleration via Symplectic Discretization of High-Resolution Differential Equations**
  **Bin Shi**, Simon S. Du, Weijie J. Su and Michael I. Jordan
  Advances in Neural Information Processing Systems, 2019, 32.

## Monographs

- **Mathematical Theories of Machine Learning - Theory and Applications**
  **Bin Shi** and Sundaraja S. Iyengar
  Springer International Publishing, 2020

## Workshop Papers

- **A Conservation Law Method in Optimization**
  **Bin Shi**, Tao Li and Sundaraja S. Iyengar
  The Tenth Workshop on Optimization for Machine Learning
  Advances in Neural Information Processing Systems, 2017, 30

## Preprints

- **On the Hyperparameters in SGD with Momentum**
  **Bin Shi**
  arXiv preprint https://arxiv.org/abs/2108.03947, (Accepted after Minor Revision) Journal of Machine Learning Research

- **Gradient Norm Minimization of Nesterov Acceleration:** $o(1/k^3)$
  Shuo Chen, **Bin Shi** and Ya-xiang Yuan
  arXiv preprint https://arxiv.org/abs/2209.08862

- **Optimal Disturbances of Blocking: A Barotropic View**
  **Bin Shi**, Dehai Luo and Wenqi Zhang
  arXiv preprint https://arxiv.org/abs/2210.06011, submitted

- **Proximal Subgradient Norm Minimization of ISTA and FISTA**
  Bowen Li, **Bin Shi** and Ya-xiang Yuan
  arXiv preprint https://arxiv.org/abs/2211.01610

- **Revisiting the Acceleration Phenomenon via High-Resolution Differential Equations**
  Shuo Chen, **Bin Shi** and Ya-Xiang Yuan
  arXiv preprint https://arxiv.org/abs/2212.05700

- **Linear Convergence of ISTA and FISTA**
  Bowen Li, **Bin Shi** and Ya-Xiang Yuan
  arXiv preprint https://arxiv.org/abs/2212.06319

- **On Underdamped Nesterov Acceleration**
  Shuo Chen, **Bin Shi** and Ya-Xiang Yuan
  arXiv preprint https://arxiv.org/abs/2304.14642

- **Linear convergence of Nesterov-1983 with the strong convexity**
  Bowen Li, **Bin Shi** and Ya-Xiang Yuan
  arXiv preprint https://arxiv.org/abs/2306.09694

- **Understanding the ADMM Algorithm via High-Resolution Differential Equations**
  Bowen Li and **Bin Shi**
  arXiv preprint https://arxiv.org/abs/2401.07096

## Grants and Funding

- **Co-PI: National Science Foundation of China, #12241105**
  Developing 4D-Var Strongly Coupled Assimilation System of Climate System Models Based on Statistical Machine Learning
- **Co-PI: CAS Project for Young Scientists in Basic Research, #YSBR-034**
  Mathematical Principles of Deep Learning

## Professional Experience

Journal Review **Mathematical Reviews/MathSciNet**
**Mathematical Programming (MP)**
**SIAM Journal on Optimization (SIOPT)**
**Mathematics of Computation (MCOM)**
**Communications in Mathematical Sciences (CMS)**
**Journal of Machine Learning Research (JMLR)**
**Computational Optimization and Applications (CoA)**
**Numerical Algorithms (NA)**
**IEEE Access**

Conf. Review **ICML**, **NeurIPS**, **ICLR**

## Invited Talks

2021.09 School of Mathematics, Shandong University, Jinan, China (Virtual)
2021.10 2021 Tsinghua Symposium on Statistics And Data Science for Young Scholars, Beijing, China
2021.11 2021 CAS Frontier Innovation Forum on Mathematics and its Intersections, Beijing, China
2022.02 Department of Computer Science and Technology, Tsinghua University, Beijing, China
2022.11 School of Mathematical Sciences, Peking University, Beijing, China
2022.11 International Forum of Climate and Environmental Changes Sustainable Development (IYBSSD)
2023.06 2023 SIAM Conference on Optimization (OP23), Seattle, USA
2023.06 School of Mathematical Sciences, Ocean University of China, Qingdao, China
2023.06 Jordan Symposium, France
2023.06 Bernoulli Institute, University of Groningen, Netherlands
2023.07 Tianyuan Mathematical Research Center, Kunming, China
2023.07 School of Mathematics and Statistics, Yunnan University, Kunming, China
2023.08 HKSIAM Biennial Conference, Hong Kong, China

## Work Experience

2022-Fall Partial Differential Equations

2021-Fall Numerical Optimization

2015-2018 Teaching Assistant in Florida International University

- Computer Programming I (COP-2210)
- Computer Programming II (COP-3337)
- Introduction to Algorithms (COT-5407)
- Theory of Computation (COT-5310)

2013-2015 Research Assistant in University of Massachusetts, Dartmouth

2013 Temporary Research Staff in Institute of Oceanology, Chinese Academy of Sciences, China

2008-2011 Teaching Assistant in Fudan University

- Mathematical Analysis
- Riemannian Geometry
- Partial Differential Equations
- Mathematical Method of Classical Mechanics

## References: Machine Learning and Applied Mathematics

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Associate Professor
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## References: Atmospheric Science and Oceanography

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