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Bin Shi

Academic Appointments

01/2025–present **Associate Professor with Tenure**
Center for Mathematics and Interdisciplinary Sciences
Fudan University

11/2024–present **Associate Professor with Tenure**
Shanghai Institute for Mathematics and Interdisciplinary Sciences

06/2021–10/2024 **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
- Data Assimilation
- Quantum Algorithms
- Nonlinear Sciences and Stochastic Sciences
- Fluid Dynamics (Turbulence, Geophysical and Astrophysical)

Journal Publications

- **Linear Convergence of ISTA and FISTA**
  Bowen Li, **Bin Shi** and Ya-Xiang Yuan
  Journal of the Operations Research Society of China, 2024, Published Online.

- **On the Hyperparameters in SGD with Momentum**
  Bin Shi
  Journal of Machine Learning Research, 25(236):1-40, 2024.

- **Linear convergence of Forward-Backward Accelerated Algorithms without Knowledge of the Modules of the Strong Convexity**
  Bowen Li, **Bin Shi** and Ya-Xiang Yuan
  SIAM Journal on Optimization, 34(2):2150-2168, 2024.

- **The Sampling Method for Optimal Precursors of ENSO Events**
  Bin Shi and Junjie Ma
  Nonlinear Processes in Geophysics, 31(1):165-174, 2024.

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

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

- **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, 195(1):79-148, 2022.

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

Conference and Workshop Papers

- **Quantum Optimization via Gradient-Based Hamiltonian Descent**
  Jiaqi Leng, **Bin Shi**
  ICML 2025.

- **Acceleration via Symplectic Discretization of High-Resolution Differential Equations**
  Bin Shi, Simon S. Du, Weijie J. Su and Michael I. Jordan
  NeurIPS 2019.

- **A Conservation Law Method in Optimization**
  Bin Shi, Tao Li and Sundaraja S. Iyengar
  Workshop on Optimization for Machine Learning, NeurIPS 2017.

Monographs

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

Preprints

- **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, submitted

- **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, submitted

- **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, submitted

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

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

- **Understanding the PDHG Algorithm via High-Resolution Differential Equations**
  Shuo Chen, **Bin Shi**
  arXiv preprint https://arxiv.org/abs/2403.11139, submitted

- **A Lyapunov Analysis of Accelerated PDHG Algorithms**
  Xueying Zeng, **Bin Shi**
  arXiv preprint https://arxiv.org/abs/2407.18681, submitted

- **Numerical Solution for Nonlinear 4D Variational Data Assimilation (4D-Var) via ADMM**
  Bowen Li, **Bin Shi**
  arXiv preprint https://arxiv.org/abs/2410.04471, submitted

- **Lyapunov Analysis For Monotonically Forward-Backward Accelerated Algorithms**
  Mingwei Fu, **Bin Shi**
  arXiv preprint https://arxiv.org/abs/2412.13527, submitted

- **A Family of Controllable Momentum Coefficients for Forward-Backward Accelerated Algorithms**
  Mingwei Fu, **Bin Shi**
  arXiv preprint https://arxiv.org/abs/2501.10051, submitted

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)
SIAM Journal on Control and Optimization (SICON)
SIAM Journal on Mathematical Analysis (SIMA)
SIAM Journal on Numerical Analysis (SINA)
Numerische Mathematik (NM)
Mathematics of Computation (MCOM)
Communications in Mathematical Sciences (CMS)
Journal of Machine Learning Research (JMLR)
Transactions on Machine Learning Research (TMLR)
Journal of Computational Mathematics (JCM)
Computational Optimization and Applications (CoA)
Numerical Algorithms (NA)
Journal of Global Optimization (JOGO)
Journal of Optimization Theory and Applications (JOTA)
Journal of the Operations Research Society of China (JORSC)
Journal of Mathematical Fluid Mechanics (JMFM)
IEEE Access

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

References: Machine Learning and Applied Mathematics

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References: Atmospheric Science and Oceanography

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