

# Bin Shi

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## 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

- **Numerical Solution for Nonlinear 4D Variational Data Assimilation (4D-Var) via ADMM**  
Bowen Li, **Bin Shi**  
Journal of Computational Physics, 538:114163, 2025.
- **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 Misiótek, **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

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## 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
- **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
- **On Pseudospectral Concentration for Rank-1 Sampling**  
Kuo Gai, **Bin Shi**  
arXiv preprint <https://arxiv.org/abs/2505.10896>, submitted

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## 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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