# Bin Shi

# Academic Appointments

06/2021 - Associate Professor

present Academy of Mathematics and Systems Science

Chinese Academy of Sciences

01/2019 Postdoctoral Scholar (Hosted by Michael I. Jordan)

05/2021 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
- Nonlinear Science & Stochastic Sciences
- Fluid Dynamics (Turbulence, Geophysical and Astrophysical)

## Journal Publications

Linear Convergence of ISTA and FISTA

Bowen Li, Bin Shi and Ya-Xiang Yuan

To appear in Journal of the Operations Research Society of China, 2024+.

 On the Hyperparameters in SGD with Momentum Bin Shi

To appear in 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 El Niño-Southern Oscillation 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, 2024.

 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 Proceedings

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

Proceedings of the 33rd International Conference on Neural Information Processing Systems, (NeurIPS 2019).

A Conservation Law Method in Optimization

**Bin Shi**, Tao Li and Sundaraja S. Iyengar The Tenth Workshop on Optimization for Machine Learning

The Thirty-first Annual Conference on Neural Information Processing Systems, (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 and Bin Shi

arXiv preprint https://arxiv.org/abs/2401.07096, submitted

### • Understanding the PDHG Algorithm via High-Resolution Differential Equations

Bowen Li and Bin Shi

arXiv preprint https://arxiv.org/abs/2403.11139, submitted

### A Lyapunov Analysis of Accelerated PDHG Algorithms

Bowen Li and **Bin Shi** arXiv preprint https://arxiv.org/abs/2407.18681, 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)

Mathematics of Computation (MCOM)

Numerische Mathematik (NM)

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)

Annals of Operations Research (ANOR)

**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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