

# Bin Shi

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## 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
- 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>

- **Understanding the PDHG Algorithm via High-Resolution Differential Equations**

Bowen Li and **Bin Shi**  
arXiv preprint <https://arxiv.org/abs/2403.11139>

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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

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## Professional Experience

PC Memeber  
Journal Review

**JCC 2024, IVP AI 2024**

**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**

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## 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

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## 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

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## References: Machine Learning and Applied Mathematics

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Pehong Chen Distinguished Professor  
Department of EECS  
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Yurii Nesterov  
Professor  
Louvain School of Engineering  
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Associate Professor  
Department of Statistics  
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## References: Atmospheric Science and Oceanography

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