Bin **Gao**

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Associate Professor

Academy of Mathematics and Systems Science
Chinese Academy of Sciences, China

Education

Sep 2014 – Jul 2019	**Ph.D. in applied mathematics**, **University of Chinese Academy of Sciences**, Beijing, China Academy of Mathematics and System Science, Chinese Academy of Sciences **Supervisor :** Prof. Ya-xiang Yuan
Sep 2010 – Jun 2014	**B.S. in mathematics**, **Sichuan University**, Chengdu, China College of Mathematics

Work experience

Sep 2022 –	**(tenure-track) Associate professor**, Academy of Mathematics and Systems Science, **Chinese Academy of Sciences**, Beijing, China Academic staff of LSEC and ICMSEC
Sep 2021 – Aug 2022	**Postdoc**, Applied Mathematics : Institute for Analysis and Numerics, **University of Münster**, Münster, Germany **Host :** Prof. Benedikt Wirth
Sep 2019 – Aug 2021	**Postdoc**, ICTEAM institute, **UCLouvain**, Louvain-la-Neuve, Belgium **Host :** Prof. Pierre-Antoine Absil

Research interests

- Riemannian optimization
- Parallel/Distributed computing
- Machine learning

My research interests include numerical methods for optimization on manifolds and their applications. I am also interested in machine learning and parallel/distributed optimization stemming from various research and engineering areas.

Publications & preprints

1. **Bin Gao**, Nguyen Thanh Son, Tatjana Stykel. Symplectic Stiefel manifold : tractable metrics, second-order geometry and Newton's methods. arXiv:2406.14299, (2024). (link)
2. Yan Yang, **Bin Gao**, Ya-xiang Yuan. Bilevel reinforcement learning via the development of hyper-gradient without lower-level convexity. arXiv:2405.19697, (2024). (link)
3. Simon Vary, Pierre Ablin, **Bin Gao**, P.-A. Absil. Optimization without retraction on the random generalized Stiefel manifold. arXiv:2405.01702, (2024). (link)
4. **Bin Gao**, Yan Yang, Ya-xiang Yuan. LancBiO : dynamic Lanczos-aided bilevel optimization via Krylov subspace. arXiv:2404.03331, (2024). (link, code)
5. **Bin Gao**, Renfeng Peng, Ya-xiang Yuan. Riemannian preconditioned algorithms for tensor completion via tensor ring decomposition. Computational Optimization and Applications, 88 (2024), 443–468. (link, code)
6. **Bin Gao**, Nguyen Thanh Son, Tatjana Stykel. Optimization on the symplectic Stiefel manifold : SR decomposition-based retraction and applications. Linear Algebra and Its Applications, 682 (2024), 50–85. (link, code)
7. **Bin Gao**, Renfeng Peng, Ya-xiang Yuan. Low-rank optimization on Tucker tensor varieties. arXiv:2311.18324, (2023). (link, code)
8. Yu Guan, Shuyu Dong, **Bin Gao**, P.-A. Absil, François Glineur. Alternating minimization algorithms for graph regularized tensor completion. arXiv:2008.12876, (2023). (link, code)

9. **Bin Gao**, Renfeng Peng, Ya-xiang Yuan. **Optimization on product manifolds under a preconditioned metric**. arXiv:2306.08873, (2023). (link, code)
10. Pierre Ablin, Simon Vary, **Bin Gao**, P.-A. Absil. **Infeasible deterministic, stochastic, and variance-reduction algorithms for optimization under orthogonality constraints**. arXiv:2303.16510, (2023). (link)
11. Shuyu Dong, **Bin Gao**, Wen Huang, Kyle A. Gallivan. **On the analysis of optimization with fixed-rank matrices : a quotient geometric view**. arXiv:2203.06765, (2022). (link)
12. **Bin Gao**, Simon Vary, Pierre Ablin, P.-A. Absil. **Optimization flows landing on the Stiefel manifold**. 25th IFAC Symposium on Mathematical Theory of Networks and Systems (MTNS 2022), IFAC-PapersOnLine, 55-30 (2022), 25–30. (link)
13. **Bin Gao**, Guanghui Hu, Yang Kuang, Xin Liu. **An orthogonalization-free parallelizable framework for all-electron calculations in density functional theory.** SIAM Journal on Scientific Computing, 44-3 (2022), B723–B745. (link)
14. **Bin Gao**, P.-A. Absil. **A Riemannian rank-adaptive method for low-rank matrix completion.** Computational Optimization and Applications, 81 (2022), 67–90. (link, code)
15. Shuyu Dong, **Bin Gao**, Yu Guan, François Glineur. **New Riemannian preconditioned algorithms for tensor completion via polyadic decomposition.** SIAM Journal on Matrix Analysis and Applications, 43-2 (2022), 840–866. (link, code)
16. Nguyen Thanh Son, P.-A. Absil, **Bin Gao**, Tatjana Stykel. **Computing symplectic eigenpairs of symmetric positive-definite matrices via trace minimization and Riemannian optimization.** SIAM Journal on Matrix Analysis and Applications, 42-4 (2021), 1732–1757. (link, code)
17. **Bin Gao**, Nguyen Thanh Son, P.-A. Absil, Tatjana Stykel. **Geometry of the symplectic Stiefel manifold endowed with the Euclidean metric.** Geometric Science of Information : 5th International Conference, GSI 2021, Lecture Notes in Computer Science, 12829 (2021), 789–796. (link, code)
18. **Bin Gao**, Nguyen Thanh Son, P.-A. Absil, Tatjana Stykel. **Riemannian optimization on the symplectic Stiefel manifold.** SIAM Journal on Optimization, 31-2 (2021), 1546–1575. (link, code)
19. Lei Wang, **Bin Gao**, Xin Liu. **Multipliers correction methods for optimization problems over the Stiefel manifold.** CSIAM Transactions on Applied Mathematics, 2-3 (2021), 508–531. (link)
20. **Bin Gao**, Xin Liu and Ya-xiang Yuan, **Parallelizable algorithms for optimization problems with orthogonality constraints**, SIAM Journal on Scientific Computing, 41-3(2019), A1949–A1983. (link, code)
21. **Bin Gao**, Xin Liu, Xiaojun Chen and Ya-xiang Yuan, **A new first-order algorithmic framework for optimization problems with orthogonality constraints**, SIAM Journal on Optimization, 28-1(2018), 302–332. (link, code, best student paper award of CSIAM 2018)
22. **Bin Gao**, Xin Liu and Ya-xiang Yuan, **First-order algorithms for optimization problems with orthogonality constraints**, OR Transactions (in Chinese), 21-4 (2017), 57–68. (link)
23. **Bin Gao**, Xin Liu, Xiaojun Chen and Ya-xiang Yuan, **On the Łojasiewicz exponent of the quadratic sphere constrained optimization problem**, arXiv:1611.08781, (2016). (link)

Presentations

- Optimization flows landing on the Stiefel manifold
  - 2023.10.15 | 2023 CSIAM Annual Meeting, Kunming, China
- Symplectic model order reduction via Riemannian optimization
  - 2023.08.25 | 10th International Congress on Industrial and Applied Mathematics (ICIAM 2023), Tokyo, Japan
- New Riemannian preconditioned algorithms for tensor completion via polyadic decomposition
  - 2023.05.14 | ORSC-MOS2023, Chengdu, China
  - 2022.11.21 | 2022 PKU Workshop on Operations Research and Machine Learning, Peking University, Beijing, China, online
- Computing symplectic eigenpairs of SPD matrices via trace minimization and Riemannian optimization
  - 2022.11.20 | 2022 CSIAM Annual Meeting, online
- Geometry of the symplectic Stiefel manifold endowed with the Euclidean metric
  - 2021.07.23 | 5th conference on Geometric Science of Information (GSI'21), Sorbonne University, Paris, France
- A Riemannian rank-adaptive method for low-rank matrix completion
  - 2021.11.17 | Oberseminar, WWU, Münster, Germany
  - 2021.05.21 | SIAM Conference on Applied Linear Algebra (LA21), happening virtually
- Riemannian optimization on the symplectic Stiefel manifold
  - 2021.07.21 | SIAM Conference on Optimization (OP21), happening virtually
  - 2021.06.02 | CASA Colloquium, Eindhoven University of Technology, online
  - 2020.12.11 | YSSEC2020, AMSS, CAS, Beijing, China, online
- Orthonormalization-free parallelizable algorithms for electronic structure calculation
  - 2020.01.12 | One-week winter school on low-rank models, Villars-sur-Ollon, Switzerland
- Optimization problems with orthogonality constraints – from feasible to infeasible

2023.09.09 | Autumn School on Control of Dynamical Systems and Nonlinear Optimization, Hanoi, Vietnam
2022.12.01 | Tianyuan Mathematical Center in Southeast China, Xiamen University, China, online
2021.11.02 | SCMS Seminar, SCMS, Shanghai, China, online
2019.10.01 | INMA Seminar, UCLouvain, Louvain-la-Neuve, Belgium
2018.09.10 | Seminar at Peking University, Beijing, China

› Parallelizable approaches for optimization problems with orthogonality constraints
2018.07.05 | The 23nd International Symposium on Mathematical Programming (ISMP 2018), Bordeaux, France
2017.08.09 | The International Conference on Numerical Optimization and Numerical Linear Algebra, Yinchuan, China

› On the Łojasiewicz exponent of quadratic sphere constrained optimization problem
2017.09.23 | OPTGRAD 2017, Nanjing University, Nanjing, China
2016.10.16 | The annual meeting of ORSC 2016, Kunming, China

› A new first-order algorithmic framework for optimization problems with orthogonality constraints
2018.09.15 | The Annual Meeting of CSIAM 2018, Chengdu, China
(Best student paper award)
2016.08.28 | OPTGRAD 2016, AMSS, CAS, Beijing, China
(Outstanding work award)
2016.06.27 | International Workshop on Modern Optimization and Applications (MOA 2016), AMSS, CAS, Beijing, China
(Honor student award)

› Column-wise BCD Method for Orthogonal Constrained Optimization Problems
2016.06.20 | The 11th East Asia SIAM Conference (EASIAM2016), Macao SAR, China

Academic visits

2023.09.07-09.22 | Vietnam Institute for Advanced Study in Mathematics, Hanoi, Vietnam | VIASM
2019.07.20-08.18 | University of Macau, Macau | Prof. Guanghui Hu

$ Grants & programs

As the PI :

2023.12-2026.12 | National High-level Young Talents Program | 2M
2023.06-2025.05 | National Science and Technology Major Project | 1.25M
2023.02-2025.12 | Talents Program of the Chinese Academy of Sciences | 1M
2023.01-2025.12 | Young Elite Scientist Sponsorship Program by CAST (No. YESS20220244) | 0.24M

As a member :

2023.12-2028.12 | National Key R&D Program of China (grant No. 2023YFA1009300) | 12M

Honors & awards

2021 | Zhong Jiaqing Mathematics Award
2018 | Best Student Paper Award of CSIAM 2018 (<15%)
2018 | CAS Special Prize of President Scholarship for Postgraduate Student (<1%)
2017 | National Scholarship for Doctoral Student (<5%)
2016 | Honor Student Award of International Workshop on Modern Optimizaion and Application

Skills

Programming Languages : C/C++, Python, SQL, Matlab, Mathematica, LaTeX
Machine Learning : Tensorflow
High Performance Computing : Linux, Shell
Parallel/Distributed Computing : OpenMP, MPI

</> Software

popman | A MATLAB solver for **p**reconditioned Riemannian **o**ptimization methods on **p**roduct **man**ifolds, AMSS, CAS, Matlab
2023.06 : Github link Reference
CCA | SVD | Riemannian optimization | Matlab

RRAM | A MATLAB solver for low-rank matrix completion based on a **R**iemannian **R**ank-**A**daptive **M**ethod, UCLouvain, C/Matlab
2021.03 : Github link Reference
Low rank | Matrix completion | Riemannian optimization | C | Matlab

speig | A Matlab solver for the **sym**plectic **eig**envalue problem via trace minimization and Riemannian optimization, UCLouvain, Matlab
2021.01 : Github link Reference
Symplectic | Eigenvalue | Trace minimization | Matlab

spopt | A Matlab solver for Riemannian **opt**imization on the **sym**plectic Stiefel manifold, UCLouvain, Matlab
2020.06 : Github link Reference
Symplectic | Manifold | Riemannian optimization | Matlab

PCAL | A MATLAB solver for **P**arallelizable **C**olumn-wise **A**ugmented **L**agrangian approaches for optimization with orthogonality constraints, UCAS, Matlab
2019.03 : Github link Reference
Orthogonality | Stiefel manifold | Parallel computing | Matlab

FOForth | A MATLAB solver for a **F**irst-**O**rder **F**ramework for optimization problems with **orth**ogonality constraints, UCAS, Matlab
2019.03 : Github link Reference
Orthogonality | Stiefel manifold | First-order | Matlab

Professional activities

Conferences :

2023.12	organizer	YSSEC2023, Beijing, China
2023.08	committee	ICNONLA23, Taiyuan, China
2022.06	mini-symposium	7th IMA Conference on Numerical Linear Algebra and Optimization, University of Birmingham, UK
2021.07	session chair	5th conference on Geometric Science of Information (GSI'21), Sorbonne University, Paris, France

Referee for journals :

- Advances in Computational Mathematics
- Asia-Pacific Journal of Operational Research
- Computational Optimization and Applications
- ESAIM : Mathematical Modelling and Numerical Analysis
- IEEE Control Systems Letters
- IMA Journal of Numerical Analysis
- Information and Inference : A Journal of the IMA
- Journal of Industrial and Management Optimization
- Journal of Machine Learning Research
- Journal of Scientific Computing
- Journal of the Operations Research Society of China
- Mathematical Programming
- Neural Networks
- Numerical Algorithms
- Operations Research Transactions
- Optimization
- Optimization Letters
- SIAM Journal on Mathematics of Data Science
- SIAM Journal on Matrix Analysis and Applications
- SIAM Journal on Optimization
- SIAM Journal on Scientific Computing
- Systems & Control Letters

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