

# Bin Gao

<https://www.gaobin.cc/>

⌚ [github.com/opt-gaobin](https://github.com/opt-gaobin) ⚖ [Google Scholar](#) ⚙ [gaobin@lsec.cc.ac.cn](mailto:gaobin@lsec.cc.ac.cn)  
☎ (+86)10-82541028 🎂 9 Oct. 1991, Lanzhou, Gansu, China  
📍 Office : LanBai Building - 218, No.55, ZhongGuanCun East Road, Beijing 100190, China



## 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 : <a href="#">Prof. Ya-xiang Yuan</a>
Sep 2010 – Jun 2014	B.S. in mathematics, Sichuan University, Chengdu, China College of Mathematics

## ☰ Work experience

Apr 2025 –	(tenured) <b>Associate professor</b> , Academy of Mathematics and Systems Science, <b>Chinese Academy of Sciences</b> , Beijing, China <b>Academic staff of ICMSEC</b>
Sep 2022 – Mar 2025	(tenure-track) <b>Associate professor</b> , Academy of Mathematics and Systems Science, <b>Chinese Academy of Sciences</b> , Beijing, China <b>Academic staff of LSEC and ICMSEC</b>
Sep 2021 – Aug 2022	<b>Postdoc</b> , Applied Mathematics : Institute for Analysis and Numerics, <b>University of Münster</b> , Münster, Germany Host : <a href="#">Prof. Benedikt Wirth</a>
Sep 2019 – Aug 2021	<b>Postdoc</b> , ICTEAM institute, UCLouvain, Louvain-la-Neuve, Belgium Host : <a href="#">Prof. Pierre-Antoine Absil</a>

## 💡 Research interests

- › Riemannian optimization
- › Tensor computation
- › Parallel/Distributed computing
- › Machine learning

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

## 📄 Publications & preprints

1. Bin Gao, Renfeng Peng, Ya-xiang Yuan. **First-order methods on bounded-rank tensors converging to stationary points**. arXiv:2503.04523, (2025). ([link](#), [code](#))
2. Yan Yang, Bin Gao, Ya-xiang Yuan. **A space-decoupling framework for optimization on bounded-rank matrices with orthonormally invariant constraints**. arXiv:2501.13830, (2025). ([link](#), [code](#))
3. Chengkai Zhu, Renfeng Peng, Bin Gao, Xin Wang. **Riemannian optimization for Holevo capacity**. arXiv:2501.11576, (2025). ([link](#), [code](#))
4. Pierre Ablin, Simon Vary, Bin Gao, P.-A. Absil. **Infeasible deterministic, stochastic, and variance-reduction algorithms for optimization under orthogonality constraints**. Journal of Machine Learning Research, 25(389) (2024), 1–38. ([link](#), [code](#))
5. Bin Gao, Renfeng Peng, Ya-xiang Yuan. **Desingularization of bounded-rank tensor sets**. arXiv:2411.14093, (2024). ([link](#), [code](#))
6. Bin Gao, Nguyen Thanh Son, Tatjana Stykel. **Symplectic Stiefel manifold : tractable metrics, second-order geometry and Newton's methods**. arXiv:2406.14299, (2024). ([link](#))
7. 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](#))

8. Simon Vary, Pierre Ablin, **Bin Gao**, P.-A. Absil. **Optimization without retraction on the random generalized Stiefel manifold.** Proceedings of the 41st International Conference on Machine Learning (ICML 2024), PMLR 235 (2024), 49226–49248. ([link](#), [code](#))
9. Yan Yang, **Bin Gao**, Ya-xiang Yuan. **LancBiO : dynamic Lanczos-aided bilevel optimization via Krylov subspace.** arXiv:2404.03331, (2024). ([link](#), [code](#))
10. **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](#))
11. **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](#))
12. **Bin Gao**, Renfeng Peng, Ya-xiang Yuan. **Low-rank optimization on Tucker tensor varieties.** arXiv:2311.18324, (2023). ([link](#), [code](#))
13. 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](#))
14. **Bin Gao**, Renfeng Peng, Ya-xiang Yuan. **Optimization on product manifolds under a preconditioned metric.** arXiv:2306.08873, (2023). ([link](#), [code](#))
15. 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](#))
16. **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](#))
17. **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](#))
18. **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](#))
19. 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](#))
20. 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](#))
21. **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](#))
22. **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](#))
23. 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](#))
24. **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](#))
25. **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)
26. **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](#))
27. **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

---

- A space-decoupling framework for optimization on bounded-rank matrices with orthogonally invariant constraints  
2024.11.23 | Seminar on Advanced Mathematical Optimization, Nanning, China
- Desingularization of bounded-rank tensor sets  
2024.11.14 | 2024 SCMS workshop on learning and optimization in non-Euclidean spaces, Shanghai, China
- Hyper-gradient in bilevel optimization : efficient computation by Krylov Subspace and enhanced investigation in reinforcement learning  
2024.12.07 | 2024 International Conference on Data Science and Brain-Inspired Intelligence, Shanghai, China  
2024.08.11 | The China conference on Scientific Machine Learning (CSML2024), Shanghai, China
- Optimization on product manifolds : preconditioned methods and applications  
2024.12.11 | 2nd Brazil-China Joint Mathematical Meeting, Dongguan, China  
2024.09.29 | Forum on Mathematical Optimization, Dalian, China  
2024.05.13 | SIAM Conference on Applied Linear Algebra (LA24), Sorbonne University, Paris, France

- › Low-rank optimization on matrix and tensor varieties  
2024.04.20 | Seminar on Advanced Optimization, Jilin, China
- › Optimization flows landing on the Stiefel manifold  
2024.11.16 | Forum on Computational Mathematics, Wuhan, China  
2024.08.12 | Workshop on Machine Learning and Data Science, Shanghai, China  
2024.06.26 | 21st Conference on Advances in Continuous Optimization (EUROPT2024), Lund University, Sweden  
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 23rd 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 Optimization and Application

## Skills

Programming Languages : C/C++, Python, SQL, Matlab, Mathematica,  $\text{\LaTeX}$

Machine Learning : Tensorflow

High Performance Computing : Linux, Shell

Parallel/Distributed Computing : OpenMP, MPI

## </> Software

---

<b>popman</b>	A MATLAB solver for preconditioned Riemannian optimization methods on product manifolds, AMSS, CAS, Matlab 2023.06 : <a href="#">Github link</a> <a href="#">Reference</a> <a href="#">CCA</a> <a href="#">SVD</a> <a href="#">Riemannian optimization</a> <a href="#">Matlab</a>
<b>RRAM</b>	A MATLAB solver for low-rank matrix completion based on a Riemannian Rank-Adaptive Method, UCLouvain, C/Matlab 2021.03 : <a href="#">Github link</a> <a href="#">Reference</a> <a href="#">Low rank</a> <a href="#">Matrix completion</a> <a href="#">Riemannian optimization</a> <a href="#">C</a> <a href="#">Matlab</a>
<b>speig</b>	A Matlab solver for the symplectic eigenvalue problem via trace minimization and Riemannian optimization, UCLouvain, Matlab 2021.01 : <a href="#">Github link</a> <a href="#">Reference</a> <a href="#">Symplectic</a> <a href="#">Eigenvalue</a> <a href="#">Trace minimization</a> <a href="#">Matlab</a>
<b>splot</b>	A Matlab solver for Riemannian optimization on the symplectic Stiefel manifold, UCLouvain, Matlab 2020.06 : <a href="#">Github link</a> <a href="#">Reference</a> <a href="#">Symplectic</a> <a href="#">Manifold</a> <a href="#">Riemannian optimization</a> <a href="#">Matlab</a>
<b>PCAL</b>	A MATLAB solver for Parallelizable Column-wise Augmented Lagrangian approaches for optimization with orthogonality constraints, UCAS, Matlab 2019.03 : <a href="#">Github link</a> <a href="#">Reference</a> <a href="#">Orthogonality</a> <a href="#">Stiefel manifold</a> <a href="#">Parallel computing</a> <a href="#">Matlab</a>
<b>FOForth</b>	A MATLAB solver for a First-Order Framework for optimization problems with orthogonality constraints, UCAS, Matlab 2019.03 : <a href="#">Github link</a> <a href="#">Reference</a> <a href="#">Orthogonality</a> <a href="#">Stiefel manifold</a> <a href="#">First-order</a> <a href="#">Matlab</a>

## Professional activities

### Conferences :

2024.12	organizer	YSSEC2024, Beijing, China
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 :

- > Acta Mathematica Sinica, English Series
  - > Advances in Computational Mathematics
  - > Applied Numerical Mathematics
  - > Asia-Pacific Journal of Operational Research
  - > Computational Optimization and Applications
  - > ESAIM : Mathematical Modelling and Numerical Analysis
  - > IEEE Control Systems Letters
  - > IEEE Transactions on Automatic Control
  - > IMA Journal of Numerical Analysis
  - > Information and Inference : A Journal of the IMA
  - > Journal of Computational Mathematics
  - > Journal of Industrial and Management Optimization
  - > Journal of Machine Learning Research
  - > Journal of Scientific Computing
  - > Journal of the Operations Research Society of China
- 
- > Mathematics of Operations Research
  - > Mathematical Programming
  - > Neural Networks
  - > Numerical Algorithms
  - > Numerical Mathematics : Theory, Methods and Applications
  - > Operations Research Transactions
  - > Optimization
  - > Optimization Letters
  - > SIAM Journal on Control and Optimization
  - > 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

(last update : 2025-04-22)