

Zhijian Lai

Contact Information

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Research Interests

Mathematical Optimization, especially in Manifold Optimization, Machine Learning, Deep Reinforcement Learning, Quantum Interior Point Methods

Professional Profile

I have devoted myself to the optimization algorithms on manifolds, with a specific emphasis on variant problems characterized by nonsmooth objectives or additional constraints. I am actively engaged in exploring the possibilities of integrating Riemannian geometry into various classical optimization domains. Currently, I am deeply involved in self-studying advanced topics such as geodesic convex optimization, bilevel optimization, and multi-objective optimization.

Education

2021 – Present

University of Tsukuba – Ibaraki, Japan

Ph.D. in Policy and Planning Sciences (expected Mar. 2024)

Supervisor: [Prof. Akiko Yoshise](#)

Dissertation: “*Riemannian optimization algorithms for applications and their theoretical properties*”

2019 – 2021

University of Tsukuba – Ibaraki, Japan

M.S. in Policy and Planning Sciences

Supervisor: [Prof. Akiko Yoshise](#)

Dissertation: “*A new method for completely positive matrix factorization*”

2013 – 2017

Dongbei University of Finance and Economics – Dalian, China

B.Mgmt.

Publications and Preprints

2022

Zhijian Lai, Akiko Yoshise. “Riemannian Interior Point Methods for Constrained Optimization on Manifolds”. *arxiv.org/abs/2203.09762* (under review).

2022

Zhijian Lai, Akiko Yoshise. “Completely Positive Factorization by a Riemannian Smoothing Method”. *Comput. Optim. Appl.* **83**, 933–966 (2022).

Working Papers

2023

Xin Yang, **Zhijian Lai**, Qian Wu, Maiko Shigeno. “CLAP: A Contrastive Learning Structure for App-usage Prediction”.

2023

Xin Yang, **Zhijian Lai**, Qian Wu, Maiko Shigeno. “Hyperbolic Graph Contrastive Learning for Recommender System”.

Fellowship

- 2021 – Present Research fellowship of Support for **Pioneering Research Initiated by the Next Generation** (SPRING), funded by Japan Science and Technology Agency (JST).
 Research Topic: “*The development of optimization theory of Riemannian manifolds and cones and its application to mathematical information engineering*”.
 Fellowship Qualified Students (Class 1): Annual amount of 20,503 US dollars.
- 2023 The Institute of Statistical Mathematics Summer Travel Grant

Research Experience

- 2023 – Present **Research Assistant, University of Tsukuba**
 Research Assistant to Prof. Akiko Yoshise
 Research Project: *Theory and Implementation of General Algorithms for Constrained Optimization Problems on Riemannian Manifolds*.
- 2022 – Present **Research Assistant, University of Tsukuba**
 Research Assistant to Prof. Akiko Yoshise
 Research Project: *Development of New Data Collaboration Methods Based on Optimization Theory on Riemannian Manifolds*.
- 2022 fuller-inc.com **Fro, University of Tsukuba**

Teaching Experience

- 2021 – 2023 **University of Tsukuba, College of Policy and Planning Sciences**
 Teaching Assistant
 – FH61141, Society and Optimization, 2023 Fall
 – FH35012, Problem Identification and Resolution, 2022 Fall
 – FH61141, Society and Optimization, 2022 Fall
 – 0AL5100, Supply Chain Management, 2021 Fall
- 2019 – 2021 **University of Tsukuba, Graduate School of Science and Technology**
 Mathematics Tutoring for Graduate Admission Examination of Master’s Program in Policy and Planning Sciences
 – “Linear Algebra” subject for summer admission exams, Aug. 2021
 – “Calculus” subject for winter admission exams, Dec. 2019
 – “Calculus” subject for summer admission exams, Aug. 2019
 Each lasted for six weeks, totaling 12 hours of instruction. During the COVID-19 pandemic, I uploaded the course videos to the [Bilibili platform](#) to help those students in need.

2019 – 2021 **University-High School Collaboration Project: Optimizing Local Issues in the Community.**

This project is a part of the “Science Partner Project” supported by Japan Science and Technology Agency. Its aim is to allow high school students to discover problems from their living environment, propose solutions using optimization models and solvers. During 2019-2021, I had the privilege of serving as a TA for three consecutive years, where my responsibilities included guiding a group and overseeing the following topics:

- Equalizing the number of cafeteria users. (2019)
- Mitigating congestion caused by the decision of stops on the Tobu Isezaki Line. (2019)
- Selecting evacuation shelters during disasters. (2020)
- Developing a self-study schedule program to maximize efficiency. (2021)
- Collaborated with high school students to develop a model for mitigating overcrowding during tsunami evacuations in Hitachi City.
- Taught basic math and programming to the students while collecting data and conducting experiments.
- Assisted high school students in creating the final presentation.

Conference Talks

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| Aug. 2023 | ICIAM 2023, Tokyo, Japan. “ <i>Riemannian Interior Point Methods for Constrained Optimization on Manifolds</i> ”. |
| June 2023 | SIAM OP23, Seattle, US. “ <i>Interior Point Methods for Nonlinear Optimization on Riemannian Manifolds</i> ”. |
| May 2023 | RAOTA: Gathering of Young Researchers for the Future 2023, Tsukuba, Japan. “ <i>Riemannian Interior Point Methods for Constrained Optimization on Manifolds</i> ”. |
| Mar. 2023 | The 2023 spring national conference of Operations Research Society of Japan (ORSJ), Tokyo, Japan. “ <i>Riemannian Interior Point Methods for Constrained Optimization on Manifolds</i> ”. |
| Dec. 2022 | International Workshop on Continuous Optimization, Tokyo, Japan (virtual). “ <i>Riemannian Interior Point Methods for Constrained Optimization on Manifolds</i> ”. |
| Sep. 2022 | The 2022 autumn national conference of ORSJ, Niigata, Japan (virtual). “ <i>On the Global Convergence of Riemannian Interior Point Method</i> ”. |
| Sep. 2022 | JSIAM 2022 annual meeting, Sapporo, Japan. “ <i>On the Global Convergence of Riemannian Interior Point Method</i> ”. |
| Mar. 2022 | The 2022 spring national conference of ORSJ, Gunma, Japan (virtual). “ <i>Superlinear and Quadratic Convergence of Riemannian Interior Point Methods</i> ”. |
| July 2021 | SIAM OP21, Hong Kong (virtual). “ <i>Completely Positive Factorization via Orthogonality Constrained Problem</i> ”. |
| Aug. 2021 | Meeting 2021 of Kyoto University Research Institute for Mathematical Sciences, Kyoto, Japan (virtual). “ <i>Application of Smoothing Methods for Completely Positive Matrices via Orthogonality Constrained Problem</i> ”. |
| Mar. 2021 | The 2021 spring national conference of ORSJ, Tokyo, Japan (virtual). “ <i>Completely Positive Factorization via Orthogonality Constrained Problem</i> ”. |
| Aug. 2020 | Meeting 2020 of Kyoto University Research Institute for Mathematical Sciences, Kyoto, Japan (virtual). “ <i>A New Approach to the Recognition Problem of Completely Positive Matrices</i> ”. |

Posters

- Aug. 2023 Summer School on Continuous Optimization and Related Fields, Institute of Statistical Mathematics, Tokyo, Japan. “*Riemannian Interior Point Methods for Constrained Optimization on Manifolds*”.
- Mar. 2023 Poster Session of 2022 SPRING Fellowship, Tsukuba, Japan. “*Riemannian Interior Point Methods for Manifold Optimization*”.
- Mar. 2022 Poster Session of 2021 SPRING Fellowship, Tsukuba, Japan. “*Riemannian Optimization and Its Applications*”.

Professional Memberships

- 2021 – Present The Operations Research Society of Japan (ORSJ)
 Society for Industrial and Applied Mathematics (SIAM)
 The Institute for Operations Research and the Management Sciences (INFORMS)

Technical Skills

Computer Skills

Proficient in: Matlab, L^AT_EX, Mathematica, Zotero, Mathpix.

Familiar with: Python, GuRoBi, Xpress.

Languages

Chinese (Native), English (Fluent), Japanese (Advanced): JLPT N1.

Additional Education

- 2017 – 2019 ARC Tokyo Japanese Language School – Tokyo, Japan
 Graduate School Preparation Class

References

Prof. Akiko Yoshise

Graduate School of Science and Technology, University of Tsukuba, Ibaraki, Japan

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