Yueqi Cao

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RESEARCH INTERESTS

Geometric and topological data analysis, tropical geometry, manifold learning, nonparametric statistics

EDUCATION

2021 – 2025	**Ph.D. Mathematics**, Imperial College London	Supervisor: Anthea Monod
2018 – 2021	**M.Sc. Mathematics**, Beijing Institute of Technology	Supervisor: Huafei Sun
2014 – 2018	**B.Sc. Mathematics**, Beijing Institute of Technology	Supervisor: Huafei Sun

HONORS AND AWARDS

2025 Turing Scheme Grant – Global Fellows Fund, *Imperial College London*. [website]

2021 **President's PhD Scholarship**, *Imperial College London*. [website]

2019 National Scholarship for Graduate Students, *Ministry of Education of the People's Republic of China*.

2017 Innovation Scholarship of Industry and Information Technology of the People's Republic of China, *Ministry of Industry and Information Technology of the People's Republic of China*.

PUBLICATIONS

Preprints

1. **Y. Cao**, A. Monod. Computing the Tropical Abel–Jacobi Transform and Tropical Distances for Metric Graphs. arXiv:2504.11619.
2. P. Lezeau, T.Walker, **Y. Cao**, S. Bhatia, A. Monod. Tropical Expressivity of Neural Networks. arXiv:2405.20174.
3. R. Talbut, D. Tramontano, **Y. Cao**, M. Drton, A. Monod. Probability Metrics for Tropical Spaces of Different Dimensions. arXiv:2307.02846.
4. **Y. Cao**, A. Monod. Approximating Persistent Homology for Large Datasets. arXiv:2204.09155.

Publications

1. **Y. Cao**, A. Monod. A Geometric Condition for Uniqueness of Fréchet Means of Persistence Diagrams. *Computational Geometry: Theory and Applications*. 2025.
2. **Y. Cao**, P. Leung, A. Monod. k-Means Clustering for Persistent Homology. *Advances in Data Analysis and Classification*. 2024.
3. **Y. Cao**, A. Vlontzos, L. Schmidtke, B. Kainz, A. Monod. Topological Information Retrieval with Dilation-Invariant Bottleneck Comparative Measures. *Information and Inference: A Journal of IMA*. 2023.
4. **Y. Cao**, D. Li, H. Sun, A. H. Assadi, S. Zhang. Efficient Weingarten Map and Curvature Estimation on Manifolds. *Machine Learning*. 2021.
5. F. Sun, **Y. Cao**, S. Zhang, H. Sun. The Bayesian Inference of Pareto Models Based on Information Geometry. *Entropy*. 2021.

6. Y. Luo, S. Zhang, **Y. Cao**, H. Sun. Geometric Characteristics of the Wasserstein Metric on SPD(n) and Its Applications on Data Processing. *Entropy*. 2021.

7. J. Jin, S. Zhang, **Y. Cao**, E. Zhang, H. Sun. Rigid Shape Registration Based on Extended Hamiltonian Learning. *Entropy*. 2020.

8. Y. Wang, H. Sun, **Y. Cao**, S. Zhang. Torsion Discriminance for Stability of Linear Time-Invariant Systems. *Mathematics*. 2020.

9. N. W. Aung, **Y. Cao**, S. Zhang, H. Sun. The Geometric Approach of Riccati Equations. *Transactions of Beijing Institute of Technology (in Chinese)*. 2020.

10. **Y. Cao**, S. Zhang, F. Yan, W. Li, F. Sun, H. Sun. Unsupervised Environmental Sound Classification Based On Topological Persistence. *2019 IEEE International Conference on Signal, Information and Data Processing (ICSIDP)*. 2019.

11. S. Zhang, **Y. Cao**, W. Li, F. Yan, Y. Luo, H. Sun. A New Riemannian Structure in SPD(n). *2019 IEEE International Conference on Signal, Information and Data Processing (ICSIDP)*. 2019.

12. A. Xiong, A. Assadi, **Y. Cao**. Calculating Persistence Homology of Attractors in High-Dimensional Chaotic Systems. *2017 International Conference on Computational Science and Computational Intelligence (CSCI)*. 2017.

CONFERENCES

Invited Talks

Nov. 2024 Generalized Multiple Subsampling for Persistent Homology. *Applied Topology Seminar*. University of Oxford, UK.

Jul. 2024 Computational Tropical Abel–Jacobi Map for Metric Graphs. *Applied Algebra and Geometry, 19th meeting, Edinburgh*. University of Edinburgh, UK.

Jul. 2023 A Condition for the Uniqueness of Fréchet Means of Persistence Diagrams. *Minisymposium on Applied Algebraic Topology: Theory and Implementation, SIAM Conference on Applied Algebraic Geometry, Eindhoven*. Eindhoven University of Technology, the Netherlands.

Jul. 2022 Convergence of Empirical Fréchet Means in Alexandrov Spaces with Nonnegative Curvature. *Symposium on Information Geometry and Its Applications*. China West Normal University, Nanchong, China.

Contributed Talks/Posters

Oct. 2024 A Tropical Geometric Perspective on Deep Learning. *Scientific Discussion Meeting: Beyond the Symbols vs Signals Debate*. The Royal Society, UK.

Jun. 2024 A Tropical Geometric Perspective on Deep Learning. *Geometric Deep Learning workshop, Cambridge*. University of Cambridge, UK.

Jun. 2024 A Tropical Geometric Perspective on Deep Learning. *Mathematics PhD Symposium*. Imperial College London, UK.

Jun. 2022 A Condition for the Uniqueness of Fréchet Means of Persistence Diagrams. *Algebraic Topology: Methods, Computation and Science (ATMCS10), Oxford*. University of Oxford, UK.

Jun. 2022 A Condition for the Uniqueness of Fréchet Means of Persistence Diagrams. *Mathematics PhD Symposium*. Imperial College London, UK.

Jan. 2022 An Introduction to Topological Data Analysis. *Aalto-Imperial-TUM workshops on Algebraic Methods in Data Science*. Online.

Jul. 2018 Data Science from a Topological Viewpoint. *The Second International Conference on Mathematical Characterization, Analysis and Applications of Complex Information.* Beijing Institute of Technology, China.

TEACHING & SUPERVISION EXPERIENCES

Teaching Assistance

Imperial College London

- Sep 2024 – Jan 2025, MATH70103 – Unstructured Data Analysis, Machine Learning and Data Science (Online) MSc, Senior GTA.
- Jul 2024, Data Challenge, MSc in Statistics, GTA.
- Sep 2023 – Jan 2024, MATH70103 – Unstructured Data Analysis, Machine Learning and Data Science (Online) MSc, Senior GTA.
- Sep 2022 – Jan 2023, MATH70103 – Unstructured Data Analysis, Machine Learning and Data Science (Online) MSc, Senior GTA.

Beijing Institute of Technology

- Aug 2019 – Jan 2020, Mathematical Analysis.
- Aug 2018 – Jun 2019, Linear Algebra.

Co-Supervision

- 2021–2022, Prudence Leung, Imperial College London, MSc Statistics.

Research Assistance

- Beijing Key Laboratory on Mathematical Characterization, Analysis, and Applications of Complex Information. Director: Huafei Sun
- National Natural Science Foundation of China (NSFC) *No. 61179031*. PI: Huafei Sun
- National Natural Science Foundation of China (NSFC) *No. 11971056*. PI: Yuxing Deng