Zhengchao Wan

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Education

The Ohio State University — **Columbus, OH, USA**
Ph.D. in Mathematics — *2016-2021*
Advisor: Facundo Mémoli

Peking University — **Beijing, China**
B.S. in Mathematics — *2012-2016*
Advisor: Bin Dong

Employment

University of California San Diego — **La Jolla, CA, USA**
HDSI Postdoc Fellow — *2022-Present*
Mentors: Gal Mishne, Yusu Wang

Research Interests

My primary research interests lie in the development of novel mathematical tools and frameworks for understanding and analyzing complex data, with a focus on geometric and topological data analysis. My work spans across multiple domains, including probability theory, geometry, graph theory, and machine learning.

Publications

Author lists are in alphabetical order except where my name is in bold.

Papers in Journals

Facundo Mémoli, Axel Munk, Zhengchao Wan, and Christoph Weitkamp. The ultrametric Gromov-Wasserstein distance. *To appear in Discrete & Computational Geometry. arXiv preprint arXiv:2101.05756*, 2023.

Facundo Mémoli and Zhengchao Wan. Characterization of Gromov-type geodesics. *Differential Geometry and its Applications*, 88:102006, 2023.

Facundo Mémoli, Zane Smith, and Zhengchao Wan. The Gromov-Hausdorff distance between ultrametric spaces: its structure and computation. *To appear in Journal of Computational Geometry. arXiv preprint arXiv:2110.03136.*, 2023.

Facundo Mémoli, Zhengchao Wan, and Yusu Wang. Persistent laplacians: Properties, algorithms and implications. *SIAM Journal on Mathematics of Data Science*, 4(2):858–884, 2022.

Facundo Mémoli and Zhengchao Wan. On p-metric spaces and the p-Gromov-Hausdorff distance. *p-Adic Numbers, Ultrametric Analysis and Applications*, 14(3):173–223, 2022.

Zhengchao Wan. A novel construction of Urysohn universal ultrametric space via the Gromov-Hausdorff ultrametric. *Topology and its Applications*, 300:107759, 2021.

Papers in Peer-Refereed Conferences

Mitchell Black, Amir Nayyeri, Zhengchao Wan, and Yusu Wang. Understanding oversquashing in GNNs through the lens of effective resistance. *To appear in International Conference on Machine Learning (ICML). arXiv preprint arXiv:2302.06835*, 2023.

Thomas Davies, **Zhengchao Wan**, and Ruben Sanchez-Garcia. The persistent Laplacian for data science: Evaluating higher-order persistent spectral representations of data. *To appear in International Conference on Machine Learning (ICML). arXiv preprint arXiv:2302.06835*, 2023.

Gal Mishne, Zhengchao Wan, Yusu Wang, and Sheng Yang. The numerical stability of hyperbolic representation learning. *To appear in International Conference on Machine Learning (ICML). arXiv preprint arXiv:2211.00181*, 2023.

Aziz Burak Gülen, Facundo Mémoli, Zhengchao Wan, and Yusu Wang. A generalization of the persistent Laplacian to simplicial maps. *To appear in 39th International Symposium on Computational Geometry (SoCG). arXiv preprint arXiv:2302.03771.*, 2023.

Samantha Chen, Sunhyuk Lim, Facundo Mémoli, Zhengchao Wan, and Yusu Wang. Weisfeiler-Lehman meets Gromov-Wasserstein. In *International Conference on Machine Learning (ICML)*, pages 3371–3416. PMLR, 2022.

Facundo Mémoli, Zane Smith, and Zhengchao Wan. The Wasserstein transform. In *International Conference on Machine Learning (ICML)*, pages 4496–4504. PMLR, 2019.

Preprints

Tristan Brugère, Zhengchao Wan, and Yusu Wang. Distances for Markov chains, and their differentiation. *arXiv preprint arXiv:2302.08621 (submitted)*, 2023.

Samantha Chen, Sunhyuk Lim, Facundo Mémoli, Zhengchao Wan, and Yusu Wang. The Weisfeiler-Lehman distance: reinterpretation and connection with GNNs. *arXiv preprint arXiv:2302.00713*, 2023.

Sunhyuk Lim, Facundo Memoli, Zhengchao Wan, Qingsong Wang, and Ling Zhou. Some results about the Tight Span of spheres. *arXiv preprint arXiv:2112.12646*, 2021.

Kun Jin, Facundo Mémoli, and Zhengchao Wan. The Gaussian transform. *arXiv preprint arXiv:2006.11698*, 2020.

Computational Software / Expository Webpages

Persistent Laplacian (with F. Mémoli and Y. Wang)
https://github.com/ndag/Persistent-Laplacian

Gromov-Hausdorff distances between ultrametric spaces (with F. Mémoli and Z. Smith)
https://github.com/ndag/ultrametrics

The ultrametric Gromov-Wasserstein distances (with F. Mémoli, A. Munk and C. Weitkamp)
https://github.com/ndag/uGW

Talks

2ND SIAM Northern States Section Conference *April 2023*
Distances between Markov chains and their differentiation

EnCORE Student Meet at UCSD *Mar. 2023*
The numerical stability of hyperbolic representation learning

TDA Conference at University of Florida *Feb. 2023*
A generalization of the persistent Laplacian to simplicial maps

Computational Persistence 2022 *Oct. 2022*
Persistent Laplacians: properties, algorithms and implications

International Conference on Machine Learning (ICML) 2022 *July 2022*
Weisfeiler-Lehman meets Gromov-Wasserstein

Topology, Geometry and Data Analysis seminar at Ohio State *Oct. 2021*
The Gromov-Hausdorff distance between ultrametric spaces

Geometry and Topology meet Data Analysis and Machine Learning (GTDAML 2021) *July 2021*
Persistent Laplacians: properties, algorithms and implications

Seminar at Centre for Topological Data Analysis, Oxford University *May 2021*
Persistent Laplacians: properties, algorithms and implications

Algebraic Topology: Methods, Computation, and Science (hosted by AATRN) *Jan. 2021*
Computing the Gromov-Hausdorff distance between ultrametric spaces

Topology, Geometry, and Applications - Graduate Students Seminar at Ohio State *Oct. 2020*
Urysohn universal ultrametric space

Geometry, Topology and Data Seminar, Florida State University *Nov. 2019*
The Wasserstein transform

Topology, Geometry, and Applications - Graduate Students Seminar at Ohio State *Sep. 2019*
Gromov-Hausdorff distance between ultrametric spaces

Air Force Research Lab in Dayton, Ohio *July 2019*
The Wasserstein transform

Poster Presentations

Conference on the Mathematical Theory of Deep Neural Networks *Nov 2022*
A numerical comparison between Lorentz and Poincaré models for representation learning

TILOS Annual Retreat / Industry Day *Oct 2022*
WL-based distance for directed graphs with attributes and Markov chain metric spaces

International Conference on Machine Learning (ICML) 2019 *June 2019*
The Wasserstein transform

GTDAML2019, the Ohio State University *May 2019*
The Wasserstein transform

Geometric Data Analysis, University of Chicago *May 2019*
The Wasserstein transform

Honors and Awards

Special Graduate Assignments, the Ohio State University *Spring 2020*

ICML (International Conference on Machine Learning) Travel Award *June 2019*

Alumina Yizheng Distinguished Scholar Award, Peking University *Oct. 2014*

Jiang Zehan Scholarship, Peking University *Sep. 2013*

Teaching Experiences

DSC 214, University of California San Diego *Spring 2023*
Topological Data Analysis

MATH 1172, the Ohio State University *Spring 2021*
Engineering Mathematics A

MATH 1172, the Ohio State University *Autumn 2018*
Engineering Mathematics A

Mini-Course, Peking University *Summer 2016*
Information Geometry

Professional Services

Organization of activities

Midwest Student Conference GTDAML2019, the Ohio State University *June 2019*
Co-organizer

Referee

Journals
Analysis and Geometry in Metric Spaces
Computational Geometry: Theory and Applications
Discrete & Computational Geometry
Journal of Combinatorial Optimization
SIAM Journal on Applied Algebra and Geometry
Conferences
Symposium on Computational Geometry (2021, 2022, 2023)
ACM-SIAM Symposium on Discrete Algorithms (2019, 2023)
Conference on the Mathematical Theory of Deep Neural Networks (2022)