Sunhyuk Lim

The SungKyunKwan University (SKKU)
lsh3109@skku.edu
https://sites.google.com/view/sunhyuklim

Positions

Assistant Professor, The SungKyunKwan University (SKKU), The Department of Mathematics, 2023–present

Postdoc in Max Planck Institute for Mathematics in the Sciences, 2021–2023
(Mentor: Dr. Jürgen Jost)

Education

B.S in Mathematics, KAIST (South Korea), 2008–2013

Ph.D in Mathematics, The Ohio State University, August 2013–June 2015
(Advisor: Dr. Facundo Mémoli)

Leave of Absence for military service, July 2015–July 2017

Ph.D in Mathematics, The Ohio State University, August 2017–May 2021
(Advisor: Dr. Facundo Mémoli)

Research Interests

I am broadly interested in Metric/Differential/Spectral Geometry, Quantitative/Geometric Topology, Optimal Transport, and Topological/Geometric Data Analysis. I primarily exploit and study the interplay between the following concepts: filling radius, injective (hyperconvex) metric space, Gromov-Hausdorff (or, Gromov-Wasserstein) distance, quantitative Borsuk-Ulam theorem, generalized notions of curvature, Markov chain, Vietoris-Rips complexes, and multidimensional scaling.

Research Papers

- *Geometry, Topology, and Spectral Methods in Data Analysis: from Injective Metric Spaces, through Gromov-type Distances, to Generalized MDS.* **Ph.D dissertation.**

- *Vietoris-Rips Persistent Homology, Injective Metric Spaces, and The Filling Radius* (with Facundo Mémoli and Osman Berat Okutan). **Algebraic & Geometric Topology. To appear (accepted in 2022).** arXiv:2001.07588.

- *The Gromov-Hausdorff distance between spheres* (with Facundo Mémoli and Zane Smith). **Geometry & Topology 27-9 (2023), 3733–3800.** arXiv:2105.00611.

- *Weisfeiler-Lehman meets Gromov-Wasserstein* (with Samantha Chen, Facundo Mémoli, Zhengchao Wan, and Yusu Wang). **International Conference on Machine Learning (ICML), pages 3371–3416. PMLR, 2022.** arXiv:2202.02495.

- *The Weisfeiler-Lehman Distance: Reinterpretation and Connection with GNNs* (with Samantha Chen, Facundo Mémoli, Zhengchao Wan, and Yusu Wang). **ICML workshop: Topology, Algebra, and Geometry in Machine Learning (2023). To appear.** arXiv:2302.00713.

- *Classical Multidimensional Scaling on Metric Measure Spaces* (with Facundo Mémoli). **submitted.** arXiv:2201.09385.

- *Gromov-Hausdorff distances, Borsuk-Ulam theorems, and Vietoris-Rips complexes* (with Henry Adams et al). **submitted.** arXiv:2301.00246.

- *Some results about the Tight Span of spheres* (with Facundo Mémoli, Zhengchao Wan, Qingsong Wang, and Ling Zhou). arXiv:2112.12646.

- *Reverse Bernstein Inequality on the Circle* (with Jürgen Jost, Parvaneh Joharinad, and Rostislav Matveev). arXiv:2302.10122.

- *The Gromov-Wasserstein distance between spheres* (with Facundo Mémoli, Shreya Arya, Arnab Auddy, Ranthony Edmonds, and Daniel Packer). arXiv:2306.10586.

Talks and Poster Presentations

- *Measuring Dissimilarity between Markov Processes.* Poster presentation given in Geometric Data Analysis (GDA) 2019 at the University of Chicago.

- *Gromov-Markov distances between Markov processes.* Talk given in GTDAML Graduate Student Conference 2019 at the Ohio State University.

- *Talks in Mémoli's group seminars.* More than 18 research or expository talks about metric/differential geometry, quantitative/geometric topology, topological data analysis, optimal transport, and probability. Link: https://research.math.osu.edu/networks/etc/group-meetings

- *Vietoris-Rips Persistent Homology, Injective Metric Spaces, and The Filling Radius.* Talk given in TGDA seminar (via Zoom, 02/16/2021) at the Ohio State University.

- *Vietoris-Rips Persistent Homology, Injective Metric Spaces, and The Filling Radius.* Talk given in Metric Geometry, Network Analysis seminar (via Zoom, 02/16/2021) at the Max Planck Institute Mathematics in the Sciences.

- *The Gromov-Hausdorff distance between spheres.* Talk given in Metric Geometry, Network Analysis seminar (07/20/2021) at the Max Planck Institute Mathematics in the Sciences.

- *The Gromov-Hausdorff distance between spheres.* Talk given in AATRN Vietoris-Rips Online Seminar (via Zoom, 09/24/2021).

- *Classical MDS on metric measure spaces.* Talk given in Metric Geometry, Network Analysis seminar (02/15/2022) at the Max Planck Institute Mathematics in the Sciences.

- *Vietoris-Rips Persistent Homology, Injective Metric Spaces, and The Filling Radius.* Poster presentation given in Algebraic topology: Methods, Computation, and Science (ATMCS10) at the University of Oxford.

- *Hyperconvex spaces, Gromov-Hausdorff distance, and TDA*. Talk given in Nonlinear algebra seminar (11/17/2022) at the Max Planck Institute Mathematics in the Sciences.

- *Vietoris-Rips persistent homology, injective metric spaces, and the filling radius.* Talk given in Workshop on Topological Data Analysis: Mathematics, Physics and beyond (02/08/2023-02/10/2023) at the Korea Institute for Advanced Study.

- *The Gromov-Hausdorff distance between spheres.* Talk given in Differential Geometry Group (AG Tuschmann) Research Seminar (06/07/2023) at the KIT (Karlsruher Institut für Technologie).

- *Interplay between Persistent Homology, Filling radius, Hyperconvex space and Gromov-type distances.* Talk will be given in "Topological and geometric data analysis: theory and applications mini-symposia in ICIAM (International Congress on Industrial and Applied Mathematics) 2023 at the Waseda University.

- *TBD.* Talk will be given in JMM 2024 (Applied Topology: Theory, Algorithms, and Applications) at San Francisco, CA.

Professional Services

Organization of activities

- Midwest Student Conference GTDAML2019, the Ohio State University, June 2019 (co-organizer)
- Bridging Applied and Quantitative Topology Online Workshop, May 9–13 2022 (co-organizer)
- AATRN Vietoris-Rips Online Seminar, 2022–present (co-organizer)

Referee

- International Symposium on Computational Geometry (SoCG)
- Journal of Applied and Computational Topology (APCT)
- Journal of the Royal Statistical Society: Series B

Teaching Experiences

TA of Mathematics *Spring 2014 to Autumn 2020*

Preparation and presentation of lectures, supervision of exams, grading homework, quizzes, exams for the course.

Math 1151	Calculus I	Spring 2014
Math 1151	Calculus I	Autumn 2014
Math 1172	Eng Math A	Spring 2015
Math 1151	Calculus I	Autumn 2017
Math 1151	Calculus I (hybrid teaching)	Autumn 2020

Scholarships

- National Science & Technology Scholarship (by South Korea Government) 2008-2011.
- Special Graduate Assignments (The Ohio State University) Spring 2019, Spring 2020.