

Woojin Kim

Email	wojin@math.duke.edu
Webpage	https://wj-kim.com
Office	Physics Building 241, Duke Univ.
Phone	+1 919 660 2810
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Employment / Education

CV — short vers.

- Aug 2020 - July 2023** - **Duke University**, NC
William W. Elliott Assistant Research Professor of Mathematics (Mentor: Ezra Miller)
- May 2020** - **The Ohio State University**, OH
Ph.D. in Mathematics
Thesis: The Persistent Topology of Dynamic Data (Advisor: Facundo Mémoli)
- Aug 2014** - **Seoul National University**, South Korea
B.S. in Mathematics Education (with Honors)
Korean National Secondary Teacher Certificate (Grade II) of Math

Research interests

Theoretical Foundations of Topological Data Analysis, Multiparameter Persistence Theory, Computational Topology. I primarily exploit concepts from algebraic & combinatorial topology, (algebraic) combinatorics, metric geometry, commutative algebra, representation theory, and category theory, blending these with ideas of *persistence* in topological data analysis. I also often run into computational geometry & topology questions during my research.

Papers (Author names are listed in alphabetical order in every publication)

Peer-reviewed journals & Preprints (■: published or accepted, □: in preprint)

- **Generalized persistence diagrams for persistence modules over posets**, with F. Mémoli, To appear in Journal of Applied and Computational Topology, arXiv preprint (47 pages), 2021.
- **Elder-rule-staircodes for augmented metric spaces** (with C. Chen, F. Mémoli, Y. Wang), To appear in SIAM Journal of Applied Algebra and Geometry, arXiv preprint (41 pages), 2021.
- **Spatiotemporal persistent homology for dynamic metric spaces** (with F. Mémoli), Discrete & Computational Geometry, Paper link, arXiv preprint (45 pages), 2020.
- **Interleaving by parts for persistence in a poset** (with F. Mémoli, A. Stefanou), arXiv/1912.04366 (30 pages), Last update: Jan, 2021.
- **Stable signatures for dynamic graphs and dynamic metric spaces via zigzag persistence**, (with F. Mémoli), arXiv/1712.04064 (58 pages), Last update: Aug, 2018.

Peer-reviewed conference papers

- Analysis of dynamic graphs and dynamic metric spaces via zigzag persistence** (with F. Mémoli, Z. Smith), The Proceedings of Abel Symposium on Topological Data Analysis, Paper link (18 pages), 2020.
- Elder-rule-staircodes for augmented metric spaces** (with C. Chen, F. Mémoli, Y. Wang), The Proceedings of the 36th International Symposium on Computational Geometry (SoCG), Paper link (17 pages), 2020.
- Formigrams: Clustering Summaries of Dynamic Data** (with F. Mémoli), The Proceedings of the 30th Canadian Conference on Computational Geometry Paper link (9 pages), 2018.

Extended Abstracts

- Stable signatures for dynamic metric spaces via persistent homology** (with F. Mémoli) in *Statistics for Data with Geometric Structure*. Oberwolfach Report, 3 (2018), p.169-172.

Computational software / Expository webpages

Spatiotemporal persistent homology (with N. Clause) <https://github.com/ndag/PHoDMSs>

Elder-rule-staircodes (with C. Cai, F. Memoli, Y. Wang) <https://github.com/Chen-Cai-OSU/ER-staircode/>

Classification of collective behaviors via zigzag persistent homology (with Z. Smith)
<https://research.math.osu.edu/networks/formigrams/>

Formigramator (with D. Verano, F. Mémoli) <https://research.math.osu.edu/networks/formigramator/>

Talks (■: invited or symposium, □: contributed or in-department, ♣: poster presentations)

■ AMS Southeastern Sectional Meeting, U of Alabama TBD	September 2021
■ Metrics in Multiparameter Persistence, Lorentz Center in Netherland (virtual) The Persistent Topology of Dynamic Data	July 2021
□ Topological Insight in Neuroscience at MSRI, Berkeley (virtual) The Persistent Topology of Dynamic Data	May 2021
□ Topological Data Analysis at IMSI, Chicago (virtual) Interleaving by Parts for Persistence In a Poset	April 2021
■ Topological Data Analysis seminar at Purdue University (virtual) The Persistent Topology of Dynamic Data	March 2021
■ DynamIC seminar at Imperial College London (virtual) The Persistent Topology of Dynamic Data	March 2021
■ Second Symposium on Machine Learning and Dynamical Systems, Fields Institute (virtual). Spatiotemporal persistent homology for dynamic metric spaces	September 2020
□ The Grad-Faculty seminar at Duke Univ (virtual). The Persistent Topology of Dynamic Data	September 2020
■ The 36th International Symposium on Computational Geometry (virtual) Elder-rule-staircodes for augmented metric spaces	June 2020
□ Algebraic Topology: Methods, Computation, and Science (hosted by AATRN, virtual) Spatiotemporal persistent homology for dynamic metric spaces	June 2020
■ The University of Florida Topological Data Analysis workshop Generalized persistence diagrams for persistence modules over posets	January 2020
■ The Joint Mathematics Meetings 2020 in Denver, Colorado (Special Session on Applied Topology) Spatiotemporal persistent homology for dynamic metric spaces	January 2020
■ Topology seminar at Colorado State Generalized persistence diagrams for persistence modules over posets	October 2019
□ Union College Math Conference (Applied Topology Session) Generalized persistence diagrams for persistence modules over posets	September 2019
■ Applied Topology seminar, University at Albany, SUNY Spatiotemporal persistent homology for dynamic metric spaces	September 2019
□ Topology, Geometry and Data Analysis seminar at Ohio State Generalized persistence diagrams for persistence modules over posets	September 2019
■ Air Force Research Lab in Dayton, Ohio Topological data analysis of time-evolving metric data	July 2019
♣ Midwest Student Conference: Geometry and Topology meet Data Analysis and Machine Learning Persistent homology for dynamic metric spaces	June 2019
♣ TGDA@OSU: Structure in the micro-world Persistent homology for dynamic metric spaces	May 2019
♣ Conference on Geometric Data Analysis at University of Chicago Persistent homology for dynamic metric spaces	May 2019
□ Great Lake SIAM at University of Michigan Multiparameter persistent homology for time-varying metric data	April 2019
□ Mathematics Graduate Student Association Lecture at Ohio State Rank of a diagram and its application in topological data analysis	April 2019
■ Brown-bag seminar at the Dept of CMSE, Michigan State Multiparameter persistent homology for time-varying metric data	April 2019
■ Bubenik's research group meeting at University of Florida Rank invariant and generalized persistence diagrams for zigzag persistence	March 2019

- **Topology seminar at Florida State** March 2019
Persistent homology for time-evolving metric/network data
- **Topology, Geometry, and Applications - Graduate Students Seminar at Ohio State** February 2019
Multiparameter persistent homology for time-varying metric data
- ♣ **Workshop on Applied Topology at Kyoto Univ** January 2019
Rank invariant for zigzag modules
- **Topology, Geometry, and Applications - Graduate Students Seminar at Ohio State** November 2018
Rank for arbitrary diagrams
- **The 30th Canadian Conference on Computational Geometry, University of Manitoba** August 2018
Formigrams: Clustering summaries of dynamic data
- **AMS Spring Central Sectional Meeting at Ohio State** March 2018
Stable signatures for dynamic metric spaces via zigzag persistent homology
- **Dept. of Mathematics Education, Seoul National University** July 2016
Topological and geometric ideas in data analysis
- **More than 30 Talks in Mémoli's group seminars or course work** 2015 - 2020
More than 30 research or expository talks about topological data analysis, networks, optimal transport, probability, and differential/metric geometry. Links: 1, 2, 3, 4, 5, 6

Awards

Special Graduate Assignments OSU Math department fellowship (exemption from teaching duty) Spring 2018, Spring 2020

Travel Grants for 9 conference attendances: U of Florida (2020), AMS (2020), Brown (2019), U of Chicago (2019), U of Michigan (2019), Kyoto Univ (2019), U of Minnesota (2018), U of Bonn (2018), Carnegie Mellon (2017)

Services

Journal Referee

Algebras and Representation Theory (Springer)
 Algorithms - Special Issue on Topological Data Analysis (MDPI)
 Computational Geometry: Theory and Applications (Elsevier)
 Discrete & Computational Geometry (Springer)
 Foundations of Data Science (AIMS)
 Journal of Applied and Computational Topology (Springer)
 Proceedings of International Symposium on Computational Geometry (2019, 2020, 2021)
 Research in Computational Topology (Springer)

Mentor of Twoples, Mentee list:

- Andrew Dias (an undergrad at Southern New Hampshire Univ.) Spring 2021

Twoples (website) is a mentorship program for undergraduates interested in pursuing a research-based graduate degree in math. Twoples especially aims to provide such mentorship to students from underrepresented groups or non-traditional backgrounds, as well as to students at non-research oriented colleges and universities.

Talks in professional development seminars in Mémoli's group at Ohio State

- How to prepare a talk, and use of Beamer July 2021
- On the final year in a Math Ph.D. program and job applications January 2021

Thesis Committee

- Joey Li (an undergrad at Duke), title: *Algebraic data structures for decomposing multipersistence modules* Autumn 2020

Vlearn faculty member (invited to informal meetings by Duke undergraduate students) Autumn 2020 -

Mentor for TA training mentor at OSU-Math Dept. (selected by TA coordinator) Summer 2019
for all Math graduate students who start teaching

Chair of the organizing committee for The 1st Midwest Graduate Student Conference: Geometry and Topology meet Data Analysis and Machine Learning (GTDAML 2019) Spring 2019

Organizer of activities in Network Data Analysis group at OSU 2018-2019

Teaching Experience

Combinatorics	Fall 2021
Linear Algebra and Differential Equations (Discussion) (3 sections)	Spring 2021
Multivariable Calculus (Discussion) (3 sections)	Fall 2020
Introduction to Applied Algebraic Topology , Lecturer for 2 weeks A substitute for the original lecturer Tom Needham	Spring 2019
Calculus for Engineers A (Recitation) (2 sections)	Fall 2016
Calculus 2 (Recitation) (2 sections)	Spring 2016
Calculus 3 and Topics for Engineers , Tutor Tutored 4 hours per week at Math and Stat Learning Center, OSU	Fall 2014, Spring 2015, Fall 2015