

Woojin Kim

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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.

Publications [Link to Google Scholar](#)

Author names are listed in alphabetical order in every publication. * Graduate students

- Computing Generalized Rank Invariant for 2-Parameter Persistence Modules via Zigzag Persistence and its Applications** (with T. Dey, F. Mémoli), arXiv/2111.15058 (21 pages) 2021
- The Generalized Persistence Diagram Encodes the Bigraded Betti Numbers** (with S. Moore*), arXiv/2111.02551 (22 pages) 2021
- Interleaving by parts for persistence in a poset** (with F. Mémoli, A. Stefanou), arXiv/1912.04366 (30 pages), Last update: Jan, 2021. 2021
- Elder-rule-staircodes for augmented metric spaces** (with C. Chen*, F. Mémoli, Y. Wang), SIAM Journal of Applied Algebra and Geometry, 5 (3) pp. 417-454 (38 pages), Paper link 2021
- Generalized persistence diagrams for persistence modules over posets** (with F. Mémoli), Journal of Applied and Computational Topology, 5, pp. 533–581 (48 pages), Paper link 2021
- Spatiotemporal persistent homology for dynamic metric spaces** (with F. Mémoli), Discrete & Computational Geometry, 66, pp.831–875 (44 pages) Paper link 2021
- The Persistent Topology of Dynamic Data**, Ph.D. Thesis, Link (244 pages) 2020
- 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
- Stable signatures for dynamic graphs and dynamic metric spaces via zigzag persistence**, (with F. Mémoli), arXiv/1712.04064 (58 pages), Last update: Aug, 2018 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, p.169-172. 2018

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 Spring Sectional Meeting, U of Virginia** March 2022
TBD (about multiparameter persistence)
- **AMS Southeastern Spring Sectional Meeting, U of Virginia** March 2022
TBD (about algebraic combinatorics and topological data analysis)
- **AMS Southeastern Sectional Meeting, U of Alabama (virtual)** November 2021
Persistent Cluster Analysis in Dynamic Data via Möbius Inversion
- **Topology and Data seminar, U of Oklahoma (virtual)** November 2021
Persistent Cluster Analysis in Dynamic Data via Möbius Inversion
- **Metrics in Multiparameter Persistence, Lorentz Center in Netherland (virtual)** July 2021
The Persistent Topology of Dynamic Data
- **Topological Insight in Neuroscience at MSRI, Berkeley (virtual)** May 2021
The Persistent Topology of Dynamic Data
- **Topological Data Analysis at IMSI, Chicago (virtual)** April 2021
Interleaving by Parts for Persistence In a Poset
- **Topological Data Analysis seminar at Purdue University (virtual)** March 2021
The Persistent Topology of Dynamic Data
- **DynamIC seminar at Imperial College London (virtual)** March 2021
The Persistent Topology of Dynamic Data
- **Second Symposium on Machine Learning and Dynamical Systems, Fields Institute (virtual).** Sept. 2020
Spatiotemporal persistent homology for dynamic metric spaces
- **The Grad-Faculty seminar at Duke Univ (virtual).** September 2020
The Persistent Topology of Dynamic Data
- **The 36th International Symposium on Computational Geometry (virtual)** June 2020
Elder-rule-staircodes for augmented metric spaces
- **Algebraic Topology: Methods, Computation, and Science (hosted by AATRN, virtual)** June 2020
Spatiotemporal persistent homology for dynamic metric spaces
- **The University of Florida Topological Data Analysis workshop** January 2020
Generalized persistence diagrams for persistence modules over posets
- **The Joint Mathematics Meetings 2020 in Denver, Colorado (Special Session on Applied Topology)** Jan. 2020
Spatiotemporal persistent homology for dynamic metric spaces
- **Topology seminar at Colorado State** October 2019
Generalized persistence diagrams for persistence modules over posets
- **Union College Math Conference (Applied Topology Session)** September 2019
Generalized persistence diagrams for persistence modules over posets
- **Applied Topology seminar, University at Albany, SUNY** September 2019
Spatiotemporal persistent homology for dynamic metric spaces
- **Topology, Geometry and Data Analysis seminar at Ohio State** September 2019
Generalized persistence diagrams for persistence modules over posets
- **Air Force Research Lab in Dayton, Ohio** July 2019
Topological data analysis of time-evolving metric data
- ♣ **Midwest Student Conference: Geometry and Topology meet Data Analysis and Machine Learning** June 2019
Persistent homology for dynamic metric spaces
- ♣ **TGDA@OSU: Structure in the micro-world** May 2019
Persistent homology for dynamic metric spaces
- ♣ **Conference on Geometric Data Analysis at University of Chicago** May 2019
Persistent homology for dynamic metric spaces
- **Great Lake SIAM at University of Michigan** April 2019
Multiparameter persistent homology for time-varying metric data

- **Mathematics Graduate Student Association Lecture at Ohio State** April 2019
Rank of a diagram and its application in topological data analysis
- **Brown-bag seminar at the Dept of CMSE, Michigan State** April 2019
Multiparameter persistent homology for time-varying metric data
- **Bubenik's research group meeting at University of Florida** March 2019
Rank invariant and generalized persistence diagrams for zigzag persistence
- **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), JMM-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, 2022)
 Research in Computational Topology (Springer)

Organizing conferences

- Co-organizer of Special Session on Algebraic Combinatorics and Category Theory in Topological Data Analysis in AMS Spring Southeastern Sectional Meetings March 2022
- Chair of the organizing committee for The 1st Midwest Graduate Student Conference: Geometry and Topology meet Data Analysis and Machine Learning June 2019

Mentor of Twoples, Mentee list:

- Elly Do (Dickinson College) Fall 2021
- Andrew Dias (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 (undergrad at Duke), *Algebraic data structures for decomposing multipersistence modules* Fall 2020

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

TA training mentor (selected by TA coordinator) Summer 2019
for all Math graduate students who start teaching at Ohio State

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

Teaching

Duke

- Probability** (Math 230) Spring 2022
- Combinatorics** (Math 371) Fall 2021
- Linear Algebra and Differential Equations - Discussion Sessions** (Math 216D - 3 sections) Spring 2021
- Multivariable Calculus - Discussion Sessions** (Math 212D -3 sections) Fall 2020

Ohio State

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