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RESEARCH AREA

Quantitative, algorithmic, and stochastic aspects of geometry and topology

EMPLOYMENT

University of California, Santa Barbara, CA, USA

Associate Professor (with tenure) **from July 2023**
Assistant Professor **September 2019–June 2023**

Ohio State University, Columbus, OH, USA

Research Visiting Assistant Professor **August 2017–August 2019**

University of Toronto, ON, Canada

Postdoctoral Fellow **July 2015–June 2017**

EDUCATION

University of Chicago, Chicago, IL, USA

Ph.D., Mathematics **June 2015**
- Dissertation: Asymptotic invariants of homotopy groups
- Advisor: Shmuel Weinberger

M.S., Mathematics **June 2011**

California Institute of Technology, Pasadena, CA, USA

B.S., Mathematics **June 2009**

VISITING POSITIONS

Israel Institute of Advanced Studies, Jerusalem

Visiting Scholar **November–December 2017**
Geometric, Topological and Computational Aspects of High-Dimensional Combinatorics

Mathematical Sciences Research Institute, Berkeley, CA, USA

Research Member, *Geometric & Topological Combinatorics* **September–October 2017**

PUBLICATIONS & PREPRINTS

1. **Quantitative PL bordism** (with Shmuel Weinberger).
   Preprint, arXiv:2311.16389 (2023), submitted.
2. **On Freedman's link packings** (with Elia Portnoy).
   Preprint, arXiv:2308.08064 (2023), submitted.
3. **Local behavior of the Eden model on graphs and tessellations of manifolds** (with Dongming (Merrick) Hua, Tahda Queer, and Tianyi Wang).
   Accepted for publication in the *Journal of Applied & Computational Topology*.
4. **Degrees of maps and multiscale geometry** (with Aleksandr Berdnikov and Larry Guth).
   Forum of Mathematics, Pi **12** (2024), article e2.

5. **Positive weights and self-maps**.
Proceedings of the AMS **150** (2022) no. 10, 4557–4566.
6. **Configuration spaces of disks in a strip, twisted algebras, persistence, and other stories** (with Hannah Alpert).
Geometry & Topology **28** (2024) no. 2, 641–700.
7. **High-dimensional holeyominoes** (with Greg Malen and Érika Roldán Roa).
Electronic Journal of Combinatorics **29** (2022) P3.15.
8. **Homological filling functions with coefficients** (with Xingzhe Li)
Groups, Geometry & Dynamics **16** (2022) no. 3, 889–907.
9. **Filling random cycles.**
Commentarii Mathematici Helvetici **96** (2021) no. 3, 561–588.
10. **Rational homotopy type and computability.**
Foundations of Computational Mathematics **23** (2023) no. 5, 1817–1849.
11. **Topology and local geometry of the Eden model**
(with Érika Roldán Roa and Benjamin Schweinhart).
Discrete & Computational Geometry **69** (2023) no. 3, 771–799.
12. **Scalable spaces** (with Aleksandr Berdnikov).
Inventiones mathematicae **229** (2022) no. 3, 1055–1100.
13. **A hardness of approximation result in metric geometry**
(with Zarathustra Brady and Larry Guth).
Selecta Mathematica **26** (2020), no. 4 art. 54.
14. **Algorithmic aspects of immersibility and embeddability** (with Shmuel Weinberger).
Preprint, arXiv:1812.09413 (2018), submitted.
15. **A zoo of growth functions of mapping class sets.**
J. of Topology and Analysis **12** (2020), no. 3, 841–855.
16. **Integral and rational mapping classes** (with Shmuel Weinberger).
Duke Math. J. **169** (2020), no. 10, 1943–1969.
17. **Plato's cave and differential forms.**
Geometry & Topology **23** (2019), no. 6, 3141–3202.
18. **Quantitative nullhomotopy and rational homotopy type.**
(with Gregory R. Chambers and Shmuel Weinberger)
Geometric and Functional Analysis (GAFA) **28** (2018), no. 3, 563–588.
19. **Quantitative nullcobordism.**
(with Gregory R. Chambers, Dominic Dotterrer, and Shmuel Weinberger)
J. of the AMS **31** (2018), no. 4, 1165–1203.
    - **Appendix: The Gromov–Guth–Whitney embedding theorem.**
    (with Shmuel Weinberger)
20. **Volume distortion in homotopy groups.**
Geometric and Functional Analysis (GAFA) **26** (2016), no. 2, 607–679.
21. **The complexity of nonrepetitive edge coloring of graphs.**
Preprint, arXiv:0709.4497, (2007). 19 pages.

Funding and awards

Individual grant DMS-2204001, National Science Foundation **2022–2025**

Sloan Fellowship **2021–2023**

Individual grant DMS-2001042, National Science Foundation **2019–2022**

AMS–Simons Travel Grant **2018–2019**

Mentorship

Postdoctoral:

- Geunho Lim (now postdoc at Hebrew University) **2020–23**

Graduate advising:

- John White (UCSB) **PhD 2027–8** (expected)
- Jeremy Khoo (UCSB) **PhD 2026–7** (expected)
- Troy Kling (UCSB) **PhD 2026** (expected)
- Kyle Hansen (UCSB) **PhD 2025** (expected)
- Daniel Epelbaum (UCSB) **PhD 2024** (expected)

Undergraduate research:

- Merrick Hua and Tianyi Wang (UCSB) and Tahda Queer (CUNY) **Summer 2022**
  Summer research through UCSB REU resulting in a joint paper
- Ely Jrade and Noah Ortiz (Caltech) **Winter–Summer 2021**
  Reading and research culminating in a Summer Undergraduate Research Fellowship (SURF)
- Xingzhe Li (UCSB '22, now at Cornell) **Winter–Summer 2020**
  MATH 199 reading and research, summer research resulting in a joint paper
- Transito-Bryan Gonzalez (UCSB) **Spring–Summer 2020**
  MATH 199 reading and research, summer research in mathematical physics

Research talks

Seminars: Louisiana–Lafayette (online), Chicago **2024**

Joint Mathematics Meetings, San Francisco, two sessions: **January 4–7, 2024**

- Bridging Applied and Quantitative Topology
- Modern Developments in the Theory of Configuration Spaces

Seminars: NYU, Princeton, Michigan, Penn (online), KIT, Maryland, Vanderbilt **2023**

LMS Workshop: Applied Algebaic Topology **January 31–February 1, 2022**
Online, hosted by Queen Mary University of London

Seminars: Penn State (colloquium, online), AATRN Vietoris–Rips Seminar (online), Chicago **2022**

Minisymposium on computational topology, part of CGWeek **June 7–11, 2021**
Online, hosted by University at Buffalo

Seminars (online): Penn State x2, Ohio State, Universidade Federal do Ceará, **2021**
University of Minnesota (colloquium), Max Planck Institute

Manifolds and Groups, Oberwolfach **February 10–14, 2020**

Seminars (online): Caltech, ZOOMerFEST (Higher School of Economics, Moscow) **2020**

Filling Volumes, Geodesics, and Intrinsic Flat Convergence **July 29–Aug. 2, 2019**
Yale University

Dubrovnik IX: Topology and Dynamical Systems **June 24–28, 2019**
Inter-University Centre Dubrovnik

LG&TBQ, University of Michigan **June 10–14, 2019**

Workshop on Riemannian and simplicial volume **April 8–11, 2019**
Karlsruhe Institute of Technology

Spring Topology & Dynamical Systems Conference **March 14–16, 2019**
University of Alabama at Birmingham

Seminars: UCSB (colloquium), Michigan, Purdue, Stony Brook, **2019**
Chicago (colloquium), Penn, Stanford, Berkeley

Singularities: Geometric, Topological, and Analytic Aspects **Aug. 13–17, 2018**
MPS Conference, Simons Foundation

Algebraic Topology: Methods, Computation and Science (ATMCS8) **June 25–29, 2018**
IST Austria

AMS Spring Sectional Meeting, Columbus **March 17–18, 2018**
Special session on Topology and Geometry in Data Analysis

Seminars: Wayne State, Max Planck, NYU, Rice, UIC (colloquium), Chicago **2018**

"Quantitative topology" **Nov. 30 & Dec. 14, 2017**
Lectures 3 & 4 of a four-part series at the Israel Institute for Advanced Studies

Mathematical Congress of the Americas, Montreal **July 23–28, 2017**
Special session on Quantitative Geometry and Topology

Applied Topology Będlewo 2017, Będlewo, Poland **June 20–25, 2017**

Seminars: Chicago, Stanford, Ohio State (topology and geometry in data analysis), **2017**
Hebrew U. (combinatorics), IST Austria

Workshop in Geometric Topology, Colorado College **June 9–11, 2016**

Stanford University Topology Seminar **May 17, 2016**

Spring Topology and Dynamics Conference, Baylor University **March 10–13, 2016**

University of Toronto Geometry and Topology Seminar **Nov. 23, 2015**

Workshop in Geometric Topology, Texas Christian University **June 25–27, 2015**

Spring Topology and Dynamics Conference **May 14–16, 2015**
Bowling Green State University

IST Austria Geometry and Topology Seminar **April 22, 2015**

Ohio State University Topology Seminar **Jan. 27, 2015**

MIT Geometric Analysis Seminar **Nov. 17, 2014**

Workshop: Metric Geometry, Geometric Topology and Groups **Aug. 5, 2013**
Banff International Research Station

Teaching experience

At UCSB

MATH CS 120 TC, *Topics in mathematics: Topological combinatorics* **Spring 2024**
MATH 227C, *Topics in algebraic and geometric topology* **Spring 2024**
Focusing on geometry of nilpotent groups
MATH 221B, *Homotopy theory* (the fundamental group) **Winter 2024**
MATH 113, *Non-Euclidean geometry* **Fall 2023**
MATH 227C, *Topics in algebraic and geometric topology* **Spring 2022**
Focusing on quasi-isometry invariants of groups
MATH CS 120 SY, *Topics in mathematics: Symmetry* **Winter 2022**
Flipped-classroom course in the College of Creative Studies. Strong first-year students were introduced to geometric group theory.
MATH CS 128, *Intro. to higher mathematics* **Fall 2021**
Flipped-classroom course in the College of Creative Studies.
MATH 221A, *Topology* (point-set topology) **Fall 2021**
MATH 147A, *Intro. to differential geometry* **Spring 2021**
MATH 232B, *Algebraic topology* (cohomology) **Spring 2021**
MATH 227A, *Topics in algebraic and geometric topology* **Fall 2020**
Focusing on rational homotopy theory.
MATH 108B, *Advanced linear algebra* (Jordan form, inner products, etc.) **Spring 2020**
MATH 111B, *Abstract algebra* (ring theory) **Winter 2020**
MATH 232A, *Algebraic topology* (homology) **Fall 2019 & Fall 2022**

Instructor, Ohio State University
MATH 4507 (*Geometry*) **Spring 2019**
Classical Euclidean and non-Euclidean geometry, taught in a flipped classroom setting.
MATH 2255 (*Ordinary differential equations & applications*) **Fall 2018**
MATH 2568 (*Linear algebra*) **Spring 2018**

Instructor, University of Toronto
MAT137Y1 (*Calculus!*) **2015–17**

Lecturer in the College, University of Chicago
Instructor for MATH 131 and 132 (*Elementary functions and calculus I and II*) **2011–12**
Instructor for MATH 195 and 196
(*Mathematical methods for the social sciences* and *Linear algebra*) **2012–14**
Instructor for MATH 152 and 153 (*Calculus II and III*) **2014–15**

College Fellow, University of Chicago **Sep 2010 – June 2011**
Teaching assistant for MATH 161–3 (*Advanced Calculus I, II, and III*),
Inquiry-Based Learning (Moore method) section.

Mentor, Canada/USA MathCamp **July – Aug 2010**
Counselor and teacher on various higher mathematical topics to advanced high school students.

Teaching Assistant, Caltech
Ma/CS 117a and b (*Computability Theory*) **Sep 2008 – March 2009**
CS 21 (*Decidability and Tractability*) **Jan – March 2008**

Service

Conference and seminar organization:

- *Quantitative Topology and Beyond* — **February 21–23, 2024**
  Simons Foundation — co-organizer
- *Spring Topology & Dynamics Conference* — **March 18–21, 2022**
  Baylor University — Geometric Topology session co-organizer
- *Topology and geometry: extremal and typical* — **2020–2021**
  Online seminar series — co-organizer with Shmuel Weinberger
- *Spring Topology & Dynamics Conference* — **March 18–21, 2020**
  Murray State University, Kentucky (cancelled) — Geometric Topology session co-organizer
- *Weekend Regional Workshop on Quantitative Topology & Geometry* — **April 27–28, 2019**
  MRI, Ohio State University — co-organizer with Hannah Alpert

Refereeing and quick opinions for *Algebraic & Geometric Topology*, *Collectanea Math.*, *Comms. in Analysis and Geometry*, *Crelle's Journal*, *Discrete & Computational Geometry*, *Duke Math. J.*, *Foundations of Computational Math.*, *Geometriae Dedicata*, *Geometric & Functional Analysis (GAFA)*, *Geometry & Topology*, *Homology Homotopy and Applications*, *International Math. Research Notices IMRN*, *J. of Applied and Computational Topology*, *J. of the London Math. Society*, *J. of Topology & Analysis*, *Pacific J. of Math.*, ACM–SIAM Symposium on Discrete Algorithms (SODA), *Topology and its Applications*, *Transactions of the AMS*

Outreach talks for undergraduates:

Zoom talk at OURFA^{2}M^2 — **November 2023**
(Online Undergraduate Resource Fair for the Advancement and Alliance of Marginalized Mathematicians)

YouTube video talk for Christina Sormani's series "Inspiring Talks in Mathematics" — **June 2021**

Augustana University colloquium — **September 2021**

FTE Committee, UCSB Math Department — **2023–24**

Geometry Hiring Committee, UCSB Math Department — **2023–24**

VAP Hiring Committee, UCSB Math Department — **2021–24**

Undergraduate Committee, UCSB Math Department — **2019–Fall 2022**

- Faculty mentor — **2021–Fall 2022**

Diversity, Equity & Inclusion Committee, UCSB Math Department — **Fall 2020**

Old awards

McCormick Fellowship, University of Chicago — **2009–2011**

Bhansali Prize, Caltech — **2008**
Awarded to a Caltech undergraduate student for outstanding research in computer science (research on computational complexity theory with Chris Umans)

Barry M. Goldwater Scholarship, US Government — **2008**
National merit scholarship given to 300 math, science, and engineering undergraduates, out of 4 nominated by each participating school

Upper Class Merit Award, Caltech — **2008**
Full tuition scholarship given to Caltech sophomores and juniors