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RESEARCH AREA   Quantitative, algorithmic, and stochastic aspects of geometry and topology

EMPLOYMENT

University of California, Santa Barbara, CA, USA

Assistant Professor (tenure-track) **from September 2019**

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. **Degrees of maps and multiscale geometry** (with Aleksandr Berdnikov and Larry Guth). Preprint, arXiv:2207.12347 (2022), submitted.

2. **Positive weights and self-maps**. *Proceedings of the AMS* **150** (2022) no. 10, 4557–4566.

3. **Configuration spaces of disks in a strip, twisted algebras, persistence, and other stories** (with Hannah Alpert). Preprint, arXiv:2107.04574 (2021), submitted.

4. **High-dimensional holeyominoes** (with Greg Malen and Érika Roldán Roa). *Electronic Journal of Combinatorics* **29** (2022) P3.15.

5. **Homological filling functions with coefficients** (with Xingzhe Li)
   Accepted for publication in *Groups, Geometry & Dynamics*.

6. **Filling random cycles.**
   Commentarii Mathematici Helvetici **96** (2021) no. 3, 561–588.

7. **Rational homotopy type and computability.**
   Accepted for publication in *Foundations of Computational Mathematics*.

8. **Topology and local geometry of the Eden model**
   (with Érika Roldán Roa and Benjamin Schweinhart).
   Accepted for publication in *Discrete & Computational Geometry*.

9. **Scalable spaces** (with Aleksandr Berdnikov).
   Inventiones mathematicae **229** (2022) no. 3, 1055–1100.

10. **A hardness of approximation result in metric geometry**
    (with Zarathustra Brady and Larry Guth).
    Selecta Mathematica **26** (2020), no. 4 art. 54.

11. **Algorithmic aspects of immersibility and embeddability** (with Shmuel Weinberger).
    Preprint, arXiv:1812.09413 (2018), submitted.

12. **A zoo of growth functions of mapping class sets.**
    J. of Topology and Analysis **12** (2020), no. 3, 841–855.

13. **Integral and rational mapping classes** (with Shmuel Weinberger).
    Duke Math. J. **169** (2020), no. 10, 1943–1969.

14. **Plato's cave and differential forms.**
    Geometry & Topology **23** (2019), no. 6, 3141–3202.

15. **Quantitative nullhomotopy and rational homotopy type.**
    (with Gregory R. Chambers and Shmuel Weinberger)
    Geometric and Functional Analysis (GAFA) **28** (2018), no. 3, 563–588.

16. **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)

17. **Volume distortion in homotopy groups.**
    Geometric and Functional Analysis (GAFA) **26** (2016), no. 2, 607–679.

18. **The complexity of nonrepetitive edge coloring of graphs.**
    Preprint, arXiv:0709.4497, (2007). 19 pages.

MENTORSHIP	**Postdoctoral:**	
	• Geunho Lim (Indiana U. PhD '20)	**2020–present**
	Graduate advising:	
	• Kyle Hansen (UCSB)	**2021–present**
	• Daniel Epelbaum (UCSB)	**2020–present**
	Undergraduate research:	
	• Merrick Hua and Tianyi Wang (UCSB) and Tahda Queer (CUNY)	**Summer 2022**
	Summer research through UCSB REU	
	• 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	*LMS Workshop: Applied Algebaic Topology*	**January 31–February 1, 2022**
	Online, hosted by Queen Mary University of London	
	Seminars (online): Penn State (colloquium), AATRN Vietoris–Rips Seminar	**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, University of Minnesota (colloquium), Max Planck Institute	**2021**
	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, Chicago (colloquium), Penn, Stanford, Berkeley	**2019**
	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

SELECTED
WORKSHOPS
ATTENDED

Analysis in Metric Spaces (AMS Mathematics Research Communities) **June 13–19, 2021**
(moved online due to COVID-19) (originally 2020)

Workshop on High-Dimensional Expanders, Sde Boker, Israel **Oct. 29–Nov. 2, 2017**

Summer School on Surgery and the Classification of Manifolds **July 18–22, 2016**
PIMS/University of Calgary

Summer School: Topology and Groups, Freie Universität Berlin **June 18–22, 2012**

Summer School: Filling Invariants and Asymptotic Geometry **July 2011**
Indiana University, Bloomington

TEACHING
EXPERIENCE

Assistant Professor, UCSB
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**

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:**
- *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 Mathematica, Discrete & Computational Geometry, Duke Mathematical Journal, Foundations of Computational Mathematics, Geometriae Dedicata, Geometric & Functional Analysis (GAFA), Geometry & Topology, Homology, Homotopy, and Applications, Journal of Applied and Computational Topology, Journal of the London Mathematical Society, Journal of Topology & Analysis, Pacific Journal of Mathematics,* ACM–SIAM Symposium on Discrete Algorithms (SODA), *Topology and its Applications, Transactions of the American Mathematical Society*

Outreach talks for undergraduates:
YouTube video talk for Christina Sormani's series "Inspiring Talks in Mathematics" **June 2021**
Augustana University colloquium   **September 2021**

Undergraduate Committee, UCSB Math Department   **2019–present**
- Faculty mentor   **2021–present**

VAP Hiring Committee, UCSB Math Department   **2021-22**

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