Joshua Zahl

CONTACT INFORMATION

UBC Department of Mathematics
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RESEARCH INTERESTS

Classical harmonic analysis, maximal functions, incidence geometry, additive combinatorics, sum-product theorems, combinatorial geometry, discrete and computational geometry.

EDUCATION

University of California, Los Angeles

Ph.D., Mathematics, 2013

- Advisor: Terence Tao

M.A., Mathematics, 2010

California Institute of Technology

B.S., Mathematics, 2008

EMPLOYMENT

The University of British Columbia
Assistant professor, 2016–present

Massachusetts Institute of Technology
NSF/pure math instructor, 2013–2016

HONORS AND AWARDS

National Science Foundation Mathematical Sciences Postdoctoral Research Fellowship (NSF MSPRF), 2013–2016

National Defense Science and Engineering Graduate Fellowship (NDSEG), 2010–2013

National Science Foundation Graduate Research Fellowship Program (NSF GRFP). Deferred to accept NDSEG

GRANTS

NSERC discovery, 2017-2021.

TEACHING

The University of British Columbia

Lecturer

Math 120	differential calculus (honors), W2019
Math 540	harmonic analysis, W2019
Math 442	optimization in graphs and networks, S2019
Math 616	polynomial method, S2019
Math 120	differential calculus (honors), W2018
Math 320	real analysis, W2018
Math 341	introduction to discrete mathematics, S2018
Math 120	differential calculus (honors), W2017
Math 320	real analysis, W2017
Math 120	differential calculus (honors), W2016

Massachusetts Institute of Technology

Lecturer

18.100B	undergraduate real analysis, W2016

Students

- Daniel Di Benedetto (joint), 2017–present
- Jacob Denson (joint), 2017–2019
- Mukul Rai Choudhuri (joint), 2019–present
- Kyle Chi Hoi Yip (joint), 2019–present

Postdocs

- Itay Londner (joint), 2018–present
- Orit Raz (joint), 2017–2019

Publications and Preprints

- New Kakeya estimates using Gromov's algebraic lemma. Submitted.
- Large Sets Avoiding Rough Patterns (with J. Denson and M. Pramanik). To appear in *Harmonic Analysis and Applications*, Springer special volume.
- A Kakeya maximal function estimate in four dimensions using planebrushes (with N.H. Katz). Accepted, *Rev. Mat. Iberoam.*
- An efficient algorithm for generalized polynomial partitioning and its applications (with P. Agarwal, B. Aronov, and E. Ezra). Submitted.
- Counting higher order tangencies for plane curves. To appear, *Combin. Probab. Comput.*
- Constructive polynomial partitioning for algebraic curves in $\mathbb{R}^3$ with applications (with B. Aronov and E. Ezra). Submitted.
- On the discretized sum-product problem (with L. Guth and N.H. Katz). To appear, *Int. Math. Res. Not.*
- A discretized Severi-type theorem with applications to harmonic analysis. *Geom. Funct. Anal.*, 28(4):1131–1181, 2018.
- Breaking the 3/2 barrier for unit distances in three dimensions. *Int. Math. Res. Not.*, Vol 2019, Issue 20: 6235–6284, 2019.
- An improved bound on the Hausdorff dimension of Besicovitch sets in $\mathbb{R}^3$ (with N.H. Katz). *J. Amer. Math. Soc.* 32(1):195–259, 2019.
- Polynomial Wolff axioms and Kakeya-type estimates in $\mathbb{R}^4$ (with L. Guth). *Proc. London Math. Soc.* 117(1): 192–220, 2018.
- Cutting algebraic curves into pseudo-segments and applications (with M. Sharir). *J. Comb. Theory Ser. A* 150:1–35, 2017.
- Curves in $\mathbb{R}^4$ and two-rich points (with L. Guth). *Disc. Comput. Geom* 58(1): 232–253, 2017.
- New bounds on curve tangencies and orthogonalities (with J. Ellenberg and J. Solymosi). *Discrete Analysis* 18, 2016.
- Spectral gaps, additive energy, and a fractal uncertainty principle (with S. Dyatlov). *Geom. Funct. Anal.* 26(4):1011–1094, 2016.
- Algebraic curves, rich points, and doubly-ruled surfaces (with L. Guth). To appear in *Am. J. Math.*, 140(5), 2018.
- A note on rich lines in truly high dimensional sets. *FoM, Sigma* 4(e2):1–13, 2016.
- Point-curve incidences in the complex plane (with A. Sheffer and E. Szabó). *Combinatorica* 38(2): 487–499, 2018.
- A semi-algebraic version of Zarankiewicz's problem (with J. Fox, J. Pach, A. Sheffer, and A. Suk). *J. Eur. Math. Soc.* 19(6): 1785–1810, 2017.
- Few distinct distances implies no heavy lines or circles (with A. Sheffer and F. de Zeeuw). *Combinatorica* 36(3):349–364, 2016.
- Quantitative visibility estimates for unrectifiable sets in the plane (with M. Bond and I. Łaba). *Trans. Amer. Math. Soc.* 368:5475–5513, 2016.
- Incidences between points and non-coplanar circles (with A. Sheffer and M. Sharir). *Combin. Probab. Comput.* 24(3):490–520, 2015.
- A Szemeredi-Trotter type theorem in $\mathbb{R}^4$. *Disc. Comput. Geom* 54(3):513–572, 2015.
- On the Wolff circular maximal function. *Illinois J. Math.* 56(4):1281–1295, 2014.
- An improved bound on the number of point-surface incidences in three dimensions. *Contrib. Discrete Math.* 8(1):100–121, 2013.
- L^3 estimates for an algebraic variable coefficient Wolff circular maximal function. *Revista Mat. Iber.* 28(4):1061–1090, 2012.
- On universal cycles for multisets. (with G. Hurlbert and T. Johnson). *Discrete Math.*

309(17):5321–5327, 2009.
- Bounds on degrees of p–adic separating polynomials. (with D.J. Katz). *J. Comb. Theory Ser. A* 115(7):1310–1319, 2008.

Recent Talks

- NYC Discrete Geometry Seminar, Baruch college, New York NY, May 2019.
- Fejes Tóth Lecture, University of Calgary, Calgary AB, April 2019.
- Geometric Measure Theory and its Connections, Helsinki FI, June 2018.
- Additive Combinatorics from a Geometric Viewpoint. USC, Columbia, SC. May 2018.
- Combinatorics Seminar. UCSD, San Diego CA, May 2018.
- Mini Real Algebraic Geometry Conference, Purdue, West Lafayette IN, April 2018.
- Colloquium, April 19-21, 2018. Indiana University, Bloomington IN, April 2018.
- Extremal Problems in Combinatorial Geometry, Banff international research station, Banff BC, February 2018.
- Algebraic Methods in Combinatorics, Center of mathematical sciences and applications, Harvard MA, November 2017.
- Harmonic Analysis and Related Areas, Clay mathematics institute, Oxford UK, September 2017.
- Real Analysis, Harmonic Analysis, and Applications workshop, Oberwolfach DE, July 2017.
- Harmonic analysis and its interactions: in honour of Tony Carbery. ICMS, Edinburgh UK, July 2017.
- Recent Developments in Harmonic Analysis, MSRI CA, May 2017.
- Discrete Geometry workshop, workshop, Oberwolfach, April 2017.
- IPAM reunion conference: Algebraic techniques for combinatorial and computational geometry, Lake Arrowhead CA. December 2016.
- Colloquium, Western Washington University, Bellingham WA, Nov 2016.
- Atlanta Lecture Series in Combinatorics and Graph Theory, Emory University, Oct 2016.
- Analysis seminar, Caltech, Pasadena CA. June 2016.
- IPAM reunion conference: Algebraic techniques for combinatorial and computational geometry, Lake Arrowhead CA. December 2015
- Combinatorics seminar, UIC. November 2015.
- Analysis seminar, Brown University. November 2015.
- Analysis seminar, UCLA. November 2015.
- Combinatorics seminar, Georgia Tech. March 2015.
- Plenary speaker, South East analysis seminar, Athena, GA. March 2015.
- Combinatorics seminar, University of Rochester. February 2015.
- Combinatorics seminar, Caltech. February 2015.

Professional service

Organizer, Banff workshop on Restriction, Kakeya, and Carleson-Type Problems.
Primary organizer, MSRI Summer Graduate School on The Polynomial Method. July 8-19, 2019, Berkeley CA.
Member of NDSEG panel 2014.
Referee for Adv. Math.; Am. J. Math.; Ann. Comb.; Ann. Acad. Sci. Fenn. Math.; BLMS; Contrib. Discrete Math.; CPC; Discr. Anal.; DCG; Discr. Math.; ESA; Eurocomb; FFA; FoCS; GAFA; IMRN; Involve; Israel J. Math.; JEMS; JCTA; Proc. AMS; Proc. Cam. Phil. Soc.; Proc. LMS; SIDMA; SoCG.

Last Updated

December 23, 2019.