LARRY GUTH

Curriculum Vitae

Department of Mathematics   617-253-4326
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77 Massachusetts Avenue
Cambridge, MA 02139

Degrees:

      B.S. Mathematics, Yale University, 2000

      Ph.D. Mathematics, MIT, 2005

Employment:

      Samelson Fellow, Stanford University, 2005-2006

      Szego Assistant Professor, Stanford University, 2006-2008

      National Science Foundation Postoctoral Fellow, 2006-2008

      Tenure-stream Assistant Professor, University of Toronto, 2008-2011

      Member, Institute for Advanced Study, 2010-2011

      Professor, New York University, 2011-2012

      Professor, MIT, Department of Mathematics, 2012-

      Claude Shannon Professor of Mathematics, MIT, 2019-

Fellowships:

      National Science Foundation Graduate Fellowship, 2001-2003

      National Science Foundation Postdoctoral Fellowship, 2006-2008

      Alfred P. Sloan Research Fellowship, 2010-2014

      Simons Investigator, 2014-

Honors:

      Sloan Research Fellowship, 2010
      Salem Prize, 2013
      Simons Investigator, Simons Fnd, 2014
      Clay Research Award, 2015
      School of Science Prize for Excellence in Graduate Teaching, 2015
      New Horizons in Mathematics Breakthrough Prize, 2015
      Fellow of the American Academy of Arts and Sciences, 2018
      Best Paper Award, International Consortium of Chinese Math., 2018
      Fellow of the American Mathematical Society, 2019
      Bôcher Memorial Prize, 2020
      Maryam Mirzakhani Prize in Mathematics, 2020
      Margaret MacVicar Faculty Fellow, MIT, 2021
      Member of the National Academy of Sciences, 2021

B.S. Student Thesis Supervised (University of Toronto):

Lisha (Janet) Li: University of Toronto: Received a 2017 PhD in Statistics & Machine Learning, from U.C. Berkeley; currently at Amplify Partners, S.F. Bay Area

Graduate Students Supervised:

<u>University of Toronto</u>:

Dominic Dotterrer: PhD, University of Toronto, 2013: Dickson Instr., University of Chicago, 2013-2016; currently: Senior Research Scientist, Goldman Sachs, 2019-.

<u>MIT</u>:

Hannah Alpert: PhD in 2016: Postdoc at Brown University, 2016-17; Visiting Assistant Professor, Ohio State University, 2017-2019; University of British Columbia, 2019-2021

Ben Yang: PhD in 2017: currently at Five Rings Capital, New York

Hong Wang: PhD in 2019: Postdoc at Princeton University and Member, Institute for Advanced Study

Thao Do: PhD in 2019: Now at Akuna Capital

Aleksandr Berdnikov: PhD, Spr. 2021: Member at the Institute for Advanced Study

Alexey Balitskiy: PhD, Spr. 2021: Member at the Institute for Advanced Study

Current:

Robin Elliott: In progress, 5th year

Sahana Vasudevan: In progress, 5th year

Luis Kumanduri: In progress, 4th year

Yuqiu Fu: In progress, 4th year

Shengwen Gan: In progress, 4th year

Lingxian (Rose) Zhang: In progress, 4th year

Sarah Tammen: In progress, 5th year

Elia Portnoy: In progress, 3rd year

Alexander Ortiz: In progress, 3rd year

Postdoctoral Researchers Supervised:

Hugo Parlier, University of Toronto: Currently a Swiss National Science Foundation Professor at the University of Fribourg, Switzerland

Yevgeny Liokumovich, Combined Pure Math Instructor and Postdoc Associate, MIT Mathematics Dept., 9/1/16–8/31/18.

Brady Zarathustra, Combined Pure Math Instructor and NSF Fellow, MIT Mathematics Dept., 9/1/17–5/31/20.

Noam Solomon, Rothschild Fellow and Postdoc Associate, MIT Mathematics Dept., 10/1/18–3/31/19.

Dominique Maldague, Simons Postdoc Associate and Pure Math Instructor, MIT Mathematics Dept., 7/1/19–6/30/21.

Teaching Experience:

<u>MIT (2012–):</u>

18.156, Differential Analysis II, spring 2021

18.01, Calculus, fall 2020

18.02, Calculus, spring 2020

18.01, Calculus, fall 2019

18.02, Calculus, spring 2019

18.02, Calculus, spring 2018

18.118, Topics in Analysis, fall 2017

18.02, Calculus, spring 2017

18.156, Differential Analysis II, spring 2016

18.103, Fourier Analysis - Theory and Application, fall 2015

18.156, Differential Analysis II, spring 2015

18.103, Fourier Analysis - Theory and Application, fall 2014

18.156, Differential Analysis, spring 2014

18.979, Graduate Geometry Seminar, spring 2014

18.821, Project Laboratory in Mathematics, fall 2013

18.966, Geometry of Manifolds, spring 2013

18.S997, Special Subject in Mathematics, fall 2012

<u>New York University (2011-12):</u>

Topics Course in Metric Geometry (graduate), spring 2012

Differential Geometry, fall 2011

<u>University of Toronto (2008-10):</u>

Real Analysis (Graduate), 2009-2010

Real Analysis (Graduate), 2008-2009

<u>Stanford University (2006-08):</u>

Ordinary Differential Equations (First Quarter Course), 2007-2008

Partial Differential Equations (Graduate) (Second Quarter Course), 2006-2007

Topics in Analysis (Advanced Undergraduates), 2005-2006

Publications:

1. Lipshitz maps from surfaces, *Geom. Funct. Anal.,* **15** (2005), no. 5, 1052–1099.

2. The width-volume inequality, *Geom. Funct. Anal.,* **17** (2007), no. 4, 1139–1179.

3. Notes on Gromov's systolic estimate, *Geom. Dedicata,* **123** (2006), 113–129.

4. Symplectic embeddings of polydisks, *Invent. Math.,* **172** (2008), no. 3, 477–489.

5. Minimax problems related to cup powers and Steenrod squares, *Geom. Funct. Anal.,* **18** (2009), no. 6, 1917-1987.

6. The endpoint case of the Bennett-Carbery-Tao multilinear Kakeya conjecture, *Acta Math.,* **205** (2010), no. 2, 263–286.

7. Systolic inequalities and minimal hypersurfaces, *Geom. Funct. Anal.,* **19** (2010), no. 6, 1688–1692.

8. Volumes of balls in large Riemannian manifolds, *Ann. of Math. (2),* **173** (2011), no. 1, 51–76.

9. Area-expanding embeddings of rectangles, preprint

10. Algebraic methods in discrete analogs of the Kakeya problem (joint with Nets Katz), *Adv. Math.,* **225** (2010), no. 5, 2828–2839.

11. Metaphors in systolic geometry, *Proceedings Intern. Congress of Math., Volume II,* Hindustan Book Agency, New Delhi (2010), 745–768.

12. Pants decompositions of random surfaces (joint with Hugo Parlier, Robert Young), *Geom. Funct. Anal.,* **21** (2011), no. 5, 1069–1090.

13. Bounds on oscillatory integral operators based on multilinear estimates (joint with Jean Bourgain), *Geom. Funct. Anal.,* **21** (2011), no. 6, 1239–1295.

14. Generalizations of the Kolmogorov-Barzdin embedding estimates (joint with Misha Gromov), *Duke Math. J.,* **161** (2012), no. 13, 2549–2603.

15. Unexpected applications of polynomials in combinatorics, <u>The mathematics of Paul Erdos, I</u>, Springer (2013), 493–522.

16. Quantum error correcting codes and 4-dimensional arithmetic hyperbolic manifolds (joint with Lubotzky, Alexander), *J. Math. Phys.* 55 (2014), no. 8, 13pp.

17. Contraction of areas vs. topology of mappings, *Geometric and Functional Analysis,* **23** (2013), no. 6, 1804–1902.

18. A short proof of the multiliner Kakeya inequality, *Math. Proc. Cambridge Philos. Soc.,* **158** (2015), no. 1, 147–153.

19. The joints problem for matroids (joint with Andrew Suk), *J. Combinatorial Theory Series A* **131** (2015), no. 1, 71–87.

20. A family of maps with many small fibers (joint with Hannah Alpert), *J. Topological Analysis,* **7** (2015), no. 1, 73–79.

21. On the Erdos distinct distance problem in the plane (joint with Nets Katz), *Ann. of Math.* **181** (2015), no. 1, 155–190.

22. A short proof of the multilinear Kakeya inequality, *Math. Proc. Cambridge Philos. Soc.,***158** (2015), no. 1, 147–153.

23. Distinct distance estimates and low degree polynomial partitioning, *Discrete Comput. Geom.,* **53** (2015), no. 2, 428–444.

24. Polynomial partitioning for a set of varieties, *Math. Proc. Cambridge Philos. Soc.,* **159** (2015), no. 3, 459–469.

25. A restriction estimate using polynomial partitioning, *Journal of the AMS* **29** (2016), no. 2, 371–413.

26. Polynomial methods in combinatorics. *University Lecture Series, 64. American Mathematical Society*, Providence, RI, 2016.

27. Degree reduction and graininess for Kakeya-type sets in R^3 (joint with Jean Bourgain and Demeter Ciprian), *Rev. Mat. Iberoam.,* **32** (2016), no. 2, 447–494.

28. Proof of the main conjecture in Vinogradov's mean value theorem for degrees higher than three, *Ann. of Math.,* **184** (2016), no. 2, 633–682.

29. Amenable groups and smooth topology of 4-manifolds (joint with Michael Freedman and Emmy Murphy), *J. Topol. Anal.,* **9** (2017), no. 1, 1–14.

30. Volumes of balls in Riemannian manifolds and Uryson width, *J. Topol. Anal.* **9** (2017), no. 2, 195–219.

31. Curves in R^4 and Two-Rich Points (joint with Joshua Zahl), *Discrete Comput. Geom.,* **58** (2017), no. 1, 232–253.

32. Strichartz estimates for the Schrödinger equation on irrational tori (joint with Yu Deng and Pierre Germain), *J. Funct. Anal,* **273** (2017), no. 9, 2846–2869.

33. A sharp Schrödinger maximal estimate in R^2 (joint with Xiumin Du and Xiaochun Li), *Ann. of Math. (2)* **186** (2017), no. 2, 607–640.

34. Ruled surface theory and incidence geometry, A Journey through Discrete Mathematics, Springer, Cham, 2017, 449-466.

35. 2-Complexes with large 2-girth (joint with Dominic Dotterer and Matthew Kahle), *Discrete Comput. Geom.,* **59** (2018), no. 2, 383–412.

36. Polynomial Wolff axioms and Kakeya-type estimates in R^4 (joint with Joshua Zahl), *Proc. London Math. Soc. (3)* **117** (2018), no. 1, 192–220.

37. Recent progress in quantitative topology (Surveys in differential geometry 2017: Celebrating the 50th anniversary of the Journal of Differential Geometry) *Surv. Diff. Geom.,* **22**, 191–216 Int. Press, Somerville (2018).

38. Pointwide convergence of Schrödinger solutions and multilinear refined Strichartz estimates (joint with Xiumin Du, Xiaochun Li, and Ruixiang Zhang), *Forum Math Sigma,* **6** (2018) e14, 18 pp.

39. Algebraic curves, rich points, and doubly-ruled surfaces (joint with Joshua Zahl), *Amer. J. Math.* **140** (2018), no. 5, 1187–1229.

40. Restriction estimates using polynomial partitioning II, *Acta Math.,* **221** (2018), no. 1, 81–142.

41. Incidence estimates for well dpaced tubes (joint with Noam Solomon and Hong Wang), *Geom. Funct. Anal.,* **29** (2019), no. 6, 1844-1.

42. Sharp estimates for oscillatory integral operators via polynomial partitioning (joint with Jonathan Hickman, Marina Iliopoulou), *Acta Math.,* **223** (2019), no. 2, 251-376.

43. On Falconer's distance set problem in the plane (joint with Alex Iosevich, Yueng Ou, and Hong Wang), *Invent. Math.,* **219** (2020), no. 3, 779-830.

44. A hardness of approximation result in metric geometry (joint with Zarathustra Brady and Fedor Manin), *Selecta Math.,* (N.S.) **26** (2020), no. 4, Paper No. 54, 20pp

45. A sharp square function estimate for the cone in R^3 (joint with Hong Wang and Ruixiang Zhang), *Ann. of Math. (2)* **192** (2020) no. 2, 551-581.

46. Small cap decouoplings. With an appendix by D. R. Heath-Brown. (joint with Ciprian Demeter and Hong Wang), *Geom. Funct. Anal.,* **30** (2020), no 4, 989-1062.

47. Weighted restriction estimates and applications to Falconer distance set problem (joint with Xiumin Du, Yumeng Ou, Hong Wang, Bobby Wilson, and Ruixiang Zhang), *Amer. J. Math.,* **143** (2021), no. 1, 175-211.

Invited Presentations:

Invited Sectional Speaker at the 2010 International Congress of Mathematics

Marston Morse lectures, IAS, 2013

Namboodiri lectures, University of Chicago, 2015

R. A. Blyth Lecture Series in Mathematics, University of Toronto, 2018

Joram Lindenstrauss lectures, Hebrew University, 2019