

Vishesh Jain

CONTACT INFORMATION

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RESEARCH INTERESTS

High dimensional phenomena, especially random matrix theory, statistical physics, and analysis on product spaces; probabilistic combinatorics and additive combinatorics; applications to statistics and theoretical computer science.

EMPLOYMENT

Department of Statistics, Stanford University, January 2021 – June 2022

- Stein Fellow

Simons Institute for the Theory of Computing, August 2020 – December 2020

- Simons-Berkeley Research Fellow

EDUCATION

Massachusetts Institute of Technology

Ph.D., Mathematics, 2020

- Advisor: Elchanan Mossel

Stanford University

B.S., Mathematics, 2015

PUBLICATIONS AND PREPRINTS

Submitted

1. **V. Jain**, A. Sah, M. Sawhney. Singularity of discrete random matrices II. arXiv:2010.06554.
2. **V. Jain**, A. Sah, M. Sawhney. Singularity of discrete random matrices I. arXiv:2010.06553.
3. **V. Jain**, A. Sah, M. Sawhney. On the smoothed analysis of the smallest singular value with discrete noise. arXiv:2009.01699.
4. **V. Jain**, A. Sah, M. Sawhney. The smallest singular value of dense random regular digraphs. arXiv:2008.04755.
5. **V. Jain**, I. Jana, K. Luh, S. O'Rourke. Circular law for random block band matrices with genuinely sublinear bandwidth. arXiv:2008.03850.
6. **V. Jain**, A. Sah, M. Sawhney. Perfectly sampling $k \geq (8/3 + o(1))\Delta$ -colorings in graphs. arXiv:2007.06360.
7. R. Chaudhuri, **V. Jain**, N.S. Pillai. Universality and least singular values of random product matrices: a simplified approach. arXiv: 2007.03595.
8. **V. Jain**, S. Silwal. A note on the universality of ESDs of inhomogeneous random matrices. arXiv:2006.05418.
9. **V. Jain**, A. Sah, M. Sawhney. On the real Davies' conjecture. arXiv:2005.08908.
10. **V. Jain**, N.S. Pillai, A. Sah, M. Sawhney, A. Smith. Fast and memory-optimal dimension reduction using Kac's walk. arXiv:2003.10069.
11. **V. Jain**. Quantitative invertibility of random matrices: a combinatorial perspective. arXiv:1908.11255.
12. A. Ferber, **V. Jain**, Y. Zhao. On the number of Hadamard matrices via anti-concentration. arXiv:1808.07222.

Published/Accepted

13. A. Ferber, **V. Jain**, K. Luh, W. Samotij. On the counting problem in inverse Littlewood–Offord theory. To appear in *Journal of the London Mathematical Society*. arXiv:1904.10425.
14. **V. Jain**. The strong circular law: a combinatorial view. To appear in *Random Matrices: Theory and Applications*. arXiv:1904.11108v2

15. **V. Jain**. Approximate Spielman-Teng theorems for the least singular value of random combinatorial matrices. To appear in *Israel Journal of Mathematics*. arXiv:1904.10592.
16. A. Ferber, **V. Jain**. Singularity of random symmetric matrices – a combinatorial approach to improved bounds. *Forum of Mathematics, Sigma*. vol. 7, e22, 29 pages (2019).
17. A. Ferber, **V. Jain**, B. Sudakov. Number of 1-factorizations of regular high-degree graphs. *Combinatorica* (2020).
18. **V. Jain**, F. Koehler, J. Liu, E. Mossel. Accuracy-memory tradeoffs and phase transitions in Belief Propagation. *32nd Annual Conference on Learning Theory (COLT 2019)*.
19. A. Ferber, J. Fox, **V. Jain**. Towards the linear arboricity conjecture. *Journal of Combinatorial Theory, Series B*, vol. 142, pp. 56–79 (2020).
20. **V. Jain**, F. Koehler, A. Risteski. Mean-field approximation, convex hierarchies, and the optimality of correlation rounding: a unified perspective. *51st ACM Symposium on the Theory of Computing (STOC 2019)*.
21. A. Ferber, **V. Jain**. 1-factorizations of pseudorandom graphs. *59th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2018)*. *Random Structures and Algorithms*, vol. 57, no. 2, pp. 257–278 (2020).
22. **V. Jain**, F. Koehler, E. Mossel. The vertex sample complexity of free energy is polynomial. *31st Annual Conference on Learning Theory (COLT 2018)*.
23. **V. Jain**, F. Koehler, E. Mossel. The Mean-Field Approximation: Information Inequalities, Algorithms, and Complexity. *31st Annual Conference on Learning Theory (COLT 2018)*.
24. J. Asplund, T. Do, A. Hamm, **V. Jain**. On the k -planar local crossing number. *Discrete Mathematics*, vol. 342, no. 4., pp. 927–933 (2019).
25. O. Chodosh, **V. Jain**, M. Lindsey, L. Panchev, Y. Rubinstein. On discontinuity of planar optimal transport maps. *Journal of Topology and Analysis*, vol. 7, no. 2, pp. 239–260 (2015).

HONORS AND AWARDS

Simons-Berkeley Research Fellowship, Fall 2020.
 Simons Foundation Fellowship, Fall 2019.
 Praecis Presidential Fellowship, Fall 2015, Spring 2016.
 AMS Math in Moscow Scholarship, Fall 2013, Spring 2014.

TEACHING AND MENTORING

Massachusetts Institute of Technology

Teaching Assistant

- 18.600 Probability and Random Variables, Fall 2018.
 - Student evaluation: 7.0/7.0
- 18.04 Complex Analysis with Applications, Spring 2018.
 - Student evaluation: 6.7/7.0

Grader

- 18.676 Stochastic Calculus, Spring 2020.
- 18.455 Advanced Combinatorial Optimization, Spring 2020.
- 18.218 Probabilistic Method in Combinatorics, Spring 2019.
- 18.155 Differential Analysis I, Fall 2018.
- 18.177 Hodge Theory, Spring 2018.
- 18.965 Geometry of Manifolds I, Fall 2017.

Mentor

Undergraduate Research Opportunities Program (UROP+), Summer 2019.

Directed Reading Program, IAP 2017.

Research Science Institute (RSI), Summer 2016.

RESEARCH SEMINAR TALKS	<ul style="list-style-type: none">◦ Stanford University Probability Seminar, October 2020.◦ Columbia University Probability Seminar, February 2020.◦ University of Illinois at Chicago Special Colloquium, January 2020.◦ Stanford University Statistics Seminar, January 2020.◦ Harvard University Random Matrix and Probability Seminar, November 2019.◦ Georgia Tech High Dimensional Seminar, November 2019.◦ Stanford University Combinatorics Seminar, October 2019.◦ UCLA Probability Seminar, October 2019.◦ UC Irvine Combinatorics and Probability Seminar, October 2019.◦ University of Illinois at Chicago Computer Science Theory Seminar, October 2019.◦ Northwestern University Probability Seminar, October 2019.◦ University of Chicago Probability and Statistical Physics Seminar, October 2019.◦ MIT Combinatorics Seminar, September 2019.◦ Yale Combinatorics Seminar, September 2019.◦ Indian Statistical Institute Stat and Math Unit Seminar, New Delhi, January 2019.◦ Princeton Topics in Probability Seminar, December 2018.◦ MIT Combinatorics Seminar, March 2018.
WORKSHOP AND CONFERENCE TALKS	<ul style="list-style-type: none">◦ AMS Fall Southeastern Sectional Meeting, Special Session on Random Discrete Structures, October 2020.◦ JMM, Special Session on Random Matrices and Integrable Systems, Denver, January 2020.◦ JMM, Special Session on Extremal and Probabilistic Combinatorics, Denver, January 2020.◦ Institute for Pure and Applied Mathematics, Quantitative Linear Algebra Reunion Conference, Los Angeles, December 2019.◦ AMS Graduate Student Conference in Analysis, PDE, and Probability, Brown University, February 2019.◦ 59th Annual IEEE Symposium on Foundations of Computer Science (FOCS), Paris, 2018.◦ AMS Sectional Meeting, Special Session on Probabilistic and Extremal Graph Theory, Ohio State University, March 2018.◦ JMM, Research in Mathematics by Undergraduates, San Diego, January 2013.
PROFESSIONAL SERVICE	Reviewer for Duke Mathematical Journal, Annals of Probability, Probability Theory and Related Fields, SIAM Journal on Computing, Discrete Analysis, Random Structures and Algorithms, Mathematical Proceedings of the Cambridge Philosophical Society, European Journal of Combinatorics, IEEE Annual Symposium on Foundations of Computer Science (FOCS).