Jiaoyang Huang

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Employment

University of Pennsylvania — *Philadelphia, PA*
Assistant Professor — *2022–now*

Courant Institute, New York University — *New York, NY*
Simons Junior Fellow (Postdoc associate) — *2020-2022*

Institute for Advanced Study — *Princeton, NJ*
Member — *2019-2020*

Education

Harvard University — *Cambridge, MA*
Ph.D., Mathematics — *2019*
Advisor: Horng-Tzer Yau

Massachusetts Institute of Technology (MIT) — *Cambridge, MA*
B.S., Mathematics — *2014*

Tsinghua University — *Beijing, China*
B.S., Computer Science and Technology — *2010-2011*

Awards

Upenn Math Department Good Teaching Awards — *Fall 2022*
Blavatnik Regional Awards — *2022*
Simons Junior Fellow — *2020–2022*
Harvard Graduate Society Term-time Research Fellowship — *2018-2019*
Gold medal in the 50th International Mathematical Olympiad — *2009*

Research Interests

Probability Theory and its applications to statistics, mathematical physics, combinatorics and computer science.

Publications

1. *Long Random Matrices and Tensor Unfolding*
with Gérard Ben Arous and Daniel Z Huang, Accepted by Annals of Applied Probability, 2023.
2. *Spectrum of Random d-regular Graphs Up to the Edge*
with Horng-Tzer Yau, Accepted by Communications on Pure and Applied Mathematics, 2023.
3. *How Does Information Bottleneck Help Deep Learning?*
with Kenji Kawaguchi, Zhun Deng and Xu Ji, International Conference on Machine Learning (ICML), 2023
4. *Efficient Derivative-free Bayesian Inference for Large-Scale Inverse Problems*
with Daniel Z Huang, Sebastian Reich and Andrew M Stuart, Inverse Problems, 2022.

5. *PatchGT: Transformer over Non-trainable Clusters for Learning Graph Representations*
with Han Gao, Xu Han, Jian-Xun Wang and Liping Liu, Learning on Graphs Conference, 2022.

6. *Robustness Implies Generalization via Data-Dependent Generalization Bounds*
with Kenji Kawaguchi, Zhun Deng and Kyle Luh, International Conference on Machine Learning (ICML), 2022.

7. *Eigenvalues for the Minors of Wigner Matrices*
Annales de l'Institut Henri Poincaré, Probabilités et Statistiques, 58(4), 2201-2215, 2022.

8. *Large Deviation Principles via Spherical Integrals*
with Serban Belinschi and Alice Guionnet,
Accepted by Probability and Mathematical Physics,2022.

9. *Power Iteration for Tensor PCA*
with Guang Cheng, Daniel Z. Huang and Qing Yang, Journal of Machine Learning Research, 23(128), 1-47, 2022.

10. *Invertibility of adjacency matrices for random d-regular graphs*
Duke Mathematical Journal 170(18): 3977-4032, 2021.

11. *Understanding End-to-End Model-Based Reinforcement Learning Methods as Implicit Parameterization*
with Clement Gehring, Kenji Kawaguchi, and Leslie Pack Kaelbling, Advances in Neural Information Processing Systems (NeurIPS), 2021.

12. *How Shrinking Gradient Noise Helps the Performance of Neural Networks*
IEEE International Conference on Big Data (Big Data), 1002-1007, 2021

13. *Law of Large Numbers and Central Limit Theorems by Jack Generating Functions*
Advances in Mathematics 380, 107545, 2021

14. *β-Nonintersecting Poisson Random Walks: Law of Large Numbers and Central Limit Theorems*
International Mathematics Research Notices (8), 5898-5942, 2021.

15. *Edge rigidity and universality of random regular graphs of intermediate degree*
with Roland Bauerschmidt, Knowles Antti and Horng-Tzer Yau, Geometric and Functional Analysis, 30(3):693–769, 2020.

16. *Dyson Brownian Motion for General β and Potential at the Edge*
with Arka Adhikari, Probability Theory and Related Fields, 178(3), 893–950, 2020

17. *Transition from Tracy-Widom to Gaussian fluctuations of extremal eigenvalues of sparse Erdős-Rényi graphs*
with Benjamin Landon and Horng-Tzer Yau, Annals of Probability, 48(2), 916–962, 2020.

18. *Spectral statistics of sparse Erdös-Rényi graph Laplacians*
with Benjamin Landom, Annales de l'Institut Henri Poincaré, Probabilités et Statistiques, 56(1), 120–154, 2020.

19. *Towards Understanding the Dynamics of the First-Order Adversaries*
with Zhun Deng, Hangfeng He and Weijie Su, In Proceedings of the 37th International Conference on Machine Learning, 2020.

20. *Dynamics of deep neural networks and neural tangent hierarchy*
with Horng-Tzer Yau, In Proceedings of the 37th International Conference on Machine Learning, 2020.

21. *Rigidity and Edge Universality of Discrete β-Ensembles*
with Alice Guionnet, Communications on Pure and Applied Mathematics, 72(9), 1875–1982, 2019.

22. *Local Law and Mesoscopic Fluctuations of Dyson Brownian Motion for General β and Potentials*
with Benjamin Landon, Probability Theory and Related Fields, 175(1-2), 209–253, 2019.

23. *Local Kesten–McKay Law for Random Regular Graphs*
with Roland Bauerschmidt and Horng-Tzer Yau, Communications in Mathematical Physics, 369(2), 523–636, 2019.

24. *Asymptotic Expansion of Spherical Integral*
Journal of Theoretical Probability, 32(2), 1051–1075, 2019.

25. *Gradient descent finds global minima for generalizable deep neural networks of practical sizes*
with Kenji Kawaguchi, In Proceedings of the 57th Allerton Conference on Communication, Control, and Computing (Allerton), IEEE, 2019.

26. *Every Local Minimum Value is the Global Minimum Value of Induced Model in Non-convex Machine Learning*
with Kenji Kawaguchi and Leslie Pack Kaelbling, Neural Computation, 31(12), 2293-2323, MIT press, 2019.

27. *Effect of Depth and Width on Local Minima in Deep Learning*
with Kenji Kawaguchi and Leslie Pack Kaelbling, Neural Computation, 31(7), 1462-1498, MIT press, 2019.

28. *Mesoscopic Perturbations of Large Random Matrices*
Random Matrices: Theory and Applications, 7(02), 1850004, 2018.

29. *Eigenvector Statistics of Sparse Random Matrices*
with Paul Bourgade and Horng-Tzer Yau, Electronic Journal of Probability, 22, 2017.

30. *Bulk eigenvalue statistics for random regular graphs*
with Roland Bauerschmidt, Antti Knowles and Horng-Tzer Yau, The Annals of Probability, 45(6A), 3626–3663, 2017.

31. *Laurent Phenomenon Sequences*
with Joshua Alman and Cesar Cuenca, Journal of Algebraic Combinatorics, 43(3), 589–633, 2016.

32. *Bulk universality of sparse random matrices*
with Benjamin Landon and Horng-Tzer Yau, Journal of Mathematical Physics, 56(12), 123301, 2015.

Preprints

1. *Local Statistics and Concentration for Non-intersecting Brownian Bridges With Smooth Boundary Data*
with Amol Aggarwal, arXiv preprint arXiv:2308.04318, 2023.

2. *Edge Rigidity of Dyson Brownian Motion with General Initial Data*
with Amol Aggarwal, arXiv preprint arXiv:2308.04236, 2023.

3. *Pearcey universality at cusps of polygonal lozenge tiling*
with Fan Yang and Lingfu Zhang, arXiv preprint: 2306.01178, 2023.

4. *Asymptotics of Generalized Bessel Functions and Weight Multiplicities via Large Deviations of Radial Dunkl Processes*
   with Colin McSwiggen, arXiv preprint: 2305.04131, 2023.
5. *Edge universality of random regular graphs of growing degrees*
   with Horng-Tzer Yau, arXiv preprint:2305.01428, 2023
6. *Gradient Flows for Sampling: Mean-Field Models, Gaussian Approximations and Affine Invariance*
   with Yifan Chen, Daniel Zhengyu Huang, Sebastian Reich and Andrew M. Stuart, arXiv preprint: 2302.11024, 2023.
7. *Edge Universality of Sparse Random Matrices*
   with Horng-Tzer Yau, arXiv preprint: 2206.06580, 2022.
8. *Dynamical Loop Equation*
   with Vadim Gorin, arXiv preprint: 2205.15785, 2022.
9. *Edge Statistics for Lozenge Tilings of Polygons, II: Airy Line Ensemble*
   with Amol Aggarwal, arXiv preprint: 2108.12874, 2021.
10. *Edge Statistics for Lozenge Tilings of Polygons, I: Concentration of Height Function on Strip Domains*
    arXiv preprint: 2108.12872, 2021.
11. *Large Deviations Asymptotics of Rectangular Spherical Integral*
    with Alice Guionnet, arXiv preprint: 2106.07146, 2021.
12. *Edge Universality for Nonintersecting Brownian Bridges*
    arXiv preprint: 2011.01752, 2020.
13. *Height Fluctuations of Random Lozenge Tilings Through Nonintersecting Random Walks*
    arXiv preprint: 2011.01751, 2020.

Teaching

Instructor, Random Matrix Theory and Applications, University of Pennsylvania	*Spring 2023*
Instructor, Probability Theory, University of Pennsylvania	*Fall 2022*
Instructor, Calculus 2, New York University	*Fall 2021*
Lecturer, Summer School: RMT 2019 at LA, UCLA	*Summer 2019*
Instructor, Calculus, Math 1b, Harvard University	*Fall 2017*
Instructor, Calculus, Math 1b, Harvard University	*Fall 2016*
Teaching Assistant, MATH 254: Topics in Random Matrices, Harvard University	*Fall 2015*
Calculus Coach, Math 1b, Harvard University	*Fall 2015*
Teaching Assistant, Introduction to Topology, Math 18.901, MIT	*Fall 2013*
Teaching Assistant, Complex Variables with Applications, Math 18.04, MIT	*Spring 2012*

Invited Talks

2023:

ICERM Workshop: Asymptotic Limits of Discrete Random Structures.
University of California Berkeley: Probability Seminar.
EcoSta 2023: Workshop on recent advances in high-dimensional statistics and machine learning.

The second International Conference for Chinese Young Probability Scholars: Universality in Probability Theory and Statistical Physics.
New Jersey Institute of Technology: Statistics Seminar.
Princeton: Physics for Neural Networks.
University of Pennsylvania: Student Seminar.
Columbia University: Probability Seminar.

2022:

Yale: Statistics and Data Science Department Seminar.
Princeton: Probability Seminar.
MIT: Stochastics and Statistics Seminar.
University of California, Davis: QMATH 15 Conference.
University of North Carolina at Chapel Hill: Southeastern Probability conference 2022.
Harvard University: New Frontiers: Interactions between Quantum Physics and Mathematics.
Spectral Geometry in the Clouds.
Northwestern University: Laplacians on Random Hyperbolic Surfaces and on Random Graphs.
University of California San Diego: Probability Seminar.
University of Pennsylvania: Wharton Statistics and Data Science Seminars.
Brown University: Applied Math Seminar.
University of California, Los Angeles: Probability Seminar.

2021:

National University of Singapore: Young Mathematician Lecture Series.
University of California Berkeley: Probability seminar.
Carnegie Mellon University: Probability seminar.
Northwestern University: Analysis seminar.
University of Washington: Probability seminar.
Cornell University: Probability Seminar.
University of Chicago: Probability Seminar.
New Jersey Institute of Technology: Applied Math Colloquium.
MSRI: Connections and Introductory Workshop.
New York University: Student Probability Seminar.
University of Victoria: Applied Math Seminar.

2020:

Columbia University: Integrable Probability Seminar.
THU-PKU-BNU Joint Probability Webinar.
University of Kansas: KU Probability and Statistics Seminar.
One World Probability Seminar.
Stanford University: Probability Seminar.
University of Minnesota: Probability Seminar.
University of Wisconsin-Madison: Probability Seminar.
University of pennsylvania: Penn/Temple Probability Seminar.
Columbia University: Probability Seminar.

2019:

University of Michigan: Integrable Systems and Random Matrix Theory Seminar.
University of Strasbourg: Probability Seminar.
8th Strasbourg/Zurich Meeting: Frontiers in Analysis and Probability.
Yale University: Combinatorics Seminar.
IAS Analysis-Mathematical Physics Seminar.

Google.
CIRM: Random Matrices and Random Graphs.
Brandeis University: Brandeis-Harvard-MIT-Northeastern Joint Mathematics Colloquium.
Brown University: 6th Annual AMS Grad Student Conferences at Brown.
University of Chicago: Probability Seminar.

2018:

Oberwolfach Workshop: Free Proability Theory.
Ohio State University: Probability Seminar.
MIT: FRG Integrable probability meeting.
Cornell University: Probability Seminar.
Princeton University: Topics in Probability Seminar.
MIT: Combinatorics Seminar.
Columbia University: Probability Seminar.
University of Virginia: Probability Seminar.
Gothenburg: Conference on Stochastic Processes and their Applications.
IPAM: Workshop "Random Matrices and Free Probability Theory".
Northeastern University: AMS Special Session on The Gaussian Free Field and Random Geometry.

2017:

ENS Lyon: Conference "ProbabLY ON Random Matrices".
University of Wisconsin-Madison: Combinatorics Seminar.

Professional Service

Reviewer for: Ann. Appl. Probab., Ann. of Math., Ann. Probab., Comm. Math. Phys., C. R. Math. Acad. Sci. Paris, Duke Math. J., Electron. Commun. Probab., Electron. J. Probab., Probab., IEEE TPAMI, IEEE Trans. Inform. Theory, Int. Math. Res. Not., J. Eur. Math. Soc., J. Funct. Anal., J. Theoret. Probab., Probab. Theory Related Fields, Proc. Lond. Math. Soc.

Co-organizer for: Harvard student probability seminar (2018-2019). Upenn probability seminar (2022-2023). Upenn statistics and data science department seminar (2022-2023).

Summer Schools attended

Summer School: RMT 2019 at LA, UCLA	*July 2019*
PCMI Summer Session 2017, Utah	*June 2017*
Michigan Summer School on Random Matrices, Michigan	*June 2016*
Summer School on Stochastic Processes and Random Matrices, Les Houches	*July 2015*