

Dmitriy (Tim) Kunisky

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CONTACT INFORMATION	Wyman Park Building, Johns Hopkins University 3100 Wyman Park Drive, Office N438 Baltimore, MD 21211	kunisky@jhu.edu http://www.kunisky.com
RESEARCH INTERESTS	My focus is on probability theory and discrete mathematics with applications to statistics, data science, algorithms, and optimization. In particular: <ul style="list-style-type: none">· computationally-hard regimes in optimization and statistical problems;· random matrix theory, spectral algorithms, pseudorandom matrices, and random tensors;· diagrammatic methods in linear and multilinear algebra with applications in statistics and computer science.	
EMPLOYMENT	Johns Hopkins University Assistant Professor in Applied Mathematics & Statistics	Baltimore, MD 07/2024–Present
	Yale University Postdoctoral Associate in Computer Science	New Haven, CT 07/2021–07/2024
	· Hosted by Daniel Spielman	
EDUCATION	Courant Institute of Mathematical Sciences Ph.D. in Mathematics	New York, NY 09/2016–05/2021
	· Dissertation: <i>Spectral Barriers in Certification Problems</i> , advised by Afonso Bandeira and Gérard Ben Arous	
	Princeton University A.B. <i>summa cum laude</i> in Mathematics	Princeton, NJ 09/2010–06/2014
	· Certificate in Applications of Computing	
	· Senior Thesis: <i>The Theft and the Honest Toil: Applications of Large Cardinal Axioms to the Theory of Measurable Selection</i> , advised by John Burgess	
	· Junior Independent Paper: <i>Discrete Applications of Brownian Motion</i> , advised by Michael Damron	
PUBLICATIONS	Computational and statistical lower bounds for low-rank estimation under general inhomogeneous noise. Debsurya De, Dmitriy Kunisky. <i>ACM Symposium on Theory of Computing (STOC)</i> , 2026, to appear.	
	Nonlinear Laplacians: Tunable principal component analysis under directional prior information. Yuxin Ma, Dmitriy Kunisky. <i>NeurIPS</i> , 2025 (Spotlight).	

The Lovász number of random circulant graphs. Afonso S. Bandeira, Jaroslaw Błasiok, Daniil Dmitriev, Ulysse Faure, Anastasia Kireeva, Dmitriy Kunisky. *Sampling Theory and Applications (SAMPTA)*, 2025.

Low coordinate degree algorithms II: Categorical signals and generalized stochastic block models. Dmitriy Kunisky. *Conference on Learning Theory (COLT)*, 2025.

Statistical inference of a ranked community in a directed graph. Dmitriy Kunisky, Daniel A. Spielman, Alexander S. Wein, Xifan Yu. *ACM Symposium on Theory of Computing (STOC)*, 2025.

On the structure of bad science matrices. Alex Albors, Hisham Bhatti, Lukshya Ganjoo, Raymond Guo, Dmitriy Kunisky, Rohan Mukherjee, Alicia Stepin, Tony Zeng. *Involve* (to appear).

Tensor cumulants for statistical inference on invariant distributions. Dmitriy Kunisky, Cristopher Moore, Alexander S. Wein. *Symposium on Foundations of Computer Science (FOCS)*, 2024.

Computational hardness of detecting graph lifts and certifying lift-monotone properties of random regular graphs. Dmitriy Kunisky, Xifan Yu. *Symposium on Foundations of Computer Science (FOCS)*, 2024.

Low coordinate degree algorithms I: Universality of computational thresholds for hypothesis testing. Dmitriy Kunisky. *Annals of Statistics* 53, No. 2, 2025.

Fitting an ellipsoid to random points: predictions using the replica method. Antoine Maillard, Dmitriy Kunisky. *IEEE Transactions on Information Theory*, 2024.

Optimality of Glauber dynamics for general-purpose Ising model sampling and free energy approximation. Dmitriy Kunisky. *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2024.

Spectral pseudorandomness and the road to improved clique number bounds for Paley graphs. Dmitriy Kunisky. *Experimental Mathematics*, 2024.

On the concentration of Gaussian Cayley matrices. Afonso S. Bandeira, Dmitriy Kunisky, Dustin G. Mixon, Ximeng Zeng. *Applied and Computational Harmonic Analysis (ACHA)* 73, November 2024.

A degree 4 sum-of-squares lower bound for the clique number of the Paley graph. Dmitriy Kunisky, Xifan Yu. *Computational Complexity Conference (CCC)*, 2023.

The spectrum of the Grigoriev-Laurent pseudomoments. Dmitriy Kunisky, Cristopher Moore. *SIAM J. Discrete Mathematics (SIDMA)* 38, No. 1, 2024.

Dual bounds for the positive definite functions approach to mutually unbiased bases. Afonso S. Bandeira, Nikolaus Doppelbauer, Dmitriy Kunisky. *Sampling Theory, Signal Processing, and Data Analysis* 20, No. 18, 2022.

The discrepancy of unsatisfiable matrices and a lower bound for the Komlőš conjecture constant. Dmitriy Kunisky. *SIAM J. Discrete Mathematics (SIDMA)* 37, No. 2, 2023.

Strong recovery of geometric planted matchings. Dmitriy Kunisky, Jonathan Niles-Weed. *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2022.

Average-case integrality gap for non-negative principal component analysis. Afonso S. Bandeira, Dmitriy Kunisky, Alexander S. Wein. *Mathematical and Scientific Machine Learning (MSML)*, 2021.

Hypothesis testing with low-degree polynomials in the Morris class of exponential families. Dmitriy Kunisky. *Conference on Learning Theory (COLT)*, 2021.

Spectral planting and the hardness of refuting cuts, colorability, and communities in random graphs. Afonso S. Bandeira, Jess Banks, Dmitriy Kunisky, Christopher Moore, Alexander S. Wein. *Conference on Learning Theory (COLT)*, 2021.

Linear programming and community detection. Alberto Del Pia, Aida Khajavirad, Dmitriy Kunisky. *Mathematics of Operations Research*, 2022.

The average-case time complexity of certifying the restricted isometry property. Yunzi Ding, Dmitriy Kunisky, Alexander S. Wein, Afonso S. Bandeira. *IEEE Transactions on Information Theory*, 2021.

A tight degree 4 sum-of-squares lower bound for the Sherrington-Kirkpatrick Hamiltonian. Dmitriy Kunisky, Afonso S. Bandeira. *Mathematical Programming* 190, No. 1, 2021.

Notes on computational hardness of hypothesis testing: predictions using the low-degree likelihood ratio. Dmitriy Kunisky, Alexander S. Wein, Afonso S. Bandeira. *ISAAC Congress*, 2019.

Subexponential-time algorithms for sparse PCA. Yunzi Ding, Dmitriy Kunisky, Alexander S. Wein, Afonso S. Bandeira. *Foundations of Computational Mathematics*, 2023.

Mapping political communities: a statistical analysis of lobbying networks in legislative politics. In Song Kim, Dmitriy Kunisky. *Political Analysis* 29, No. 3, 2021.

Computational hardness of certifying bounds on constrained PCA problems. Afonso S. Bandeira, Dmitriy Kunisky, Alexander S. Wein. *Innovations in Theoretical Computer Science (ITCS)*, 2020.

Connections between sum-of-squares optimization and structured tight frames. Afonso S. Bandeira, Dmitriy Kunisky. *SPIE Wavelets and Sparsity*, 2019.

Sum-of-squares optimization and the sparsity structure of equiangular tight frames. Afonso S. Bandeira, Dmitriy Kunisky. *Sampling Theory and Applications (SAMPTA)*, 2019.

Hysteresis control of epithelial-mesenchymal transition dynamics conveys a distinct program with enhanced metastatic ability. Toni Celià-Terrassa, Caleb Bastian, Daniel D. Liu, Brian Ell, Nicole M. Aiello, Yong Wei, Jose Zamalloa, Andres M. Blanco, Xiang Hang, Dmitriy Kunisky, Wenyang Li, Elizabeth D. Williams, Herschel Rabitz, Yibin Kang. *Nature Communications* 9, No. 1, 2018.

PREPRINTS

μ pscaling small models: Principled warm starts and hyperparameter transfer. Yuxin Ma, Nan Chen, Mateo Díaz, Soufiane Hayou, Dmitriy Kunisky, Soledad Villar. [arXiv:2602.10545](https://arxiv.org/abs/2602.10545), 2026.

Universal entrywise eigenvector fluctuations in delocalized spiked matrix models and asymptotics of rounded spectral algorithms. Shujing Chen, Dmitriy Kunisky. [arXiv:2512.11785](https://arxiv.org/abs/2512.11785), 2025.

Empirical universality and non-universality of local dynamics in the Sherrington-Kirkpatrick model. Grace Liu, Dmitriy Kunisky. [arXiv:2511.17428](https://arxiv.org/abs/2511.17428), 2025.

Asymptotic bounds and online algorithms for average-case matrix discrepancy. Dmitriy Kunisky, Timm Oertel, Nicola Wengiel, Peiyuan Zhang. [arXiv:2410.23915](https://arxiv.org/abs/2410.23915), 2025.

Computational lower bounds for multi-frequency group synchronization. Anastasia Kireeva, Afonso S. Bandeira, Dmitriy Kunisky. [arXiv:2406.03424](https://arxiv.org/abs/2406.03424), 2024.

Generic MANOVA limit theorems for products of projections. Dmitriy Kunisky. [arXiv:2301.09543](https://arxiv.org/abs/2301.09543), 2023.

Positivity-preserving extensions of sum-of-squares pseudomoments over the hypercube. Dmitriy Kunisky. [arXiv:2009.07269](https://arxiv.org/abs/2009.07269), 2020.

A Gramian description of the degree 4 generalized elliptope. Afonso S. Bandeira, Dmitriy Kunisky. [arXiv:1812.11583](https://arxiv.org/abs/1812.11583), 2018.

INVITED TALKS

An invitation to diagrammatic methods. Hopkins Undergraduate Society for Applied Mathematics, 2025.

Tailoring matrices to boost spectral algorithms. Johns Hopkins Data Science Seminar, 2025.

Tailoring matrices to boost spectral algorithms. Columbia Statistics Seminar,

2025.

Lower bounds against low coordinate degree algorithms. TTIC Workshop on Information-Computation Tradeoffs for Statistical Tasks: New Challenges and Opportunities, 2025.

Ramanujan graphs and the hardness of certifying properties of random regular graphs. BIRS Workshop on Frontiers in Combinatorics and Theoretical Computer Science, 2025.

Statistical inference of a ranked community in a directed graph. INFORMS Applied Probability Society Conference 2025, 2025.

Towards a general theory of low degree algorithms in statistics. NYU Math and Data (MaD) Seminar, 2025.

Tensor networks, tensor cumulants, and tensor PCA. Oberwolfach-RIMS Tandem Workshop on Optimization, Theoretical Computer Science and Algebraic Geometry: Convexity and Beyond, 2025.

Simple statistics beyond low-degree polynomials. American Institute of Mathematics Workshop on Low-Degree Polynomial Methods in Average-Case Complexity, 2024.

Towards a general theory of low degree algorithms in statistics. Georgia Tech Algorithms and Randomness Center (ARC) Colloquium, 2024.

Spectral pseudorandomness, free probability, and the clique number of the Paley graph. Ohio State University Data Science Seminar, 2024.

Computational hardness of testing for graph lifts and certifying properties of random regular graphs. CodEx Online Seminar, 2024.

Tensor networks, tensor cumulants, and tensor PCA. Johns Hopkins University Applied Mathematics and Statistics Seminar, 2024.

Computational hardness of testing for graph lifts and certifying properties of random regular graphs. Johns Hopkins University Computer Science Theory Seminar, 2024.

The finite free cumulants of a tensor and their statistical applications. Virtual Tensor Journal Club, 2024.

Low coordinate degree algorithms: a flexible framework for computational thresholds. Bocconi University Workshop on Conceptual Challenges in AI: from ML to Average-Case Computation and Cryptography, 2024.

Computational hardness of testing for graph lifts and certifying properties of

random regular graphs. ETH Zurich Data, Algorithms, Combinatorics, and Optimization (DACO) Seminar, 2024.

Computational hardness of testing for graph lifts and certifying properties of random regular graphs. University of Chicago Computer Science Theory Seminar, 2024.

Universality of computational thresholds in hypothesis testing for low coordinate degree algorithms. AMS Spring Western Sectional Special Session on Random Structures, Computation, and Statistical Inference, 2024.

Optimality of Glauber dynamics for general-purpose sampling and free energy approximation. CRM-ISM Montreal Probability Seminar, 2024.

Universal lower bounds against low-degree polynomials. BIRS Workshop on Computational Complexity of Statistical Inference, 2024.

Gramian constructions of sum-of-squares lower bounds and the spectra of pseudomoments. SIAM Conference on Applied Algebraic Geometry, 2023.

Spectral limit theorems for submatrices and products of projections. MIT Probability Seminar, 2023.

Spectral pseudorandomness and the clique number of the Paley graph. MIT Stochastics and Statistics Seminar, 2023.

What average-case optimization can tell number theory. Lehigh University Engineering Seminar, 2023.

Spectral pseudorandomness and the clique number of the Paley graph. BIRS-CMO Workshop on Learning in Networks, CMO Oaxaca, 2022.

The degree 4 sum-of-squares relaxation of the clique number of Paley graphs. AMS Fall Western Sectional Special Session on Algebraic Combinatorics and Applications in Harmonic Analysis, 2022.

Dual bounds for the positive semidefinite functions approach to mutually unbiased bases. CodEx Online Seminar, 2022.

Strong recovery of geometric planted matchings. Workshop on Rigorous Evidence for Information-Computation Trade-Offs, Simons Institute for the Theory of Computing, 2021.

A positivity-first approach to sum-of-squares over the hypercube. Workshop on Computational Phase Transitions, Simons Institute for the Theory of Computing, 2020.

The low-degree method for identifying statistical-to-computational gaps. MOKA-

PLAN Seminar, INRIA Paris, 2020.

Certifying bounds on random quadratic programs is hard. SIERRA Seminar, INRIA Paris, 2020.

Hardness of certification for random optimization problems. Computer Science Theory Seminar, Columbia University, 2019.

Hardness of certification for random optimization problems. Seminar on Algebra, Statistics, and Optimization, MIT, 2019.

HONORS

US Junior Oberwolfach Fellow (2025, NSF DMS-2230648)
Predoctoral Summer Fellowship, New York University
Graduate Research Initiative Award, New York University
Student Government Conference Fund Award, New York University
Harold Grad Memorial Prize, New York University
Best Poster Award, Princeton Day of Optimization 2018
Charles Newman Fellowship, New York University
Honorable Mention, NSF Graduate Research Fellowship
Phi Beta Kappa Society (Early Admission), Princeton University
Shapiro Award for Academic Excellence, Princeton University

TEACHING

Probability Theory II Johns Hopkins University	Spring 2026
Random Matrix Theory in Data Science and Statistics Johns Hopkins University	Fall 2025
Probability Theory II Johns Hopkins University	Spring 2025
Random Matrix Theory in Data Science and Statistics Johns Hopkins University	Fall 2024
Modern Probability for Theoretical Computer Science Yale University	Spring 2023
Sum-of-Squares Optimization Yale University	Spring 2022
Mathematical Statistics (Teaching Assistant) New York University	Fall 2020
Discrete Mathematics (Teaching Assistant) New York University	Summer 2020
Probabilistic Time Series Analysis (Teaching Assistant) New York University	Fall 2018

Algebra II (Teaching Assistant)
Princeton University

Spring 2013

ORGANIZING

Session: Structured Random Matrices and their Applications
INFORMS Applied Probability Society

July 2025

OTHER
SERVICE

Reviewed for publications: AMS Mathematical Reviews (MathSciNet), Annals of Probability, Annals of Statistics, Digital Signal Processing, Discrete & Computational Geometry, IEEE Transactions on Information Theory, IEEE Transactions on Signal Processing, Information and Inference: A Journal of the IMA, Information Processing Letters, Journal of Machine Learning Research (JMLR), Mathematical Programming, Mathematics of Operations Research, Operations Research, Political Analysis, Random Structures & Algorithms, SIAM Journal on Discrete Mathematics (SIDMA), SIAM Journal on Mathematics of Data Science (SIMODS).

Reviewed for conferences: CCC (2021, 2025, 2026), COLT (2018), FOCS (2020, 2021, 2024, 2025), IPCO (2026), MSML (2020, 2021, 2022), NeurIPS (2025), RANDOM (2024), SODA (2022, 2024, 2025, 2026), STOC (2023, 2024, 2025, 2026).

Organized Courant Institute student probability seminar, Fall 2018–Spring 2021.

INDUSTRY
EXPERIENCE

Google, Inc.
Software Engineer

Mountain View, CA; New York, NY
10/2014–07/2016

- Developed interactive semantic code differencing tools for working with complex search ranking algorithms.
- Improved machine learning infrastructure for semantic parsing tasks in natural language processing.