Kevin Shu

kshu@caltech.edu kevinshu.me

Work

2024- **Postdoctoral Researcher** (Computing and Mathematical Sciences),
California Institute of Technology, Pasadena, CA

Education

2019-2024 **PhD.,** Algorithms Combinatorics and Optimization,
Georgia Institute of Technology, Atlanta, GA

- Advised by Grigoriy Blekherman in the Department of Mathematics.

2014-2018 **B.S.**, Mathematics, Computer Science,
California Institute of Technology, Pasadena, CA

As is traditional in pure mathematics, authors of publications are listed alphabetically, and author ordering does not reflect the contributions of any coauthors.

Publications

Debiasing Polynomial and Fourier Regression (with Chris Camaño and Raphael A. Meyer), accepted at SOSA 2026.

Composing Optimized Stepsize Schedules for Gradient Descent (with Ben Grimmer and Alex L. Wang), to appear in Mathematics of Operations Research in 2025.

A Semidefinite Hierarchy for the Expected Independence Number of a Random Graph (with Diego Cifuentes, and Alejandro Toriello), Optimization Letters, 2025

Accelerated Objective Gap and Gradient Norm Convergence for Gradient Descent via Long Steps (with Ben Grimmer and Alex L. Wang), Informs Journal on Optimization, 2025

Symmetric Hyperbolic Polynomials (with Greg Blekherman and Julia Lindberg), Journal of Pure and Applied Algebra, 2025

Hidden convexity, optimization, and algorithms on rotation matrices (with Akshay Ramachandran and Alex L. Wang), Mathematics of Operations Research, 2024

Linear Principal Minor Polynomials: Hyperbolic Determinantal Inequalities and Spectral Containment (with Greg Blekherman, Mario Kummer, Raman Sanyal and Shengding Sun), International Mathematics Research Notices, 2022

Hyperbolic Relaxation of k-Locally Positive Semidefinite Matrices (with Grigoriy Blekherman, Santanu Dey and Shengding Sun), SIAM Journal on Optimization, 2022

Sums of Squares and Sparse Semidefinite Programming (with Grigoriy Blekherman), SIAM Journal for Applied Algebra and Geometry, 2021

Syntactic Structures and Code Parameters (with Matilde Marcolli), Mathematics in Computer Science, 2017

Preprints

Lagrangian Dual Sections: A Topological Perspective on Hidden Convexity (with Venkat Chandrasekaran, Tim Duff, Jose Israel Rodriguez), arXiv:2510.06112, in submission

Beyond Minimax Optimality: A Subgame Perfect Gradient Method (with Ben Grimmer and Alex Wang), arXiv:2412.06731, in revision at Mathematical Programming

Accelerated Gradient Descent via Long Steps (with Ben Grimmer and Alex Wang), arXiv:2309.09961, 2023

Quadratic Programming with Sparsity Constraints via Polynomial Roots , arxiv:2208.11143, 2022

Talks and Presentations Given

Hidden Convexity, presented at ICCOPT, 2025
Hidden Convexity and the Rotation Group, presented at the SIAM Conference on Applied Algebraic Geometry, 2025
Algebraic Methods in Convex Optimization, presented at the UCLA Math Colloquium, 2025
Semialgebraic Methods in Convex Optimization, presented at the Joint Mathematics Meetings, 2025
Hidden convexity, optimization, and algorithms on rotation matrices , presented at the Informs Optimization Society conference, 2024
Symmetric Hyperbolic Polynomials, presented at the SIAM Conference on Applied Algebraic Geometry, 2023
Sparse Regression and PCA via Polynomial Roots, presented at the SIAM Conference on Optimization, 2023
Hyperbolicity Cones and Sparse Optimization, presented at the MIT LIDS seminar, 2023
Symmetrically Hyperbolic Polynomials, presented at the Öberwolfach Meeting on New Directions in Algebraic Geometry, 2023
Sparse Quadratic Programs via Polynomial Roots, presented at the Carnegie Mellon University ACO seminar, 2023
Sparse Quadratic Programs via Polynomial Roots, presented at the Centrum Wiskunde and Informatica Networks and Optimization seminar, 2022
Approximating Sparse Semidefinite Programs, presented at the INFORMS conference, 2021
Poster on Sparse Semidefinite Programs, presented at the MIP and IPCO conferences, 2021
Causal Inference and Optimization, presented at the ACO Student Seminar, 2021
Lightning Talk on Hyperbolic Relaxations of Locally-PSD Matrices , presented at the ICERM - Symmetry, Randomness, and Computations in Real Algebraic Geometry. , 2020

Academic Honors

2025 Best Thesis Award for the Georgia Tech Mathematics Department
2022 ACO-ARC Fellowship
2022 ARCS Foundation award
2021 Honorable Mention at the MIP Conference Poster Competition
2021 Honorable Mention at the IPCO Conference Poster Competition
2021 David L. Brown Fellowship from the Georgia Tech Math Department
2018 National Science Foundation Graduate Research Fellowship Recipient
2018 Georgia Institute of Technology President's Fellowship Recipient

Conference Organization

Coorganizer for the Session on Algebraic Methods in Optimization, ICCOPT
July 2025
Coorganizer for the Georgia Tech Student Algebra Seminar, Georgia Tech, GA
August 2022-December 2023
Coorganizer for the Special Session on Convexity, SIAM Conference on Applied Algebraic Geometry, Georgia Tech, GA
July 2023
Organizer for the AMS Special Session on Algebraic Methods in Algorithms, Spring 2023 Southeastern Section Meeting of the AMS, Georgia Tech, GA
March 2023

Research Experience

Visiting Scholar, Max-Planck Institute for Mathematics in the Sciences, Leipzig, Germany
Summer 2022

- Working under the supervision of Rainer Sinn and Bernd Sturmfels.

Research Assistantship, Georgia Tech, Atlanta, GA
Summer 2020

- Funded in part by NSF grant DMS-1901950 and the ACO department.
- Advised by Grigoriy Blekherman.

Outreach and Community Service

Representative for the Diversity, Equity, and Inclusion committee, Georgia Tech, GA
2022-2023
First Year Mentor, Georgia Tech, Atlanta, Georgia
2020-2021
Directed Reading Program Mentor, Georgia Tech, Atlanta, Georgia
2020-2021
Senior Class President, Caltech, Pasadena, CA
2018-2019
Board of Control Secretary, Caltech
2017

Teaching Experience

Differential Equations Teaching Assistant, Georgia Tech, Atlanta, GA
Aug 2022-Dec 2022
Differential Equations Teaching Assistant, Georgia Tech, Atlanta, GA
Aug 2021-Dec 2021
Number Theory Lecture Assistant, Georgia Tech, Atlanta, GA
Jan 2021-May 2021
Differential Equations Teaching Assistant, Georgia Tech, Atlanta, GA
Jan 2020-May 2020
Linear Algebra Teaching Assistant, Georgia Tech, Atlanta, GA
Aug 2019-Dec 2019
Advanced Algorithms Teaching Assistant, Caltech, Pasadena, CA
Jan 2018-Mar 2018
Linear Algebra Teaching Assistant, Caltech, Pasadena, CA
Sep 2017-Dec 2017
Introduction to Algorithms Teaching Assistant, Caltech, Pasadena, CA
Jan 2017-Mar 2017

Work Experience

Full-time Software Engineer, Google, Mountain View, CA
August 2018-July 2019

- Full stack web development for a data labelling service (Crowd-Compute)
- Lead an initiative to update authentication/authorization to more modern technologies.
- Added a major feature for tracking work in the system.
- Managed production releases and infrastructure issues.
- Worked with C++, Java.

Software Engineering Intern, Google, Mountain View, CA
Aug 2018-Jul 2019

- Gathered data from online sources by parsing Reddit pages.
- Built a machine learning model to provide movie recommendations.
- Worked with C++, Python.