Alex Dunbar

Contact

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Education

Emory University

- Ph.D., Mathematics (Expected Summer 2025)
- M.S., Mathematics (Spring 2023)
- Advisors: Vicki Powers (Emory University), Greg Blekherman (GA Tech)

Rice University

- B.S., Mathematics, *Cum Laude* (2020)
- B.A., Computational and Applied Mathematics, *Magna Cum Laude* (2020)
- Minor: Statistics

Research

Interests: Applied Algebraic Geometry, Real Algebraic Geometry, Optimization, and Machine Learning

Publications

3. "A Topological Approach to Simple Descriptions of Convex Hulls of Sets Defined by Three Quadrics" with Greg Blekherman. To appear in *SIAM Journal on Applied Algebra and Geometry* (2025)
2. Dunbar, Alex, and Lars Ruthotto. "Alternating minimization for regression with tropical rational functions." *Algebraic Statistics* 15.1 (2024): 85-111. DOI
1. Dunbar, Alex, Saumya Sinha, and Andrew J. Schaefer. "Relaxations and duality for multiobjective integer programming." *Mathematical Programming* (2023): 1-40 DOI

Preprints

1. "Pythagoras Numbers for Ternary Forms", with Greg Blekherman and Rainer Sinn, submitted

In Preparation

1. "Tensor-Tensor Products, Group Representations, and Semidefinite Programming", with Elizabeth Newman

Conference Presentations

4. "A Topological Approach to Simple Descriptions of Convex Hulls of Sets Defined by Three Quadrics" – MEGA (Effective Methods in Algebraic Geometry) 2024
3. "Alternating Minimization for Regression with Tropical Rational Functions" – SIAM Conference on Applied Algebraic Geometry 2023, Minisymposium on Real Algebraic Geometry and Optimization
2. "Alternating Minimization for Regression with Tropical Rational Functions" – AMS Spring Southeastern Sectional Meeting 2023, Special Session on Algebraic Methods in Algorithms

1. "Relaxation and Duality for Multiobjective Integer Programming" – INFORMS Annual Meeting 2020, Undergraduate Operations Reserach Prize Session A

Upcoming:

2. "Pythagoras Numbers for Ternary Forms"–SIAM Conference on Applied Algebraic Geometry 2025, Minisymposium on Real Algebraic Geometry: Semidefinite Optimization and Applications.

1. "Pythagoras Numbers for Ternary Forms"–ICCOPT 2025 International Conference on Continuous Optimization, session on "Algebraic Methods in Optimization"

Conference Posters:

4. "Alternating Minimization for Regression with Tropical Rational Functions"–SIAM Conference on the Mathematics of Data Science 2024, Minisymposium on Algebraic Geometry and Machine Learning, Poster Session

3. "A Topological Approach to Simple Descriptions of Convex Hulls of Sets Defined by Three Quadrics"–ICERM Workshop Discrete Optimization: Mathematics, Algorithms, and Computation, Poster Session

2. "Tensor-Tensor Products, Group Respresentations, and Semidefinite Programming" – JM Invariant at 60 Conference on Tensor Invariants in Geometry and Complexity Theory, May 2024, Poster Session

1. "An Alternating Minimization Algorithm for Regression with Tropical Rational Functions" – Computational, Combinatorial, and Applied Algebraic Geometry 2022 (CCAAGS-22), Poster Session

Seminar Talks

1. "Tropical Rational Regression and ReLU Network Initialization" – Computational and Data Enabled Science Seminar, Emory University, 11/3/22

Teaching Experience

- Emory University
  - MATH 211: Advanced Calculus, Instructor, Fall 2024
  - MATH 211: Advanced Calculus, Instructor, Fall 2023
  - MATH 111: Calculus 1, Instructor, Spring 2023
  - MATH 111: Calculus 1, Instructor, Fall 2022
  - MATH 221: Linear Algebra, TA, Spring 2022
  - MATH 315: Numerical Analysis, TA, Fall 2021
  - MATH 315: Numerical Analysis, Grader, Spring 2021
  - MATH 361: Mathematical Statistics I, Grader, Fall 2020
- Rice University
  - STAT 405: R for Data Science, Grader, Fall 2018

Organization

- Emory Math Directed Reading Program
  - Steering Committee (Spring 2022 - Spring 2024)
  - Co-Director (with Shilpi Mandal) (2023-2024 academic year)

Outreach

- Emory Math Directed Reading Program Mentor
  - Computational Algebra, 1 student (Spring 2024)
  - Convex Geometry, 1 student (Spring 2023)
  - Concrete Algebra, 1 student (Fall 2022)
  - Computational Algebra Part II, 2 students (Spring 2022)
  - Computational Algebra Part I, 2 students (Fall 2021)
- STEM Enhancement Summer Intern (Summer 2018)
  - CSTEM Teacher & Student Support Services, Inc. Houston, TX
- AmeriCorps VISTA (Summer 2017)
  - STEMup Baton Rouge, Baton Rouge, LA

Activities

- ICERM Workshop Discrete Optimization: Mathematics, Algorithms, and Computation (August 2024)
- Emory SIAM Student Chapter Member (May 2021 - present)
- MSRI-BIRS Graduate Summer School on "Sums of Squares Methods in Geometry, Combinatorics and Optimization" participant (Summer 2022)
- Moncrief Summer Undergraduate Internship, University of Texas at Austin, (Summer 2019)
  - Project: Dynamic Mode Decomposition and Koopman Spectral Analysis
  - Advisor: Chandrajit Bajaj

Honors And Awards

INFORMS Undergraduate Operations Research Prize Finalist	2020
NCAA CoSIDA Academic All-District Track and Field District 7	2020
Phi Beta Kappa Rice University Chapter	2020
C-USA Academic All-Conference Cross Country Team	2019
Dr. Hubert E. Bray Scholar Athlete of the Year	2019
Louis J. Walsh Scholarship	2018-2019

Other

- NCAA Division 1 Cross Country and Track & Field (Fall 2016 - Spring 2020)
  - Rice University Athletics
  - XC/5,000m/10,000m
  - Team Peer Academic Advisor (Fall 2018 - Spring 2020)