Alperen Ali Ergür

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Education

2016 PhD in Mathematics - *Texas A&M University, USA*

2011 MS in Mathematics- *Tobb University, Turkey*

2009 BS in Mathematics- *Bilkent University, Turkey*

Employment

Aug 2020-present University of Texas at San Antonio
Assistant Professor
Computer Science Department (25 %) Mathematics Department (75 %)

Sep 2019-Aug 2020 Carnegie Mellon University, Theoretical Computer Science Group
Postdoctoral Fellow
Mentors: Venkatesan Guruswami and Pravesh Kothari

May 2017-Aug 2019 Technical University of Berlin, Algorithmic Algebra Group
Einstein Postdoctoral Fellow
Mentors: Peter Bürgisser and Felipe Cucker

Aug 2016-May 2017 North Carolina State University, Symbolic Computation Group
Postdoctoral Research Scholar
Mentor: Cynthia Vinzant

Sep 2011-Aug 2016 Texas A&M University, Probability Theory and Algebraic Geometry Groups
Graduate Research/Teaching Assistant, and REU Instructor
Mentors: Grigoris Paouris and J. Maurice Rojas

Research Interest

Real Algebraic Geometry, Convex Geometry, Optimization, Theory of Computation
High Dimensional Probability, Randomized Numerical Algorithms, Reinforcement Learning

Grants, Awards, etc

Dec 2024	The Kay and Steve Robbins Faculty Teaching Fellowship in Computer Science
Sept 2024	NSF-CCF-2414160, Algorithmic Foundations Program
	Title: Algorithmic Foundations for Processing Algebraic Sets
2023+	MAA NExt Fellow, 2023 Class
Oct 2021	NSF-CCF-2110075, Algorithmic Foundations Program
	Title: Beyond Worst-Case Analysis for Computing with Polynomials
Jan 2017	Postdoctoral Fellowship by Einstein Foundation
2014-2015	Travel Grants by University of Trento, Institut Henri Poincare, and AMS
Sept 2009	Full Scholarship by Tobb University including tuition and stipend
Sept 2004	Full Scholarship by Bilkent University including tuition and stipend
< 2004	Two Bronze, One Silver Medal in National Math Competitions

Teaching Experience

1. San Antonio Creative Mathematics Circle, 2024 +
   Rodrigo Velez, Süleyman Tek, and I started a math circle for middle school children.
   We only admitted 8 sixth graders and plan to train them as a cohort.

2. University of Michigan
   Lead a group of student researchers (REU) on a reinforcement learning project in summer 25.

3. University of Texas at San Antonio

   - *Mentoring:*
     Thanuka Hansemeenu Wijenayaka (Visiting Scholar, Control Theory-RL, Current)
     Ethan Payne (M.S. in Pure Math, Current)
     Vincent Miller (M.S. in CS, Current)
     Chris La Velle (M.S. in Pure Math, Current)
     Yaseen Syed (M.S. in Applied Math, Current)
     Jonathan de Konig (undergrad researcher, Current)
     Melika Golestani (undergrad researcher, Current)
     Farhan Tajwar Romit (undergrad researcher, Current)
     Rahul Savishkumar (high school researcher, 2024 → UT Dallas CS)
     Jesus Rebollo-Bueno (postdoc, 2022 → Lecturer @ Sevilla, Spain)
     Josue Tonelli-Cueto (postdoc, 2023 → Postdoc @ John Hopkins Applied Math)
     Abigail Martinez (M.S. student, 2022)
     Ian Solis (undergrad researcher, 2022 → Southwest R&D, UT Austin Grad School)
     Nina De La Torre, (undergrad researcher, 2023 → Grad School @ UT Austin)
     Chris La Velle, (undergrad researcher, 2023 → Grad School @ UTSA)
   - *Reinforcement Learning Seminar*
     In Fall 24, I run a seminar on fundamentals of RL where I lectured and we implemented basic algorithms together. Link to resources
   - *Student-accessible research seminar on Geometry, Probability, and Computing*
     Link to resources

- *New Course Design and Redesign*
  Probability and Computing
  Algorithmic Foundations of Data Science Link to resources
  Introduction to Optimization (with C. Walton)
  Abstract algebra series from an algorithmic view (under development)
- *Instructor of the record @ UTSA School of Data Science:*
  Probability and Computing, Algorithmic Foundations of Data Science
- *Instructor of the record @ UTSA Main Campus:*
  Linear Algebra, Probability and Computing, Abstract Algebra,
  Algebra and Number Systems (intro to proofs), Calc 2

4. Technische Universität Berlin
   - *Seminar:* Interior Point Methods in Convex Optimization (with T. de Wolff)
   - *Graduate Class:* Effective Algebraic Geometry (with P. Bürgisser, J. Tonelli-Cueto)
5. NC State University
   - Instructor of the Record: Linear Algebra for Science Majors, Calculus, Precalc
6. Texas A&M University
   - *Assistant Instructor @ Research Experience for Undergraduates Program (REU)*
     Mentored *eight* undergraduate research projects in four summers: 2013-2016
     7 Students → grad school @ MIT, Harvard, Chicago, Notre Dame, Brown, UIUC
     Two students won NSF gradaute fellowship.
   - Recitation Leader for Graduate Algebra, Probability, Advanced Calculus

Publications and Preprints

Google scholar
UTSA students and postdoc co-authors are written **bold**.

Probability

1. The Rank of Sparse Random Matrices
   (with A. Coja-Oghlan, Pu Gao, S. Hettereich, H. Rolvien)
   Random Structures and Algorithms, 2022
   `https://doi.org/10.1002/rsa.21085`
2. Probabilistic Condition Number Estimates for Real Polynomials I
   (with G. Paouris and J.M. Rojas)
   Foundations of Computational Mathematics, 2019
   `https://doi.org/10.1007/s10208-018-9380-5`
3. Smoothed Analysis for the Condition Number of Structured Real Polynomial Systems
   (with G.Paouris and J.M. Rojas)
   Mathematics of Computation, 2021
   `https://doi.org/10.1090/mcom/3647`
4. On the Expected Number of Zeros of Random Fewnomials
   (with P. Bürgisser and J. Tonelli-Cueto)
   SIAM Journal on Applied Algebra and Geometry (SIAGA), 2019
   `https://doi.org/10.1137/18M1228682`

5. On the Number of Real Zeros of Random Sparse Polynomial Systems
(with Mate Telek, **Josue Tonelli-Cueto**) available at Arxiv submitted to SIAGA journal

Optimization

6. Approximating Nonnegative Polynomials via Spectral Sparsification
SIAM Journal on Optimization, 2019
`https://doi.org/10.1137/17M1121743`

7. Multihomogenous Nonnegative Polynomials and Sums of Squares
Discrete & Computational Geometry, 2018
`https://doi.org/10.1007/s00454-018-0011-3`

8. Approximate Real Symmetric Tensor Rank
(with **J. Rebollo-Bueno**, P. Valettas)
Arnold Mathematical Journal, 2023
`https://doi.org/10.1007/s40598-023-00235-4`
Jupyter Notebook for the code: `https://alpergur.xyz/energy_increment.ipynb`

9. Optimal Preconditioning is a Geodesically Convex Optimization Problem
(with M.L. Doğan, E. Tsigaridas), $\sim 40pg$ submitted to SODA 2026

10. A Metric Geometry Approach to Extension Complexity
(with G. Paouris, P. Valettas) – in preperation to be submitted to Arnold Journal of Mathematics

Algorithms in Algebra and Geometry - Conferences

11. Plantinga-Vegter Algorithm Takes Average Polynomial Time
(with F. Cucker, J. Tonelli-Cueto)
ACM Symposium on Symbolic and Algebraic Computation (ISSAC), 2019
`https://doi.org/10.1145/3326229.3326252`

12. The Rank of Sparse Random Matrices
(with A. Coja-Oghlan, Pu Gao, S. Hettereich, H. Rolvien)
ACM Symposium on Discrete Algorithms (SODA), 2020
`https://epubs.siam.org/doi/pdf/10.1137/1.9781611975994.35`

13. Beyond Worst-Case Analysis for Root Isolation Algorithms
(with **J. Tonelli-Cueto**, E. Tsigaridas)
ACM Symposium on Symbolic and Algebraic Computation, (ISSAC), 2022
`https://doi.acm.org?doi=3476446.3535475`

14. On the Number of Iterations of the DBA Algorithm
(with F. Brüning, A. Driemel, H. Röglin)
SIAM Conference on Data Mining, 2024
`https://epubs.siam.org/doi/pdf/10.1137/1.9781611978032.20`

15. Feasibility of Circuit Polynomials without Purple Swans
(with W. Deng, G. Paouris, J.M. Rojas)
ACM Symposium on Symbolic and Algebraic Computation, (ISSAC), 2024
`https://dl.acm.org/doi/abs/10.1145/3666000.3669716`

16. Accuracy and Stability of Algorithms for Computing the Fundamental Matrix
(with S. Agarwal, E. Connelly, R. Thomas) – in preperation to be submitted to CVPR 2026

Algorithms in Algebra and Geometry - Journals

17. Tropical Varieties for Exponential Sums
(with G. Paouris and J.M. Rojas)
Mathematische Annalen, 2020
https://doi.org/10.1007/s00208-019-01808-5

18. On the Complexity of Plantinga-Vegter Algorithm
(with F. Cucker and **J. Tonelli-Cueto**)
Discrete & Computational Geometry, 2022
https://doi.org/10.1007/s00454-022-00403-x

19. A Polyhedral Homotopy Algorithm for Real Zeros
(with T. de Wolff)
Arnold Mathematical Journal, 2022
https://doi.org/10.1007/s40598-022-00219-w

20. Functional Norms, Condition Numbers, and Numerical Algorithms
in Algebraic Geometry (with F. Cucker, **J. Tonelli-Cueto**)
Forum Mathematics Sigma, 2022
https://doi.org/10.1017/fms.2022.89

21. On the Complexity of Chow and Hurwitz Forms
(with M. L. Doğan, E. Tsigaridas)
ACM Communication in Computer Algebra, 2024
https://doi.org/10.1145/3653002.3653003

22. On the Number of Iterations of the DBA Algorithm
(with F. Brüning, A. Driemel, H. Röglin)
Konwledge Discovery and Data Mining, 2025
https://link.springer.com/article/10.1007/s10618-025-01116-4

Algebraic Geometry and Combinatorics

23. The Geometry of Rank Drop in a Class of Face-Splitting Matrix Products
(with S. Agarwal, E. Connelly, R. Thomas)
Advances in Geometry, 2024
https://www.degruyter.com/document/doi/10.1515/advgeom-2024-0016/html

24. The Multivariate Schwartz-Zippel Lemma
(with M. L. Doğan, J. Mundo, E. Tsigaridas)
SIAM Journal of Discrete Mathematics, 2022
https://doi.org/10.1137/20M1333869

25. Toric Compactifications for Analytic Combinatorics
(with T. George, S. Gillen, S. Melczer, R. Pemantle) – in preperation, to be submitted to Mathematics of Computation

Reinforcement Learning

26. Average and Extremal Power-Flow Configurations
(with J. Lindberg, **V. Miller**) – in preparation to be submitted to RLC 2026

27. Learning Biochemical Reaction Networks with Many Equilibrium States
(with **Y. Syeed**) – in preperation to be submitted to RLDM 2026

28. Learning Monomial Selection Strategies in Gröbner Basis Algorithms
(with C. Bunch, **M. Golestani**, M. Walewski, J. Tong, Y. Zeytuncu) – in preperation to be submitted to ICML 2026

29. An Interpretable Model of Architectural Beauty
(with E. Kara, **J. de Koning**, N. Salingaros), in preperation

Selected Talks

April 2025 UT Austin Oden Institute Scientific Computing Seminar
May 2024 Algebra and Geometry Seminar, New Mexico State
Oct 2023 Senior Seminar, Spielman College
Nov 2022 Algebraic Geometry and Complexity Theory Workshop, Polish Academy of Sciences
May 2022 Real Algebraic Geometry and Optimization Seminar, Purdue University
April 2022 Workshop on Analytical Combinatorics, AIM, San Jose, CA
Jul 2021 Mathematical Congress of Americas, Buenos Aires, Argentina
Jun 2021 Effective Methods in Algebraic Geometry, MEGA 2021, Tromso Norway
Sept 2020 Data Seminar, U Missouri Columbia
Mar 2020 ACO Seminar, Carnegie Mellon University
Jul 2019 SIAM Conference on Applied Algebraic Geometry 2019, Bern, Switzerland
Jun 2019 Effective Methods in Algebraic Geometry (MEGA) 2019, Madrid, Spain
Apr 2019 Computational Geometry Workshop, Schloss Dagstuhl, Germany
Feb 2019 Universität Bonn, Theoretical Computer Science Seminar
Nov 2018 Goethe Universität Frankfurt, Applied Discrete Mathematics Seminar
Mar 2018 Emerging Trends in Geometric Functional Analysis, Banff (BIRS), Canada
Dec 2017 Methods on Discrete Structures Lecture Series, TU Berlin
Nov 2017 Algebra Meets Numerics Workshop, Berlin Academy of Sciences
Mar 2017 U Michigan Ann Arbor, Analysis and Probability Seminar
July 2016 Geometric Functional Analysis Concentration Week, Texas A&M
Apr 2016 MIT, LIDS Seminar
Apr 2016 Georgia Tech, Algebra Seminar
Mar 2016 Univ of Chicago, Scientific Computing Seminar
Mar 2016 NC State University, Symbolic Computation Seminar
Dec 2015 Colorado State University, FRAGMENT Seminar
Oct 2015 Technical University of Munich, Applied Geometry Seminar, Germany
Sept 2015 University of Athens, Convex Geometric Analysis Seminar, Greece

Service

Sept 25 + Organizer, UTSA Algorithms Seminar

May 25 Panelist, NSF CCF Directory

2021-23 Organizer, Geometry, Probability, and Computing Seminar
A student accessible research seminar co-organized with G. Paouris and P. Valettas

Sept 24 Organizer, AMS Meeting Minisyposia:
with A. Shui and F. Sottile, Applications of Algebraic Geometry (22 speakers)

2023 PC Member, ACM Symposium in Algebraic Computation (ISSAC 2023)

March 23 Panelist, NSF CCF Directory

Nov 2021 Organizer, SIAM TX-Louisiana Section Meeting Minisymposia:
with J. M. Rojas and F. Sottile, Algorithmic Algebra and Geometry (4 sessions)

July 2021 Organizer, Mathematical Congress of Americas Minisymposia:
with D. Armentano, M. Bender, and J. Tonelli Cueto,
Numeric-Symbolic Computation with Polynomials (3 Sessions)

April 2020 Panelist, NSF CCF Directory

July 2019 Organizer, SIAM Applied Algebraic Geometry Minisymposia:
with P. Lairez, G. Malajovich, and J. Tonelli Cueto,
Numerical Methods for Structured Polynomial System Solving (4 sessions)

Fall 2017 Organizer, Algorithmic Algebra OberSeminar, with P. Bürgisser, TU Berlin

Jan 2016 Organizer, Combinatorial Algebraic Geometry Workshop, Nesin Math Village
with Ö. Kişisel, H. Güntürkün, and Ö. Öztürk

PhD Thesis Committee

Maurice Rolvien, TU Dortmund Theoretical Computer Science, December 24
Ethan Payne, UTSA Computer Science, August 24
Jodh Pannu, UTSA Computer Science, August 24
Kumar Thummapudi, UTSA Computer Science, August 24
Sharvari Komajwar, UTSA Computer Science, August 21

References

Teaching Timothee Bryan (Term Assistant Professor of Mathematics, George Mason University)
Peter Bürgisser (Professor of Algorithmic Algebra, Technical University of Berlin)
Felipe Cucker (Professor of Mathematics, City University of Hong Kong)
Pravesh Kothari (Assistant Professor of Computer Science, Princeton University)
Grigoris Paouris (Professor of Mathematics, Texas A&M University)
J.Maurice Rojas (Professor of Mathematics and Computer Science, Texas A&M University)
Cynthia Vinzant (Associate Professor of Mathematics, University of Washington, Seattle)