

# Alperen Ali Ergür

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<b>Address</b>	U Texas at San Antonio Mathematics Department One UTSA Circle San Antonio, TX, 78249	<b>Phone</b>	412 499 2678
		<b>Email</b>	alperen.ergur@utsa.edu <a href="http://alpergur.xyz">http://alpergur.xyz</a>

## 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. 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)
- *Student-accessible research seminar on Geometry, Probability, and Computing*  
Resources available at <http://alpergur.xyz/gpcseminar.html>
- *New Course Design and Redesign*
  - Probability and Computing
  - Introduction to Optimization (with C. Walton)
  - Abstract algebra series from an algorithmic view (under development)
  - 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
- *Instructor of the record @ UTSA School of Data Science:*
  - Probability and Computing, Algorithmic Foundations of Data Science

2. 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)
3. NC State University
  - Instructor of the Record: Linear Algebra for Science Majors, Calculus, Precalc
4. 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 graduate fellowship.
  - Recitation Leader for Graduate Algebra, Probability, Advanced Calculus

## Publications and Preprints

Google scholar

### Journal Papers

1. Multihomogenous Nonnegative Polynomials and Sums of Squares  
Discrete & Computational Geometry, 2018  
<https://doi.org/10.1007/s00454-018-0011-3>
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. Approximating Nonnegative Polynomials via Spectral Sparsification  
SIAM Journal on Optimization, 2019  
<https://doi.org/10.1137/17M1121743>
4. Tropical Varieties for Exponential Sums  
(with G. Paouris and J.M. Rojas)  
Mathematische Annalen, 2020  
<https://doi.org/10.1007/s00208-019-01808-5>
5. 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>
6. 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>
7. 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>

8. 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>
9. 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>
10. A Polyhedral Homotopy Algorithm for Real Zeros  
(with T. de Wolff)  
Arnold Mathematical Journal, 2022  
<https://doi.org/10.1007/s40598-022-00219-w>
11. 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>
12. 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](https://alpergur.xyz/energy_increment.ipynb)
13. 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>
14. The Geometry of Rank Drop in a Class of Face-Splitting Matrix Products  
(with S. Agarwal, E. Connelly, R. Thomas)  
Advances in Geomtry  
<https://www.degruyter.com/document/doi/10.1515/advgeom-2024-0016/html>

## Conference Papers

15. Plantinga-Vegter Algorithm Takes Average Polynomial Time  
ACM Symposium on Symbolic and Algebraic Computation (ISSAC), 2019  
<https://doi.org/10.1145/3326229.3326252>
16. 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>
17. 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>

18. On the Number of Iterations of the DBA Algorithm  
(with F. Brünig, A. Driemel, H. Röglin)  
SIAM Conference on Data Mining, 2024  
<https://epubs.siam.org/doi/pdf/10.1137/1.9781611978032.20>
19. 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>

## Preprints

Articles listed here are available at [https://arxiv.org/a/ergur\\_a\\_1.html](https://arxiv.org/a/ergur_a_1.html)

20. On the Number of Real Zeros of Random Sparse Polynomial Systems  
(with Mate Telek, Josue Tonelli-Cueto)

## Papers in Preparation

21. Accuracy and Stability of Algorithms for Computing the Fundamental Matrix  
(with S. Agarwal, E. Connelly, R. Thomas)
22. Toric Compactifications for Analytic Combinatorics  
(with T. George, S. Gillen, S. Melczer, R. Pemantle)
23. A Metric Geometry Approach to Extension Complexity  
(with G. Paouris, P. Valettas)
24. Preconditioning Multivariate Polynomials via Riemannian Optimization  
(with M.L. Doğan, E. Tsigaridas)
25. Average and Extremal Power-Flow Equations  
(with J. Lindberg, V. Miller, R. Savishkumar)

## Selected Talks

- 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, Tromsø 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

- 2021+** Organizer, Geometry, Probability, and Computing Seminar  
A student accessible research seminar co-organized with G. Paouris and P. Valettas
- Sept 24** Organizer, AMS Meeting Minisymposia:  
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 )