Kisun Lee

Clemson University, School of Mathematical and Statistical Sciences, Post Doctoral Fellow.

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pronouns: he, him, his

Research Interest

Nonlinear algebra and applied algebraic geometry

Algorithms in numerical algebraic geometry (homotopy continuation, numerical certification)

Applications of numerical algebraic geometry (game theory, algebraic statistics, and combinatorics)

Polyhedral and tropical geometry, tensor rank problems

Employment

Clemson University, Clemson, South Carolina	*Aug 2023 - Present*
Post Doctoral Fellow.	
Mentor : Michael Burr	
University of California San Diego, La Jolla, California	*Jul 2020 - Jun 2023*
Stefen E. Warschawski Visiting Assistant Professor.	
Mentor : Jiawang Nie	
Semester Program Nonlinear Algebra at ICERM	*Sep 2018 - Dec 2018*
Short Term Visiting.	

Education

Georgia Institute of Technology, Atlanta, Georgia	*Aug 2015 - May 2020*
Ph.D, Mathematics	
Advisor : Anton Leykin	
Thesis : Finding and certifying numerical roots of systems of equations	
Sogang University, Seoul, Korea	*Mar 2009 - Feb 2015*
B.S, Mathematics	

Preprints/Publications

M. Burr, J. D. Hauenstein & K. Lee. Certified surface approximations using the interval Krawczyk test. *preprint.*

K. Lee. Asymptotic rank bounds: a numerical census. *preprint.*

K. Lee. A priori bounds for certified Krawczyk homotopy tracking. *preprint.*

M. Burr, M. Byrd & K. Lee. Certified algebraic curve projections by path tracking. *In Proceedings of the 2025 on International Symposium on Symbolic and Algebraic Computation* (2025) pp 87-96.

M. Cai, K. Lee & J. Yu. The tropical variety of symmetric rank 2 matrices. *Linear Algebra and its Applications.* **720** (2025) pp 50-71.

K. Lee. Effective alpha theory certification using interval arithmetic: alpha theory over regions. *Lecture Notes in Computer Science.* **14749** (2024) pp 275-284.

T. Duff & K. Lee. Certified homotopy tracking using the Krawczyk method. *In Proceedings of the 2024 on International Symposium on Symbolic and Algebraic Computation* (2024) pp 274-282.

K. Lee, N. Li & L. Zhi. Two-step Newton's method for deflation-one singular zeros of analytic systems. *Journal of Symbolic Computation.* **123** (2024) 102278.

M. Burr, K. Lee & A. Leykin. Isolating clusters of zeros of analytic systems using arbitrary-degree inflation. *In Proceedings of the 2023 on International Symposium on Symbolic and Algebraic Computation.* (2023) pp 126-134.

K. Lee, S. Melczer & J. Smolčić. Homotopy techniques for analytic combinatorics in several variables. *In Proceedings of International Symposium on Symbolic and Numeric Algorithms for Scientific Computing 2022.* (2022).

K. Lee & X. Tang. On the polyhedral homotopy method for solving generalized Nash equilibrium problems of polynomials. *Journal of Scientific Computing.* **95** (2023) no. 13.

K. Lee. The NumericalCertification package in Macaulay2. *preprint.*

K. Lee, J. Lindberg & J. I. Rodriguez. Implementing real polyhedral homotopy. *Journal of Software for Algebra and Geometry.* **14** (2024) no. 1, pp 59-71.

D. I. Bernstein, G. Blekherman & K. Lee. Typical ranks in symmetric matrix completion. *Journal of Pure and Applied Algebra.* **225** (2021) no. 7, 106603.

K. Lee. Certifying approximate solutions to polynomial systems on `Macaulay2`. *ACM Communications in Computer Algebra.* **53** (2019) no. 2, pp 45–48.

M. Burr, K. Lee & A. Leykin. Effective certification of approximate solutions to systems of equations involving analytic functions. *In Proceedings of the 2019 on International Symposium on Symbolic and Algebraic Computation.* (2019) pp 267–274.

T. Duff, C. Hill, A. N. Jensen, K. Lee, A. Leykin & J. Sommars. Solving polynomial systems via homotopy continuation and monodromy. *IMA Journal of Numerical Analysis.* **39** (2019) no. 3, pp 1421–1446.

W. Jung, J. L. Kim, Y. Kim & K. Lee. The dimension of magic squares over fields of characteristics two and three. *Linear Algebra and its Applications.* **472** (2015) pp 118-134.

Software

`ACSVHomtopy.jl` (joint with S. Melczer & J. Smolčić), a Julia package.

`RealPolyhedralHomotopy.jl` (joint with J. Lindberg & J. I. Rodriguez), a Julia package.

`NumericalCertification.m2`, a Macaulay2 package.

`EigenSolver.m2` (joint with L. Busé, J. Chen, A. Leykin, T. Pajdla & E. Pirnes), a Macaulay2 package.

`MonodromySolver.m2` (joint with T. Duff, C. Hill, A. N. Jensen, A. Leykin & J. Sommars), a Macaulay2 package.

Awards/Honors

AMS MRC Travel Grant. ($1200)	*January 2026*
SIAM AG 25 Travel Grant. ($650)	*July 2025*
ICERM Workshop on Matroids, Rigidity, and Algebraic Statistics Travel Grant. ($1420)	*Spring 2025*
Workshop on Computational and Applied Enumerative Geometry Travel Grant. ($1200)	*Summer 2024*
ISSAC 2023 Travel Grant. ($326)	*Summer 2023*
SIAM Conference on Applied Algebraic Geometry (AG 23) Travel Grant. ($530)	*Summer 2023*
Meeting on Applied Algebraic Geometry Travel Grant. ($543)	*Spring 2023*
AMS MRC Travel Grant. ($950)	*Winter 2022*
CCAAGs-22 Travel Grant. ($636)	*Summer 2022*
Macaulay2 Conference at CSU Travel Grant. ($879)	*Spring 2022*
Grant for AMS Mathematical Research Community Program. ($1175)	*Summer 2021*
Georgia Tech Outstanding TA. ($300)	*Spring 2020*
ISSAC 2019 Travel Grant.	*Summer 2019*
SIAM AG 19 Travel Grant.	*Summer 2019*
MEGA 2019 Travel Grant.	*Summer 2019*
Georgia Tech Outstanding Student Teaching Evaluation.	*Spring 2018*
Sogang University Dean's List.	*Fall 2012, Fall 2013*
Korea Student Aid Foundation (KOSAF) The Scholarship for Natural Sciences and Engineering Students.	*2012 - 2013*

Conference Talks and Posters

Presentation : "Asymptotic rank bounds: a numerical census", January 2026, Joint Mathematics Meeting 2026, Washington D.C., US.

Presentation : "*A priori* predictor for Krawczyk homotopy tracking", October 2025, AMS Sectional Meeting, St Louis, Missouri, US.

Presentation : "Certified curve tracking using interval arithmetic", July 2025, SIAM Conference on Applied Algebraic Geometry, Madison, Wisconsin, US.

Presentation : "Symmetric matrix completion problems", March 2025, Matroids, Rigidity, and Algebraic Statistics, Providence, Rhode Island, US.

Presentation : "Algebraic geometry in the generalized Nash equilibrium problems", February 2025, Applied Algebra Seminar at University of Wisconsin - Madison, Madison, Wisconsin, US.

Presentation : "Certified curve tracking using interval arithmetic", January 2025, Joint Mathematics Meeting 2025, Seattle, Washington, US.

Presentation : "Symmetric Tropical Rank 2 Matrices", January 2025, Joint Mathematics Meeting 2025, Seattle, Washington, US.

Presentation : "Symmetric Tropical Rank 2 Matrices", August 2024, 2024 Workshop on (Mostly) Matroids, Daejeon, South Korea.

Presentation : "Symbolic-Numeric Methods in Algebraic Geometry", July 2024, International Congress on Mathematical Software 2024, Durham, UK. (Cancelled)

Presentation : "Certified homotopy tracking using the Krawczyk method", July 2024, 49th International Symposium on Symbolic and Algebraic Computation, Raleigh, South Carolina, US.

Presentation : "Symmetric Tropical Rank 2 Matrices", July 2024, Discrete Math Seminar at IBS Discrete Mathematics Group (DIMAG), Daejeon, South Korea.

Presentation : "Introduction to Numerical Algebraic Geometry", June 2024, Algebra Seminar at Sogang University, Seoul, South Korea.

Presentation : "Numerical Certification and Certified Homotopy Tracking", June 2024, Algebraic Geometry Seminar at IBS Center for Complex Geometry (CCG), Daejeon, South Korea.

Presentation : "Introduction to Numerical Algebraic Geometry", June 2024, Algebraic Geometry Seminar at IBS Center for Complex Geometry (CCG), Daejeon, South Korea.

Presentation : "Symmetric Tropical Rank 2 Matrices", June 2024, KIAS HCMC Algebraic Geometry Seminar, Seoul, South Korea.

Presentation : "Certified homotopy tracking using the Krawczyk method", June 2024, Workshop on Computational and Applied Enumerative Geometry, Toronto, Ontario, Canada.

Presentation : "Certified homotopy tracking using the Krawczyk method", April 2024, AMS Sectional Meeting, Milwaukee, Wisconsin, US.

Presentation : "Introduction to numerical nonlinear algebra", April 2024, MATH for all in Nola Satellite Conference in Clemson, Clemson, South Carolina, US.

Presentation : "Rank 2 symmetric matrices, tropicalization, and algebraic matroids", March 2024, AMS Sectional Meeting, Tallahassee, Florida, US.

Presentation : "Certified computation in algebraic geometry using interval arithmetic", December 2023, Georgia Tech Algebra Seminar, Atlanta, Georgia, US.

Presentation : "Certified homotopy tracking via interval arithmetic", November 2023, Joint CUNY/Courant/NCSU Seminar in Symbolic-Numeric Computing, New York, US. (Virtual)

Presentation : "Algorithms, applications and certification in numerical nonlinear algebra", August 2023, Tensor and Geometry with Applications, Daejeon, South Korea.

Presentation : "Isolating Clusters of Zeros of Analytic Systems using Arbitrary-degree Inflation", July 2023, 48th International Symposium on Symbolic and Algebraic Computation, Tromsø, Norway.

Presentation : "Isolating Clusters of Zeros of Analytic Systems using Arbitrary-degree Inflation", July 2023, SIAM Conference on Applied Algebraic Geometry, Eindhoven, Netherlands.

Poster : "Symmetric Tropical Rank 2 Matrices" (joint with May Cai), April 2023, Meeting on Applied Algebraic Geometry, Atlanta, US.

Presentation : "Homotopy techniques for analytic combinatorics in several variables", January 2023, Joint Mathematics Meeting 2023, Boston, Massachusetts, US.

Presentation : "Homotopy techniques for analytic combinatorics in several variables", September 2022, International Symposium on Symbolic and Numeric Algorithms for Scientific Computing 2022, Linz, Austria. (Virtual)

Presentation : "Certifying roots of polynomial systems on Macaulay2", May 2022, Macaualy2 Conference at CSU, Cleveland, Ohio, US.

Presentation : "Polyhedral Homotopy Method for Nash Equilibrium Problem", April 2022, AMA Colloquium Series on Young Scholars in Optimization and Data Science, Hong Kong. (Virtual)

Presentation : "Computing asymtotics for multivariate rational functions using numerical algebraic geometry", April 2022, Joint Mathematics Meeting 2022, Seattle, Washington, US. (Virtual)

Presentation : "Polyhedral Homotopy Method for Nash Equilibrium Problem", April 2022, Joint Mathematics Meeting 2022, Seattle, Washington, US. (Virtual)

Presentation : "Polyhedral Homotopy Method for Nash Equilibrium Problem", November 2021, UCSD Optimization and Data Science Seminar, La Jolla, California, US. (Virtual)

Presentation : "Polyhedral Homotopy Method for Nash Equilibrium Problem", July 2021, SIAM Conference on Applied Algebraic Geometry, College Station, Texas, US. (Virtual)

Presentation : "Finding and certifying numerical roots of systems of equations", February 2021, University of California San Diego Algebraic Geometry Seminar, La Jolla, California, US. (Virtual)

Presentation : "Typical ranks in real symmetric matrix completion.", March 2020, AMS Sectional Meeting, Charlottesville, Virginia, US. (Cancelled)

Presentation : "Certifying Solutions to a Square Analytic System", October 2019, Joint CUNY Graduate Center-Courant Seminar in Symbolic-Numeric Computing, New York, US.

Presentation : "Certifying Solutions to a Square Analytic System", October 2019, Clemson University Algebra and Discrete Mathematics Seminar, Clemson, US.

Presentation : "Certifying Solutions to a Square Analytic System", October 2019, Georgia Institute of Technology Algebra Seminar, Atlanta, US.

Presentation : "Certifying Approximate Solutions to Polynomial Systems on Macaulay2", July 2019, 44th International Symposium on Symbolic and Algebraic Computation, Beijing, China.

Presentation : "Certifying Solutions to a Square System Involving Analytic Functions", July 2019, 44th International Symposium on Symbolic and Algebraic Computation, Beijing, China.

Presentation : "Certifying Solutions to a Square System Involving Analytic Functions", July 2019, SIAM Conference on Applied Algebraic Geometry, Bern, Switzerland.

Poster : "Typical Ranks of Semisimple Graphs", July 2019, Summer School on Randomness and Learning in Non-Linear Algebra, Leipzig, Germany.

Poster : "Typical Ranks of Semisimple Graphs", June 2019, Effective Methods in Algebraic Geometry, Madrid, Spain.

Poster : "Certification for Roots of Systems Involving Analytic Functions", April 2019, Meetings on Applied Algebraic Geometry, Atlanta, US.

Poster : "Monodromy Solvers", November 2018, Nonlinear Algebra in Applications, Providence, US.

Poster : "Monodromy Solvers", September 2018, Core Computational Methods, Providence, US.

Poster : "Monodromy Solvers", April 2018, Meeting on Applied Algebraic Geometry, Atlanta, US.

Poster : "Solving Polynomial System Using Package MonodromySolver", August 2017, SIAM Conference on Applied Algebraic Geometry, Atlanta, US.

Presentation : "Solving Polynomial Systems via Homotopy Continuation and Monodromy" (joint with Timothy Duff), October 2016, AMS Sectional Meeting , Denver, US.

Teaching Experience & Mentoring

Mentoring Experience

- Aniket Iyer (Undergraduate, UC San Diego)   *Fall 2022 - Spring 2023*
- Liangyu Hu (Undergraduate, UC San Diego)   *Fall 2022 - Spring 2023*
  - Received TRELS Conference Funding.
- Group Leader : Directed Reading - Real Polyhedral Homotopy   *Summer 2021*
- Program Mentor : AWM Mentorship program   *Spring 2021*

School of Mathematical and Statistical Sciences, Clemson University

- Math 4130, Algebra II, Spring 2025 (Lead Instructor).
- Math 4120, Algebra I, Fall 2024 (Lead Instructor).
- Math 3110, Linear Algebra, Spring 2024, Fall 2024, Spring 2025, Fall 2025 (Lead Instructor).
- Math 1020, Business Calculus I, Fall 2023 (Lead Instructor).

Department of Mathematics, University of California San Diego

- Math 20D, Introduction to Differential Equations, Winter 2021, Fall 2021, Winter 2022, Fall 2022, Winter 2023, Spring 2023 (Lead Instructor).
- Math 20C, Calculus & Analytic Geometry For Science & Engineering, Fall 2021, Spring 2022 (Lead Instructor).
- Math 10C, Calculus III, Winter 2021, Spring 2021 (Lead Instructor).
- Math 103A, Modern Algebra I, Fall 2020 (Lead Instructor).

School of Mathematics, Georgia Institute of Technology

- Math 1711, Finite Mathematics, Spring 2019, Fall 2019, Spring 2020 (Lead Instructor).
- Math 1552, Integral Calculus, Summer 2019 (Lead Instructor).
- Math 1555, Calculus for Life Science, Spring 2018 (Lead Instructor).
- Math 1551, Differential Calculus, Fall 2017, Summer 2018 (Lead Instructor).

- Math 2552, Differential Equation, Spring 2016, Fall 2016, Spring 2017, Summer 2017 (Teaching Assistant).
- Math 1553, Introduction of Linear Algebra, Fall 2015 (Lecture Assistant).

Department of Mathematics, Sogang University

- Undergraduate Student Tutor.

Skills

Programming : MATLAB, Macaulay2, Julia, Python (SageMath).

Foreign Languages : Native Korean, Fluent English.

Activities & Services

Reviewer

- Computer Algebra in Scientific Computing, Foundations of Computational Mathematics, International Congress on Mathematical Software, International Symposium on Symbolic and Algebraic Computation, Mathematics in Computer Science, Mathematical Reviews (MathSciNet)

Organizer of the Special Session "Applied and Computational Algebraic Geometry" at the 2025 AMS Spring Southeastern Sectional Meeting (joint with Matthew H. Faust and Jordy L. Garcia). *March 2026*

Organizer of the mini-symposium "Numerical and Certified Methods in Algebraic Geometry" at the SIAM Conference on Applied Algebraic Geometry (AG25). *July 2025*

Program Committee of MAAG 2025. *April 2025*

Organizer of the Special Session "Recent trends in applied algebra and geometry" at the 2025 AMS Spring Southeastern Sectional Meeting (joint with Michael Byrd). *March 2025*

Program Committee of 2024 ICMS. *July 2024*

Organizer of the Session "Symbolic-numeric methods in algebraic geometry" at 2024 ICMS (joint with Thomas Yahl). *July 2024*

Software Presentation Committee of 2024 ISSAC. *July 2024*

Organizer of the Special Session "Combinatorics in Geometry of Polynomials" at the 2024 AMS Spring Southeastern Sectional Meeting (joint with Papri Dey). *March 2024*

UC San Diego Undergraduate Research Conference Moderator. *April 2023*

UC San Diego AWM Mentorship Program Coordinator. *Fall 2022 - Spring 2023*

UC San Diego AWM Mentorship Program (Mentor). *2021*

Group Leader for NumericalCertification Project at Macaulay2 Workshop at CSU. *2020*

Georgia Tech School of Mathematics Graduate Student Council. *2019 - 2020*

Georgia Tech LGBTQIA+ Allyship Program. *2019*

Organizer of the Student Algebraic Geometry Seminar at Georgia Tech. *2018*

AMS Graduate Student Chapter (Treasury). *2017 - 2018*

SIAM Conference on Applied Algebraic Geometry 2017 (Volunteer).	*August 2017*
Seoul International Congress of Mathematicians 2014 (Volunteer).	*August 2014*

References

1. Anton Leykin (Ph.D. advisor) / Georgia Institute of Technology /
   686 Cherry St, Atlanta, GA 30332 / 404-894-9204 / leykin@math.gatech.edu

2. Michael Burr / Clemson University /
   220 Parkway Dr, Clemson, SC 29634 / 864-656-5220 / burr2@clemson.edu

3. Donna Simms (Teaching) / Clemson University /
   220 Parkway Dr, Clemson, SC 29634 / 864-656-5210 / dsimms@clemson.edu

4. Frank Sottile / Texas A&M University /
   Department of Mathematics Texas A&M University College Station, TX 77843 / 979-845-7554 /
   sottile@tamu.edu

5. Josephine Yu / Georgia Institute of Technology /
   686 Cherry St, Atlanta, GA 30332 / 404-894-2710 / jyu@math.gatech.edu

6. Jonathan Hauenstein / University of Notre Dame /
   University of Notre Dame Notre Dame, IN 46556 / 574-631-6566 / hauenstein@nd.edu