Kisun Lee

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

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website: https://klee669.github.io
pronouns: he, him, his

Research Interest

Applied algebraic geometry and nonlinear algebra. Specifically, algorithms and applications of numerical algebraic geometry, algebraic combinatorics and convex geometry.

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, M. Byrd & K. Lee. Certified algebraic curve projections by path tracking. *Accepted in 2025 International Symposium on Symbolic and Algebraic Computation.*

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

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 : "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 : "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 (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

- CASC, Foundations of Computational Mathematics, ICMS, ISSAC, Mathematics in Computer Science, Mathematical Reviews (MathSciNet)

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*