Rainer Sinn
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Lebenslauf

STELLE
Seit 2020: Professur für Angewandte Algebra (W2) an der Universität Leipzig

WERDEGANG
2017 - 2020: Juniorprofessur für Diskrete Geometrie an der Freien Universität Berlin; von Juli 2018 bis September 2020 stellvertretende Leitung der Arbeitsgruppe
2017: Mitarbeiter in der Arbeitsgruppe Nonlinear Algebra am Max-Planck-Institut für Mathematik in den Naturwissenschaften, Leipzig
2014 - 2017: Visiting Assistant Professor am Georgia Institute of Technology, Atlanta, GA

ABSLÜSSE
- Doktor der Naturwissenschaften (Dr. rer. nat.), summa cum laude, 2014 Betreuer: Claus Scheiderer
- Diplom in Mathematik (1,0), 2010

AUSBILDUNG
- Doktorand an der Universität Konstanz, 2010 - 2014
- Erasmus Student an der Université Paris Diderot Paris VII, 2008/2009
- Student an der Universität Konstanz 2004-2009

FORSCHUNGSINTERESSEN
Algebraische, diskrete, konvexe, reelle Geometrie
- Nichtnegative Polynome und Quadratsummen
- Spektraeder und lineare Matrixungleichungen
- Konvexe, semi-algebraische Mengen

DRITTMITTEL UND PREISE
- SAXAG (Anschubsprojekt des Sächsischen Staatsministeriums für Wissenschaft, Kultur und Tourismus)
- MaRDI (Verbundprojekt im Rahmen der NFDI), beteiligt an TA6 (Data Culture and Community Integration)
- DFG Projekt „Geometrie hyperbolischer Polynome“ (mit Daniel Plaumann, TU Dortmund)
- Simons-Berkeley Research Fellowship für das Semesterprogramm Geometry of Polynomials am Simons Institute, Berkeley (2019)
Längerer Aufenthalt

- Januar - Mai 2019: Simons Institute - Semesterprogramm Geometry of Polynomials
- September - Oktober 2018: ICERM - Semesterprogramm Nonlinear Algebra
- August - September 2017: MSRI - Semesterprogramm Geometric and Topological Combinatorics (Research Membership)
- Mai - Juli 2014: National Institute of Mathematical Sciences in Daejeon, Südkorea - Thematic Program on Applied Algebraic Geometry

Publikationen

1. Convex hulls of surfaces in fourspace, mit Chiara Meroni und Kristian Ranestad, Preprint 2022. https://arxiv.org/abs/2209.01151
2. Tropical Positivity and Determinantal Varieties, mit Marie-Charlotte Brandenburg und Georg Loho, Preprint 2022. https://arxiv.org/abs/2205.14972
3. Weak and Strong Extremal Biquadratics, mit Grigoriy Blekherman, Bogdan Raita und Isabelle Shankar, Preprint 2022. https://arxiv.org/abs/2204.10625
4. Moments, Sums of Squares, and Tropicalization, mit Grigoriy Blekherman, Felipe Rincon, Cynthia Vinzant und Josephine Yu, Preprint 2022. https://arxiv.org/abs/2203.06291
5. Adjoints and Canonical Forms of Polypols, mit Kathlén Kohn, Ragni Piene, Kristian Ranestad, Felix Rydell, Boris Shapiro, Miruna-Stefana Sorea und Simon Telen, Preprint 2021. https://arxiv.org/abs/2108.11747
6. Do alcoved lattice polytopes have unimodal $h^*$-vector, mit Hannah Sjöberg, Preprint, 2021. https://arxiv.org/abs/2104.15080
7. Families of Faces and the Normal Cycle of a Convex Semi-algebraic Set, mit Daniel Plaumann und Jannik Lennart Wesner, Preprint 2021. https://arxiv.org/abs/2104.13306
8. The Chiral Domain of a Camera Arrangement, mit Sameer Agarwal, Andrew Pryhuber und Rekha Thomas. erscheint in Journal of Mathematical Imaging and Vision
9. *Hyperbolic Secant Varieties of M-Curves*, mit Mario Kummer, Preprint, 2020, erscheint im Journal für die Reine und Angewandte Mathematik
10. *On the Existence of Two View Chiral Reconstructions*, mit Andrew Pryhuber und Rekha Thomas. SIAM Journal on Applied Algebra and Geometry, 6(1), 41-76, 2022
11. *Sums of Squares and Quadratic Persistence on Real Projective Varieties*, mit Grigoriy Blekherman, Gregory G. Smith und Mauricio Velasco. Journal of the EMS, 24(3), 925-965, 2022
12. *Maximum Likelihood Estimation for Nets of Conics*, mit Stefan Dye, Kathlén Kohn, und Felix Rydell. Le Matematiche, 76(2), 399-414, 2021
13. *Sums of Squares: A real projective story*, mit Grigoriy Blekherman, Gregory G. Smith und Mauricio Velasco. Notices of the AMS, 68(5), 734-747, 2021
14. *On the Dimensions of the Realization Spaces of Polytopes*, mit Laith Rastanawi und Günter Ziegler. Mathematika, 67(2), 342-365, 2021
15. *Conic Programming: Infeasibility Certificates and Projective Geometry*, mit Simone Naldi. Journal of Pure and Applied Algebra, 225(7), 22 Seiten, 2021
16. *Kippenhahn’s Theorem for Joint Numerical Ranges and Quantum States*, mit Daniel Plaumann und Stephan Weis. SIAM Journal on Applied Algebra and Geometry, 5(1), 86-113, 2021
17. *Combinatorial Inscribability Obstructions for Higher-dimensional Polytopes*, mit Joseph Doolittle, Jean-Philippe Labbé, Carsten Lange, Jonathan Spreer, und Günter Ziegler. Mathematika, 66(4), 927-953, 2020
18. *Typical and Generic Ranks in Matrix Completion*, mit Daniel Bernstein und Grigoriy Blekherman. Linear Algebra and its Applications, 585, 71-104, 2020
19. *Positive Semidefinite Univariate Matrix Polynomials*, mit Christoph Hanselka. Mathematische Zeitschrift, 292(1-2), 83-101, 2019
20. *Maximum Likelihood Threshold and Generic Completion Rank of Graphs*, mit Grigoriy Blekherman. Discrete and Computational Geometry, 61(2), 303-324, 2019
21. *Gram Spectrahedra*, mit Lynn Chua, Daniel Plaumann und Cynthia Vinzant. In Ordered Algebraic Structures and Related Topics, vol. 697 of Contemporary Mathematics, 81-105. American Mathematical Society, Providence, RI, 2017
22. *Do Sums of Squares Dream of Free Resolutions?* mit Grigoriy Blekherman und Mauricio Velasco.  
SIAM Journal on Applied Algebra and Geometry 1(1) 175-199, 2017

23. *Low-Rank Sum-of-Squares Representations on Varieties of Minimal Degree*, mit Grigoriy Blekherman, Daniel Plaumann und Cynthia Vinzant.  
International Mathematical Research Notices, 2019(1), 33-54, 2019

24. *Extreme Rays of the Hankel Spectrahedra for Ternary Forms*, mit Grigoriy Blekherman.  
Journal of Symbolic Computation 79 (1), 23-42, 2017

25. *Real Ranks with Respect to Varieties*, mit Grigoriy Blekherman.  
Linear Algebra and its Applications, 505, 344-360, 2016

26. *Computing hermitian determinantal representations of hyperbolic curves*, mit Daniel Plaumann, David E Speyer, und Cynthia Vinzant.  
International Journal of Algebra and Computation, 25(8), 1327-1336, 2015

27. *Generic Spectrahedral Shadows*, mit Bernd Sturmfels.  
SIAM Journal on Optimization, 25 (2), 1209-1220, 2015

28. *Algebraic Boundaries of Convex Semi-algebraic Sets*.  
Research in the Mathematical Sciences, 2 (1), 2015

29. *Algebraic Boundaries of Convex Semi-algebraic Sets*, Dissertation, 2014.  
http://nbn-resolving.de/urn:nbn:de:bsz:352-352-281616

30. *Algebraic Boundaries of SO(2)-Orbitopes*.  
Discrete and Computational Geometry, 50 (1), 219-235, 2013

**PUBLIKATIONEN OHNE PEER-REVIEW**

1. Sums of Squares on Projective Varieties, Oberwolfach Report 14/2017.  
https://www.mfo.de/occasion/1710/www_view

**DOKTORANDEN**

1. Marie-Charlotte Brandenburg  
2. Chiara Meroni (im Rahmen der IMPRS, MPI Leipzig)  
3. Laith Rastanawi (betreut gemeinsam mit Günter Rote, FU Berlin)  
4. Jannik Wesner (betreut gemeinsam mit Daniel Plaumann, TU Dortmund)

**ABGESCHLOSSENE PROMOTIONEN**

1. Hannah Sjöberg (betreut gemeinsam mit Günter Ziegler, FU Berlin)

**SEMINARVORTRÄGE**

- Seminar Gruppen und Geometrie, Bielefeld  
  *Sums of Squares and Projective Geometry* (2022)
- Seminar Algebra, Jena  
  *Sums of Squares and Projective Geometry* (2022)
• Seminar Algebra-Geometrie-Kombinatorik, TU Dresden
  *Polypols and their adjoints* (2021)
• Numerical Algebra and Optimization Seminar, MPI Leipzig
  *Chirality in Computer Vision* (2021)
• Seminar on Nonlinear Algebra, MPI Leipzig
  *Adjoins and Canonical Forms of Polypols* (2021)
• Discrete Mathematics/Geometry Seminar, TU Berlin
  *Realization Spaces of Polytopes* (2020)
• Nonlinear Algebra Seminar Online, Max-Planck Institut Leipzig
  *Chirality from Multiple Views* (2020)
• Algebra, Geometry, Combinatorics Seminar, San Francisco State University
  *Local Properties of Realization Spaces of Polytopes* (2019)
• Introduction to Algebraic Statistics by Bernd Sturmfels, Freie Universität
  Berlin
  *The Cone of Sufficient Statistics* (eingeladene Vorlesung, 2018)
• Seminar Algorithmische Algebra, Technische Universität Berlin
  *Quadratic Persistence of Real Projective Varieties* (2018)
• Seminar Diskrete Geometrie, Freie Universität Berlin
  *Matrix Completion Problems from the Geometric Point of View* (2017)
• Algebra Geometry Combinatorics Seminar, San Francisco State University
  *Positive Semidefinite Matrix Completion and Free Resolutions* (2017)
• Geometric and Topological Combinatorics Seminar, MSRI, Berkeley
  *Positive Semidefinite Matrix Completion and Free Resolutions* (2017)
• Nonlinear Algebra Seminar, Max-Planck Institut Leipzig
  *Positive Semidefinite Matrix Completion and Sums of Squares* (2017)
• Kolloquium Methods for Discrete Structures, FU Berlin
  *Positive Semidefinite Matrix Completion* (2017)
• Computational Algebra Seminar an der NCSU, Raleigh, NC
  *Pythagoras Number of Real Projective Varieties* (2017)
• TU Eindhoven
  *Geometry of Sums of Squares* (2017)
• TU Berlin
  *Geometry of Sums of Squares* (2017)
• Trends in Optimization Seminar, University of Washington, Seattle, WA
  *Positive semidefinite matrix completion and sums of squares* (2016)
• Seminar Diskrete Geometrie, FU Berlin
  *Geometry of Sums of Squares* (2016)
• Combinatorics Seminar, University of Miami, Miami, FL
  *Positive semidefinite matrix completion and free resolutions* (2016)
• Algebraic Geometry Seminar, University of Illinois, Urbana-Champaign, IL
  *Sums of Squares on Projective Varieties* (2016)
• Algebra Seminar, Osnabrück
  *Positive Semidefinite Matrix Completion, Sums of Squares, and Free Resolutions* (2016)
• Oberseminar Reelle Geometrie und Algebra, Konstanz
  *Low-Rank Sum-of-Squares Representations on Varieties of Minimal Degree* (2016)
• Algebra Seminar, Emory University, Atlanta, GA
  *Matrix Completion and Free Resolutions* (2016)
• Geometry Seminar Texas A&M, College Station, TX
  *Matrix Completion and Small Schemes* (2016)
• Colloquium an der Georgia Southern, Statesboro, GA
  *Sums of Squares and Projective Varieties* (2015)
• Oberseminar Reelle Geometrie und Algebra, Konstanz
  *Generic Spectrahedral Shadows* (2015)
• Oberseminar Diskrete Mathematik, Frankfurt
  *Generische Projizierte Spektraeder* (2015)
• Computational Algebra Seminar an der NCSU, Raleigh, NC
  *Generic Spectrahedral Shadows* (2015)

**VORTRÄGE BEI KONFERENZEN**

• Minisymposium on Lattice Polytopes, online
  *h^*-Vectors of Alcoved Lattice Polytopes* (2022)
• POEMA 4th Workshop, online
  *Sums of Squares and Projective Geometry* (2022)
• Numerical and Probabilistic Nonlinear Algebra, MPI Leipzig
  *Image Reconstruction and Chirality in Computer Vision* (2021)
• Degeneracy Loci and Applications, online
  *Spectrahedra* (2021)
• POEMA 2nd Workshop, online
  *Kippenhahn's Theorem for Joint Numerical Ranges* (2020)
• Workshop Computational Algebra 2020, online
  *Realization Spaces of Polytopes* (2020)
• Opening Conference des Thematic Einstein Semesters Algebraic Geometry, Berlin
  *Sums of Squares and Projective Varieties* (2019)
• ICCOPT, Berlin
  *Kippenhahn's Theorem in Higher Dimensions* (2019)
• SIAM Conference on Applied Algebraic Geometry, Bern, Schweiz
  *Real Geometry of Matrix Completion* (2019)
• BIRS Workshop Geometry of Real Polynomials, Convexity and Optimization, Banff, Kanada
  *Kippenhahn's Theorem for the Joint Numerical Range* (2019)
• Geometry of Polynomials Boot Camp, Simons Institute for the Theory of Computing, Berkeley, CA
  Hyperbolic Polynomials and Determinantal Representations I and II (2019)
• Symposium on Discrete Mathematics, TU Graz, Österreich
  Graph invariants from positive semidefinite matrix completion (2018)
• GDMV 2018, Paderborn
  Sektion Diskrete Mathematik und Computeralgebra
  Matrixvervollständigung vom geometrischen Standpunkt (2018)
• Geometrietag 2017, Magdeburg
  Quadratic Persistence of Projective Varieties (2017)
• BMS-BGSMath Keynote Lecture, Barcelona
  Extension Complexity and the Matching Polytope (2017)
• SIAM Conference on Applied Algebraic Geometry
  Minisymposium Convex Algebraic Geometry and Semidefinite Optimization
  Sum-of-Squares Representations of Shortest Length (2017)
• Oberwolfach Workshop Real Algebraic Geometry with a View Toward Moment Problems and Optimization, Oberwolfach
  Sums of Squares on Projective Varieties (2017)
• Joint Mathematics Meeting, Atlanta, GA
  Special Session on Gaussian Graphical Models and Combinatorial Algebraic Geometry
  Positive Semidefinite Matrix Completion and Algebraic Geometry (2017)
• Harmony of Real and Complex Algebraic Geometry, Daejeon, Südkorea
  Matrix Completion and Free Resolutions I & II (2016)
• AMS Sectional Meeting, Raleigh, NC
  Special Session on Applied Algebraic Geometry
  More on the Geometry of Positive Semidefinite Matrix Completion (2016)
• ALaNT 4, Telč, Tschechien
  Sums of Squares and Positive Semidefinite Matrix Completion (2016)
• GOAL Workshop, Paris, Frankreich
  Gaussian Graphical Models and Regularity (2016)
• Applied Algebra Days 3, Madison, WI
  Sums of Squares and Maximum Likelihood Estimation (2016)
• AMS Sectional Meeting, Fargo, ND
  Special Session on Combinatorial Ideals and Applications
  Matrix Completion, Free Resolutions, and Sums of Squares (2016)
• AMS Sectional Meeting, Athens, GA
  Special Session on Discrete and Applied Algebraic Geometry
  Low rank psd lifts of nonnegative quadratic forms (2016)
• Joint Mathematics Meeting, Seattle, WA
  Special Session on Nonlinear Algebra
  Real Rank with Respect to Varieties (2016)
• Algebra, Geometry, and Proofs in Symbolic Computation, Fields Institute, Toronto, Kanada
  *Sums of Squares on Projective Varieties* (2015)
• Ordered Algebraic Structures and Related Topics, CIRM Workshop, Luminy, Frankreich
  *Gram Spectrahedra* (2015)
• Third Workshop on Hybrid Methodologies for Symbolic-Numeric Computation (embedded meeting of ICIAM 2015), Beijing, China
  *Algebraic Boundaries of Convex Sets* (2015)
• SIAM Conference on Applied Algebraic Geometry, Daejeon, Südkorea
  *Generic Spectrahedral Shadows* (2015)
• Nonlinear Algebra, Berlin
  *Gram Spectrahedra* (2015)
• Optimization and Algebraic Geometry, Daejeon, Südkorea
  *Extreme Rays of the Hankel Spectrahedra for Ternary Forms* (2014)
• Polyhedra, Lattices, Algebra and Moments, Singapur
  *Extreme Rays of Cones of Moment Matrices for Ternary Forms* (2014)
• SIAM Conference on Applied Algebraic Geometry, Fort Collins, CO
  *Algebraic Boundaries of Convex Semi-algebraic Sets* (2013)
• SIAM Conference on Applied Algebraic Geometry, Raleigh, NC
  *The Algebraic Boundary of SO(2)-Orbitopes* (2011)
• Real Algebraic Geometry, Rennes, Frankreich
  *SO(2)-Orbitopes* (2011)
• Real Algebra, Geometry and Convexity, Leipzig
  *SO(2)-Orbitopes* (2011)

**ORGANISATION**

• Minisymposium „Convex Algebraic Geometry“ während SIAM Conference on Applied Algebraic Geometry 2021, mit Greg Blekherman und Cynthia Vinzant, College Station, TX, USA (2021)
• Fall School des Thematic Einstein Semester on Algebraic Geometry - Varieties, Polyhedra, Computation, mit Daniele Agostini, Thomas Krämer, Marta Panizzut an der FU Berlin (2019)
• Real Applied Algebraic Geometry, mit Mario Kummer und Bernd Sturmfels an der TU Berlin (2019)
• Convexity Day am MPI Leipzig, mit Thomas Wannerer (2019)
• Minisymposium „Algebraic Methods for Convex Sets“ während SIAM Conference on Applied Algebraic Geometry 2019, mit Greg Blekherman, Daniel Plaumann, Yong Sheng Soh und Dogyoon Song in Bern, Schweiz (2019)
• Besuch von Rekha Thomas als Gast des Graduiertenkollegs Facets of Complexity an der FU Berlin (Juni 2019)
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• Berlin-Leipzig Seminar on Algebra, Geometry, and Combinatorics
  Zweitägige Konferenz an der FU Berlin, mit Christian Haase (2017)
• Reading Group on Real Algebraic Geometry, mit Mario Kummer und Kristin
  Shaw, am MPI Leipzig (2017)
• Joint Mathematics Meeting in Atlanta, GA
  Special Session on Gaussian Graphical Models and Combinatorial Algebraic
  Geometry (2017)
• Minisymposium “Polynomial Optimization and Moments” während SIAM
  Conference on Applied Algebraic Geometry 2015 in Daejeon, Südkorea

LEHRE

REU (Research Experiences for Undergraduates) in Leipzig 2022

Vorlesungen

• Algebraische Geometrie (U Leipzig 2022)
• Algebra II (U Leipzig 2022)
• Algebra I (U Leipzig 2021/22)
• Reelle Algebra und Geometrie (U Leipzig 2021)
• Lineare Algebra II (U Leipzig 2021)
• Riemannsche Flächen und algebraische Kurven (U Leipzig 2020/21)
• Lineare Algebra I (U Leipzig 2020/21)
• Lineare Algebra II (FU Berlin 2020)
• Lineare Algebra I (FU Berlin 2019/20)
• Mathematisches Panorama/Panorama der Mathematik (FU Berlin 2018/19)
• Diskrete Geometrie III (FU Berlin 2018/19)
• Diskrete Geometrie II (FU Berlin 2018)
• Diskrete Geometrie I (FU Berlin 2017/2018)
• MATH-4150 Introduction to Number Theory (GT 2017)
• MATH-8803-sin Algebraic Curves (GT 2016)
• MATH-2552 Differential Equations (GT 2016)
• MATH-1552 Integral Calculus (GT 2015)
• MATH-4150 Introduction to Number Theory (GT 2015)
• MATH-2403 Differential Equations (GT 2014)

Seminare

• Seminar zur Schulmathematik (Lehramt): Buch der Beweise (U Leipzig
  2021/22)
• Seminar Themen in Algebra und Geometrie (U Leipzig 2021/22)
• Seminar Real Algebraic Geometry and Optimization (FU Berlin 2019)
• Proseminar Panorama der Mathematik (Storytelling in der Mathematik) (FU
  Berlin 2019)
• Themen aus der Zahlentheorie und algebraischen Geometrie (Konstanz 2010/2011)

Sommerschulen

• Summer School on Hyperbolic Polynomials, Sums of Squares, and Optimization, Georgia Institute of Technology, mit Greg Blekherman, Daniel Plaumann und Cynthia Vinzant (2018)
• Summer School on Real Algebraic Geometry and Optimization, Georgia Institute of Technology, mit Greg Blekherman und Mauricio Velasco (2016)

SERVICE

• Gutachten: Alexander von Humboldt Stiftung, verschiedene Zeitschriften (unter anderem DCG, IMRN, Journal of Algebra, Linear and Multilinear Algebra, SIOPT, SIAGA)
• Gremienarbeit: Tutorenauswahlkommission (FU Berlin; Juni 2018 bis September 2020), Besetzungskommissionen (für zwei Postdoc-Stellen), BMS Committee (Oktober 2019 bis September 2020), Einstellungskommission für Postdocs in der Nonlinear Algebra Gruppe am MPI MiS in Leipzig (2020)

KONFERENZTEILNAHMEN (AUSWAHL)

• SIAM Conference on Applied Algebraic Geometry, College Station, TX, USA (2021)
• Oberwolfach Workshop „Real Algebraic Geometry with a View toward Hyperbolic Programming and Free Probability (2020)
• SIAM Conference on Applied Algebraic Geometry, Bern, Schweiz (2019)
• BIRS Workshop Geometry of Real Polynomials, Convexity and Optimization, Banff, Kanada (2019)
• Simons Workshops Geometry of Polynomials (2019)
• SIAM Conference on Applied Algebraic Geometry, Atlanta (2017)
• Real Algebraic Geometry with a View Toward Moment Problems and Optimization, Oberwolfach Workshop (2017)
• Joint Mathematics Meeting in Atlanta, Georgia (2017)
• Joint Mathematics Meeting in Seattle, Washington (2016)
• Algebra, Geometry, and Proofs in Symbolic Computation, Fields Institute, Toronto, Kanada (2015)
• Ordered Algebraic Structures and Related Topics, CIRM Workshop, Luminy, Frankreich (2015)
• Algebraic Vision, Berlin (2015)
• SIAM Conference on Applied Algebraic Geometry, Daejeon, Südkorea (2015)
• Real Algebraic Geometry with a View to Systems Control and Free Positivity, Oberwolfach (2014)
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• SIAM Conference on Applied Algebraic Geometry, Fort Collins, Colorado (2013)
• Workshop Polynomial Optimisation, Isaac Newton Institute, Cambridge, UK (2013)
• Structured Function Systems and Applications, Oberwolfach (2013)
• SIAM Conference on Applied Algebraic Geometry, Raleigh, North Carolina (2011)
• Real Algebraic Geometry, Rennes, Frankreich (2011)
• BIRS Workshop Convex Algebraic Geometry, Banff, Kanada (2010)

Sprachen

Deutsch (Muttersprache)
Englisch (fließend)
Französisch (gut)

Postadresse

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Anschrift

Prof. Dr. Rainer Sinn
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