

PERSONAL INFORMATION	Technische Universität Dresden Bereich Mathematik und Natur- wissenschaften Fakultät Mathematik Institut für Geometrie D-01062 Dresden	<i>Born:</i> 19th of July 1989 <i>Nationality:</i> German <i>E-mail:</i> mario.kummer@tu-dresden.de <i>Phone:</i> +49351463-37579
EMPLOYMENT	<p>Technische Universität Dresden, Dresden, Germany Junior Professor (W1, tenure track) for “Real Algebraic Geometry”, since October 2020</p> <p>Technische Universität Berlin, Berlin, Germany Junior Professor (W1) for “Computeralgebra”, January 2018 – September 2020</p> <p>Max-Planck-Institute for Mathematics in the Sciences, Leipzig, Germany Postdoctoral Research Assistant, August 2016 – December 2017</p>	
EDUCATION	<p>Universität Konstanz, Konstanz, Germany Dr. rer. nat., Mathematics, July 2016 (summa cum laude)</p> <ul style="list-style-type: none"> • Dissertation Topic: “From Hyperbolic Polynomials to Real Fibered Morphisms” • Advisor: Prof. Dr. Claus Scheiderer <p>M.Sc., Mathematics with minor in Economics, April 2013 (1.0) B.Sc., Mathematics with minor in Psychology, September 2011 (1.0)</p>	
GRANTS	<p>DFG grant KU 3895/2-1 “Real algebraic geometry, convexity and topology”, one graduate student, approved in March 2022</p> <p>DFG grant KU 3895/1-1 “Spectrahedra and Hyperbolic Polynomials”, one graduate student, approved in March 2019</p> <p>Ph.D. fellowship with the German National Academic Foundation (Studienstiftung des deutschen Volkes), October 2013 to March 2016</p>	
STAFF	<p>Dr. Philipp di Dio, October 2018 – September 2020</p> <p>Büşra Sert, since October 2019</p> <p>Dr. Christoph Schulze, since October 2020</p>	
EXTENDED STAYS	<p>Simons Institute for the Theory of Computing, Berkeley, USA Invited Long Term Visitor, February–March, 2019</p> <ul style="list-style-type: none"> • Participation in the program “Geometry of Polynomials” <p>Simons Institute for the Theory of Computing, Berkeley, USA Visiting Graduate Student, August–December, 2014</p> <ul style="list-style-type: none"> • Participation in the program “Algorithms and Complexity in Algebraic Geometry” 	

AWARDS

Best dissertation prize, awarded by the department for mathematics and statistics at the university of Konstanz, 2017

Staatsanzeiger-Preis for my master's degree, 2014

Main prize for my master's thesis, titled "Real Polynomials with Definite Determinantal Representation", awarded by the DMV, 2013

PUBLICATIONS

Real-fibered morphisms of del Pezzo surfaces and conic bundles, *Discrete Comput. Geom.*, with C. Le Texier and M. Manzaroli, to appear.

<https://arxiv.org/abs/2101.08703>

Hyperbolic Secant Varieties of M-Curves, with R. Sinn. *J. Reine Angew. Math.*, 787, 125–162, 2022. <https://doi.org/10.1515/crelle-2022-0012>

Iso Edge Domains, with M. Dutour Sikirić. *Expo. Math.*, 40(2), 302–314, 2022. <https://doi.org/10.1016/j.exmath.2021.09.004>

Nodes on quintic spectrahedra, with T. Brysiewicz and K. Kozhasov. *Matematiche*, 76(2), 415–430, 2021.

<https://doi.org/10.4418/2021.76.2.8>

A generalization of the space of complete quadrics, with A. Al Ahmadih and M.-S. Sorea. *Matematiche*, 76(2), 431–446, 2021. <https://doi.org/10.4418/2021.76.2.9>

On Huisman's conjectures about unramified real curves, with D. Manevich. *Adv. Geom.*, 21(4), 545–549, 2021.

<https://doi.org/10.1515/advgeom-2021-0032>

Deformations of Hyperbolic Varieties, with E. Shamovich. *Mosc. Math. J.*, 21(3), 593–612, 2021.

<http://dx.doi.org/10.17323/1609-4514-2021-21-3-593-612>

The multidimensional truncated Moment Problem: Carathéodory Numbers from Hilbert Functions, with Philipp J. di Dio. *Math. Ann.*, 380(1), 267–291, 2021.

<http://dx.doi.org/10.1007/s00208-021-02166-x>

Convex Algebraic Geometry of Curvature Operators, with R. Bettiol and R. Mendes. *SIAM J. Appl. Algebra Geometry*, 5(2), 200–228, 2021.

<https://doi.org/10.1137/20M1350777>

Spectral linear matrix inequalities. *Adv. Math.*, 384, 107749, 2021.

<http://doi.org/10.1016/j.aim.2021.107749>

Generalized Eigenvalue Methods for Gaussian Quadrature Rules, with G. Blekherman, C. Riener, M. Schweighofer, and C. Vinzant.

Ann. H. Lebesgue, 3, 1327–1341, 2020.

<http://doi.org/10.5802/ahl.62>

The Separating Semigroup of a Real Curve, with K. Shaw.

Ann. Fac. Sci. Toulouse, 29(1), 79–96, 2020.

<http://doi.org/10.5802/afst.1624>

Real Fibered Morphisms and Ulrich Sheaves, with E. Shamovich.

- J. Algebraic Geometry*, 29, 167–198, 2020.
<http://dx.doi.org/10.1090/jag/735>
- Spectrahedral Representations of Plane Hyperbolic Curves*,
 with S. Naldi and D. Plaumann.
Pacific J. Math., 303(1), 243–263, 2019.
<http://dx.doi.org/10.2140/pjm.2019.303.243>
- Totally Real Theta Characteristics*.
Ann. Mat. Pura Appl., 198(6), 2141–2150, 2019.
<http://dx.doi.org/10.1007/s10231-019-00858-5>
- The Chow Form of a Reciprocal Linear Space*, with C. Vinzant.
Michigan Math. J., 68(4), 831–858, 2019.
<http://dx.doi.org/10.1307/mmj/1571731287>
- Schottky Algorithms: Classical meets Tropical*, with L. Chua and B. Sturmfels.
Math. of Comp., 88, 2541–2558, 2019.
<http://dx.doi.org/10.1090/mcom/3406>
- Sixty-Four Curves of Degree Six*, with N. Kailhnsa, D. Plaumann, M. Sayyary Namin and B. Sturmfels.
Exper. Math., 28(2), 132–150, 2019.
<http://dx.doi.org/10.1080/10586458.2017.1360808>
- On the Connectivity of the Hyperbolicity Region of Irreducible Polynomials*.
Adv. Geom., 19(2), 231–233, 2019.
<http://dx.doi.org/10.1515/advgeom-2017-0055>
- Interlacing Ehrhart Polynomials of Reflexive Polytopes*, with A. Higashitani and M. Michałek.
Selecta Math., 23(4), 2977–2998, 2017.
<http://dx.doi.org/10.1007/s00029-017-0350-6>
- On the Real Rank of Monomials*, with E. Carlini, A. Oneto, and E. Ventura. *Math. Z.*, 286(1–2), 571–577, 2017.
<http://dx.doi.org/10.1007/s00209-016-1774-y>
- The Geometry of Rank-one Tensor Completion*, with T. Kahle, K. Kubjas, and Z. Rosen.
SIAM J. Appl. Algebra Geometry, 1(1), 200–221, 2017.
<http://dx.doi.org/10.1137/16M1074102>
- Determinantal Representations and Bézoutians*.
Math. Z., (285), 445–459, 2017.
<http://dx.doi.org/10.1007/s00209-016-1715-9>
- Eigenvalues of Symmetric Matrices over Integral Domains*.
J. Algebra, (466), 195–203, 2016.
<http://dx.doi.org/10.1016/j.jalgebra.2016.07.024>
- Two Results on the Size of Spectrahedral Descriptions*.
SIAM J. Optim., 26(1), 589–601, 2016.
<http://dx.doi.org/10.1137/15M1030789>
- A Note on the Hyperbolicity Cone of the Specialized Vámos Polynomial*.
Acta Appl. Math., 144(1), 11–15, 2016.

<http://dx.doi.org/10.1007/s10440-015-0036-z>

Hyperbolic Polynomials, Interlacers, and Sums of Squares, with D. Plaumann and C. Vinzant. *Math. Program.*, 153(1, Ser. B), 223–245, 2015.

<http://dx.doi.org/10.1007/s10107-013-0736-y>

PREPRINTS

Equivariant algebraic and semi-algebraic geometry of infinite affine space, with C. Riener. Submitted, 2022.

<https://arxiv.org/abs/2203.11921>

Matroids on Eight Elements with the Half-plane Property and Related Concepts, with B. Sert. Submitted, 2022.

<https://arxiv.org/abs/2111.09610>

Linear Principal Minor Polynomials: Hyperbolic Determinantal Inequalities and Spectral Containment, with G. Blekherman, R. Sanyal, K. Shu und S. Sun. Submitted, 2021.

<https://arxiv.org/abs/2112.13321>

Geography of pinched four-manifolds, with R. Bettiol and R. Mendes. Submitted, 2021.

<https://arxiv.org/abs/2106.02138>

Positive Ulrich Sheaves, with C. Hanselka. Submitted, 2020.

<https://arxiv.org/abs/2008.00201>

CONFERENCE
PRESENTATIONS

A day on K3 surfaces, Max Planck Institute for Mathematics in the Sciences, Leipzig, 2022. *A signed count of 2-torsion points on real abelian varieties*.

Combinatorial Coworkspace: a session in algebraic and geometric combinatorics, Haus Bergkranz, Kleinwalsertal, 2022. *Realrooted, hyperbolic, and Lorentzian polynomials* (with L. Solus).

Real Polynomials: Counting and Stability (Online), Casa Matemática Oaxaca, 2021. *Matroids with the half-plane property and related concepts*.

Real algebraic geometry in Saint Petersburg (Online), 2021. *Viro's writhe and Ulrich sheaves*.

MFO-RIMS Tandem Workshop: Symmetries on Polynomial Ideals and Varieties (Hybrid), Mathematisches Forschungsinstitut Oberwolfach, 2021. *Symmetric spectrahedra with respect to the permutation and orthogonal group*.

SIAM Conference on Applied Algebraic Geometry (Online), 2021. *Computational Real Algebraic Geometry in Riemannian Geometry*.

Real algebraic and convex geometry (Hybrid), TU Braunschweig, 2021. *Positive Ulrich sheaves*.

AMS Spring Southeastern Sectional Meeting (Online), 2021. *Carathéodory numbers of high dimensional moment problems*.

Geometry of Polynomials Reunion Workshop (Online), Simons Institute for the Theory of Computing, Berkeley, 2020. *Spectral sets and derivatives of the psd cone*.

Symmetry, Randomness, and Computations in Real Algebraic Geometry (Online), Institute for Computational and Experimental Research in Mathematics (ICERM), Providence, 2020. *Spectral sets and derivatives of the psd cone*.

- 2TART Conference (Online), University of Florida, 2020. *Spectral sets and derivatives of the psd cone.*
- Real Algebraic Geometry with a View Toward Hyperbolic Programming and Free Probability, Mathematisches Forschungsinstitut Oberwolfach, 2020. *Positive Ulrich sheaves.*
- Workshop on “Discrete geometry with a view on symplectic and tropical geometry”, University of Cologne, 2019. *Tropical Schottky recovery.*
- Workshop on “Tropical Methods in Real Algebraic Geometry”, Casa Matemática Oaxaca, 2019. *Some aspects of total reality.*
- 6th International Conference on Continuous Optimization, Technische Universität Berlin, 2019. *When is the conic hull of a curve a hyperbolicity cone?*
- SIAM Conference on Applied Algebraic Geometry, University of Bern, 2019. *Orbit closures in the Zariski spectrum of the infinite polynomial ring.*
- Plenary talk at the BMS – BGSMATH Junior Meeting, Berlin, 2019. *Hyperbolic polynomials, matroid theory, and optimization.*
- Workshop on “Geometry of Real Polynomials, Convexity and Optimization”, Banff International Research Station, 2019. *When is the conic hull of a curve a hyperbolicity cone?*
- ASGARD Math 2018: Real algebraic geometry and tropical mathematics, Universitetet i Oslo, 2018. *Convex hulls of canonical curves.*
- GDMV — Gemeinsamen Jahrestagung der Deutschen Mathematiker-Vereinigung (DMV) und der Gesellschaft für Didaktik der Mathematik (GDM), Universität Paderborn, 2018. *An algebro-geometric view on semidefinite programming.*
- Workshop “Numerical methods for algebraic curves”, Centre Henri Lebesgue, Rennes, 2018. *Schottky Algorithms in Genus Four.*
- Workshop “Recent advances on the geometry of valuations”, Goethe-Universität, Frankfurt am Main, 2017. *Tropical Schottky Recovery.*
- Sums of Squares — Real Algebraic Geometry and its Applications, Leopold-Franzens-Universität, Innsbruck, 2017. *Eigenvalues of symmetric matrices over integral domains.*
- XXII Coloquio Latinoamericano de Álgebra, Pontificia Universidad Católica del Ecuador, Quito, 2017. *Eigenvalues of symmetric matrices over integral domains.*
- SIAM Conference on Applied Algebraic Geometry, Georgia Institute of Technology, Atlanta, 2017. *Reciprocal Linear Spaces.*
- International Conference On Effective Methods in Algebraic Geometry, Université Nice Sophia Antipolis, Nice, 2017. *Interlacing Ehrhart Polynomials Arising from Graphs.*
- Algebraic Statistics, Mathematisches Forschungsinstitut Oberwolfach, 2017. *Rank-one Tensor Completion.*
- Real Algebraic Geometry With a View Toward Moment Problems and Optimization, Mathematisches Forschungsinstitut Oberwolfach, 2017. *Hyperbolicity in Higher Codimension.*

Saxonian Geometry Day, TU Chemnitz, 2016. *Hyperbolic Varieties*.

International Workshop on Operator Theory and Applications, Washington University, St. Louis, 2016. *On the Size of Spectrahedral Descriptions*.

22nd International Symposium on Mathematical Theory of Networks and Systems, University of Minnesota, Minnesota, 2016. *Hyperbolic Varieties and Ulrich Sheaves*.

Arbeitsgemeinschaft: The Kadison–Singer Conjecture, Mathematisches Forschungsinstitut Oberwolfach, 2015. *Multivariate Stable Polynomials*.

Classical Algebraic Geometry, Mathematisches Forschungsinstitut Oberwolfach, 2014. 5-Minute Talk on *Definite Determinantal Representations*.

Real Algebraic Geometry With A View Toward Systems Control and Free Positivity, Mathematisches Forschungsinstitut Oberwolfach, 2014. *Determinantal Representations of Hyperbolic Polynomials*.

Applications of Real Algebraic Geometry, Aalto University, Helsinki, 2014. *Determinantal Representations of Hyperbolic Polynomials*.

ÖMG/DMV-Studierendenkonferenz, Universität Innsbruck, 2013. *Real Polynomials with Definite Determinantal Representation*.

INVITED SEMINARS LAGARTOS: Latin American Geometria Algebraica Real y TrOpical Seminar (Online), 2022. *A signed count of 2-torsion points on real abelian varieties*.

ZAG: Zoom Algebraic Geometry Seminar (Online), 2022. *Secant varieties of real curves*.

KTH Stockholm, Combinatorics Seminar (Online), 2022. *Matroids with the half-plane property and related concepts*.

IIT Bombay, Seminar on Facets of CACAAG (Online), 2021. *Matroids with the half-plane property and related concepts*.

Max-Planck-Institut für Mathematik in den Naturwissenschaften, Leipzig seminar on Algebra, Algebraic Geometry and Algebraic Topology (Online), 2021. *Determinantal representations, sums of squares and del Pezzo surfaces*.

TU Berlin, Seminar on Discrete Mathematics/Geometry (Online), 2021. *Iso Edge Domains*.

Universität Konstanz, Oberseminar Reelle Geometrie und Algebra, 2020. *Tropical abelian varieties*.

Humboldt-Universität zu Berlin, Forschungsseminar Algebraische Geometrie, 2019. *Positive Definite Ulrich Bundles*.

Simons Institute for the Theory of Computing, Weekly Seminar on Geometry of Polynomials, 2019. *Hyperbolicity cones and spectrahedra*.

TU Dortmund, Oberseminar Algebra und Geometrie, 2018. *Totally real theta characteristics*.

Universitetet i Oslo, Seminar in Algebra and Algebraic geometry, 2018. *Rational Representations of Plane Spectrahedra*.

Max-Planck-Institut für Mathematik in den Naturwissenschaften, Special Seminar, 2018. *Rational*

Representations of Plane Spectrahedra.

Universität Konstanz, Oberseminar Reelle Geometrie und Algebra, 2018. *Rational Representations of Plane Spectrahedra.*

Leibniz Universität Hannover, Research Seminar Algebraic Geometry, 2018. *Spectrahedra and Ulrich Sheaves.*

Goethe Universität Frankfurt am Main, Oberseminar Diskrete Mathematik, Geometrie und Optimierung, 2018. *Rational representations of plane spectrahedra.*

Scuola Internazionale Superiore di Studi Avanzati, Trieste, 2018. *Hyperbolic Varieties.*

TU Berlin, Discretization in Geometry and Dynamics Seminar, 2018. *What is a tropical period matrix?*

FU Berlin, Discrete Geometry Seminar, 2018. *Interlacing Ehrhart Polynomials of Reflexive Polytopes.*

Berlin Mathematical School, “What is...?” Seminar Series, 2017. *What is... a spectrahedron?.*

TU Dresden, Seminar “Geometrie”, 2017. *Interlacing Ehrhart Polynomials of Reflexive Polytopes.*

TU Berlin, Oberseminar “Algorithmische Algebra”, 2017. *Eigenvalues of symmetric matrices over integral domains.*

Max-Planck-Institut für Mathematik in den Naturwissenschaften, Leipzig, Seminar on Non-Linear Algebra, 2017. *Separating Morphisms from Real Algebraic Curves.*

Universität Osnabrück, Oberseminar Algebra, 2017. *Separating Morphisms from Real Algebraic Curves.*

Universität Konstanz, Oberseminar Reelle Geometrie und Algebra, 2017. *Separating Morphisms from Real Algebraic Curves.*

TU Dortmund, Oberseminar Algebra und Geometrie, 2017. *Interlacing Ehrhart Polynomials of Reflexive Polytopes.*

Otto-von-Guericke Universität, Magdeburg, Seminar in Non-Linear Algebra, 2016. *The real rank of monomials.*

TU Berlin, Workshop on Discrete and Non-Linear Geometry, 2016. *Hyperbolic Varieties, Reciprocal Linear Spaces and their Chow Forms.*

Aalto University, Helsinki, Large Structures Seminar, 2015. *Real Fibered Morphisms and their Applications.*

TU Berlin, Kolloquium “Algorithmische Mathematik und Komplexitätstheorie”, 2015. *Real Fibered Morphisms.*

Universität Osnabrück, Oberseminar Algebra, 2015. *Determinantal Representations of Determinantal Varieties.*

UC Berkeley, Computational Algebraic Geometry Seminar, 2014. *Spectrahedra and Hyperbolic Poly-*

nomials.

Max-Planck-Institut für Mathematik, Bonn, Seminar on Computational Algebraic Geometry, 2013. *Determinantal Representations of Hyperbolic Polynomials.*

Universität Leipzig, Seminar “Algebra und Geometrie”, 2013. *Determinantal Representations and the Bézout Matrix.*

TEACHING
EXPERIENCE

TU Dresden, Dresden, Germany

Lectures

Convex Geometry, 2020.

Real algebraic geometry, 2021.

Algebraic Geometry I, 2021.

Algebraic Geometry II, 2022.

TU Berlin, Berlin, Germany

Lectures

Algebra I, 2017.

Algebra II: Algebraic Number Theory, 2018.

Algebraic Geometry I, 2018.

Algebra III: Real Algebra, 2019.

Algebra IV: Representation Theory, 2019.

Real Algebra II, 2019.

Discrete Geometry I, 2020.

Seminars

Seminar on *Algebra*, 2019.

Thesis supervision

Master’s thesis on *Berechnung der Determinantendarstellungen ebener hyperbolischer Kurven* (A. Grigorieva, 2019).

Bachelor’s thesis on *Abelian Categories* (N. Brauch, 2019).

Bachelor’s thesis on *Der Satz von Quillen–Suslin* (R. Eiben, 2019).

Bachelor’s thesis on *Der Hilbertsche Syzygiensatz* (N. Waldau, 2019).

Bachelor’s thesis on *Der Satz von Kronecker–Weber* (M. Weckbecker, 2019).

Bachelor’s thesis on *Der Satz von Riemann–Roch für Zahlkörper* (D. Spaulding, 2020).

Bachelor’s thesis on *Algebraische Gruppen* (J. Pauckert, 2020).

Master’s thesis on *Real Tropicalization of Semialgebraic Sets* (F. Blatt, 2020).

Max-Planck-Institute for Mathematics in the Sciences, Leipzig, Germany

Lectures

Introduction to Real Algebraic Geometry, 2016.

Universität Konstanz, Konstanz, Germany

Seminars

Introductory Seminar Course on *Konvexe Mengen, Polytope und lineare Ungleichungen* - joint with C. Scheiderer and T. Kobert, 2015.

Thesis supervision

Bachelor's thesis on *Freie Auflösung von Moduln* (P. Weise, 2016) - joint supervision with C. Scheiderer.

Bachelor's thesis on *Der LLL-Algorithmus und Faktorisierung von ganzzahligen Polynomen* (Y. Kreuzer, 2016) - joint supervision with C. Scheiderer.

Tutorials

Calculus, Complex Analysis, Algebra, Number Theory, Algebraic Geometry.

Berlin Mathematical School, Berlin, Germany

Teaching Assistant

At the summer school on *Convex Geometry — Discrete and Computational*, for the course on *Convex Geometry of Nonnegative Polynomials* by G. Blekherman, 2015.

COMMITTEE
WORK

Head of the committee for awarding the Deutschland-Stipendium, TU Dresden, since 2021.

Member of the institute council of the institute for geometry, TU Dresden, since 2020.

Member of the habilitation committee of Henri Mühle (TU Dresden), 2021.

Member of the PhD committee of Stephanie Feilitzsch, Johannes Greiner (TU Dresden), Sima Mehri, Jan Techter (TU Berlin), Thorsten Jörgens (Uni Frankfurt), Christoph Schulze (Uni Konstanz).

Postdoc selection committee for the research group in Nonlinear Algebra at the Max Planck Institute for Mathematics in the Sciences in Leipzig, 2017/18.

ORGANIZATION

Oberwolfach Workshop “New Directions in Real Algebraic Geometry” — joint with Saugata Basu, Tim Netzer and Cynthia Vinzant, 2023.

Saxonian Seminar Day on Algebra and Geometry — joint with R. Sinn, B. Sturmfels, A. Thom, TU Dresden, May 2022.

Opening Conference for the Thematic Einstein Semester on Algebraic Geometry — joint with A. Ortega, A. Petracchi and K. Schaller, FU Berlin, October 2019.

Workshop on “Real Applied Algebraic Geometry” — joint with R. Sinn and B. Sturmfels, TU Berlin, September 2019.

Dies Mathematicus (graduation celebration for the mathematical study programs), TU Berlin, November 2018.

Summer School on Numerical Computing in Algebraic Geometry — joint with P. Breiding, Y. Ren and E. Sertöz, MPI MIS Leipzig, August 2018.

Berlin–Leipzig Two-Day-Seminar on Algebra, Geometry and Combinatorics — joint with T. De Wolff, TU Berlin, December 2017.

Reading Group on Real Algebraic Geometry (summer school) — joint with K. Shaw and R. Sinn, MPI MIS Leipzig, July 2017.

Berlin–Leipzig Seminar on Non-Linear Algebra — joint with B. Sturmfels and K. Kohn, MPI MIS Leipzig, Fall 2016.

PEER REVIEWING for the following journals: *Advances in Mathematics*, *Algebraic Geometry*, *Annals of Mathematics*, *Beiträge zur Algebra und Geometrie*, *Bulletin of the London Mathematical Society*, *Confluentes Mathematici*, *Discrete & Computational Geometry*, *Iranian Journal of Science and Technology*, *Journal of Algebra*, *Journal of Mathematical Imaging and Vision*, *Journal of Pure and Applied Algebra*, *Journal of Symbolic Computation*, *Linear Algebra and its Applications*, *Mathematische Zeitschrift*, *Open Mathematics*, *Publicationes Mathematicae Debrecen*, *SIAM Journal on Optimization*, *SIAM Journal on Applied Algebra and Geometry*, *Systems & Control Letters*.

for *MathSciNet*

of the PhD theses of Thorsten Jörgens and Christoph Schulze

LANGUAGES German (native)
English (fluent)
French (intermediate)