Khazhgali Kozhasov

Curriculum Vitae

Institut für Mathematik
Friedrich-Schiller-Universität Jena
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Research interests

— real, computational, convex and random (algebraic) geometry
— polynomial and tensor optimization
— multilinear algebra

Work experience

April 2023 – present	*Substitute Professor in the Institute for Mathematics*, Friedrich-Schiller-Universität Jena
April 2022 – present (on leave)	*Postdoctoral researcher in the Applied Algebra group*, Technische Universität Braunschweig
April 2021 – March 2022	*Substitute Professor in the Applied Algebra and Data Analysis group*, Universität Osnabrück
April 2019 – March 2021	*Postdoctoral researcher in the Applied Algebra group*, Technische Universität Braunschweig
April 2018 – March 2019	*Postdoctoral researcher in the Nonlinear Algebra group*, Max-Planck-Institut für Mathematik in den Naturwissenschaften
September 2013 – August 2014	*Young research fellow in the Laboratory of Geometric Control Theory led by Andrei Agrachev*, Sobolev Institute of Mathematics
Summer 2013	*Intern at Intel Math Kernel Library*, Intel development center in Novosibirsk

Education

October 2014 – May 2018	*Ph.D., International School for Advanced Studies* (with distinction), under the supervision of Andrei Agrachev and Antonio Lerario
2010 – 2014	*B.Sc., Novosibirsk State University* (with distinction), under the supervision of Yaroslav Bazaikin

Publications and preprints

1. Non-negative forms, volumes of sublevel sets, complete monotonicity and moment matrices, with J.-B. Lasserre, arXiv:2206.05170 [math.AG]

2. Probabilistic bounds on best rank-one approximation ratio, with J. Tonelli-Cueto, arXiv:2201.02191 [math.FA]

3. On eigenvalues of symmetric matrices with PSD principal submatrices, Journal of Symbolic Computation (2023), 119, 90-100

4. *Rational functions with only real periodic points*, with M. Kummer,
   arXiv:2004.10003 [math.AG]

5. *Minimality of tensors of fixed multilinear rank*, with A. Heaton and L. Venturello,
   Linear and Multilinear algebra (2022)

6. *Nodes on quintic spectrahedra*, with T. Brysiewicz and M. Kummer,
   Le Matematiche (2021), 76(2), 415–430

7. *Positivity Certificates via Integral Representations*, with M. Michałek and B. Sturmfels,
   LMS volume "Facets of Algebraic Geometry"dedicated to Fulton's 80th birthday

8. *On minimality of determinantal varieties*,
   Linear Algebra and its Applications (2021), 626, 56-78

9. *Nonnegative forms with sublevel sets of minimal volume*, with J.-B. Lasserre,
   Math. Program. (2020)

10. *Chebyshev polynomials and best rank-one approximation ratio*,
    with A. Agrachev and A. Uschmajew, SIAM J. Matrix Anal. Appl., 41(1), 308–331

11. *Random spectrahedra*, with P. Breiding and A. Lerario,
    SIAM Journal on Optimization, 29(4), 2608-2624

12. *The Real Polynomial Eigenvalue Problem is Well Conditioned on the Average*,
    with C. Beltrán, Foundations of Computational Mathematics (2019)

13. *On the number of flats tangent to convex hypersurfaces in random position*,
    with A. Lerario, Discrete Comput Geom 63, 229–254 (2020)

14. *On the Geometry of the Set of Symmetric Matrices with Repeated Eigenvalues*,
    with P. Breiding and A. Lerario, Arnold Math J. 4, 423–443 (2018)

15. *On fully real eigenconfigurations of tensors*,
    SIAM Journal on Applied Algebra and Geometry (2018), 2(2), 339-347

16. *A Geometric flow in the space of G_2-structures on the cone over $S^3 \times S^3$*,
    Siberian Mathematical Journal (2015), 56(6), 1093-1100

Presentations at conferences

March 2023	Workshop on Future Directions (Konstanz), invited (job) talk "*Real geometry of the rank-one approximation problem*"
October 2022	CIRM Real Algebraic Geometry Workshop, invited talk "*Non-negative forms, volumes of sublevel sets, complete monotonicity and moment matrices*"
September 2022	AGATES Kick-off Workshop (Warsaw), invited talk *Real aspects of the problem of rank-one approximation*"
September 2022	POEMA Final Workshop (Paris), contributed talk "*Non-negative forms, volumes of sublevel sets, complete monotonicity and moment matrices*"
July 2022	Lluís Santaló School 2022 (Santander) "Random and Deterministic Point Configurations", contributed talk "*Gaussian-like distributions and sums of squares*"

June 2022	Effective Methods in Algebraic Geometry (Krakow), contributed talk *"On eigenvalues of symmetric matrices with psd principal submatrices"*
October 2021	Workshop "Real Polynomials: Counting and Stability" (Casa Matemática Oaxaca, online), invited talk *"The many faces of polynomial capacity"*
September 2021	VI Congreso Latinoamericano de Matematicos (Montevideo, online), invited session *"On eigenvalues of symmetric matrices with PSD principal submatrices"*
August 2021	SIAM Conference on Applied Algebraic Geometry (College Station, online), mini-symposium talk *"Minimality of tensors of fixed multilinear rank"*
December 2020	BYMAT 2020 (online), contributed talk *"Minimality of tensors of fixed multilinear rank"*
March 2020	MFO workshop "Real Algebraic Geometry With a View Toward Hyperbolic Programming and Free Probability", talk *"On morphisms of the projective line with only real periodic points"*
January 2020	North German Algebraic Geometry Seminar (Hannover), invited talk *"On the number of critical points of a real form on the sphere"*
October 2019	Opening conference of the thematic semester "Algebraic Geometry" (Berlin), poster *"Nonnegative forms with sublevel sets of minimal volume"*
September 2019	Real Applied Algebraic Geometry (Berlin), invited talk *"Chebyshev polynomials and best rank-one approximation ratio"*
August 2019	"Complexity of numerical computation", a conference in honor of Felipe Cucker (Berlin), poster *"On the condition number of the real polynomial eigenvalue problem with random inputs"*
July 2019	ICIAM 2019 (Valencia), talk at the minisymposium "Tensor methods" titled *"Chebyshev polynomials and best rank-one approximation ratio"*
July 2019	SIAM conference on applied algebraic geometry (Bern), talk at the minisymposium "Matrix and tensor optimization" titled *"Chebyshev polynomials and best rank-one approximation ratio"*
May 2019	Otto-Sturmfels meeting (Leipzig), talk *"Analytic properties of inverse powers of hyperbolic polynomials"*
May 2019	Workshop "Hyperbolic polynomials and hyperbolic programming" (Berkeley), invited talk *"Formulas for Riesz kernels"*
April 2019	Tensor meeting (Leipzig), talk *"Chebyshev polynomials and best rank-one approximation ratio"*
January 2019	MPI-INF and MPI-MiS joint workshop on Theoretical Computer Science and Algebraic Geometry (Saarbrücken), talk *"Chebyshev polynomials and best rank-one approximation ratio"*
October 2018	Workshop "Random algebraic geometry" (Trieste), invited talk *"On random Hermitian matrices with multiple spectrum"*
August 2018	ICM 2018 (Rio de Janeiro), contributed talk *"On random Hermitian matrices with multiple spectrum"*
December 2017	"Contemporary mathematics", a conference in honor of the 80th birthday of Vladimir Arnold (Moscow), contributed talk *"Spherical harmonics with maximum number of critical points"*
September 2017	SIAM event "A Day in Applied Mathematics" (Milan), contributed talk *"Symmetric tensors with only real eigenvectors"*
August 2017	Master Class in Tropical Geometry (Stockholm), contributed talk *"Eigenvectors of high order tensors"*
July 2017	FoCM workshop "Real number complexity" (Barcelona), poster *"On the number of tangents to hypersurfaces in $\mathbb{R}\mathrm{P}^n$ in random position"*

August 2014	International conference "Geometric control theory and analysis on metric structures" (Lake Baikal), invited talk "*First order flow of G_2-structures on $C(S^3 \times S^3)$*"
July 2014	Research school "An Invitation to Geometry and Topology via G_2" (London), poster "*First order flow of G_2-structures on $C(S^3 \times S^3)$*"
April 2014	International Youth Conference "Geometry and Control" (Moscow), invited talk "*Laplacian flow of G_2-structures on $S^3 \times \mathbb{R}^4$*"
April 2014	International Scientific Student Conference (Novosibirsk), contributed talk "*Deformations of G_2-structures on $S^3 \times \mathbb{R}^4$*"

Invited seminars

July 2021	"*Nodes on quintic spectrahedra*", Seminar in Real and Complex Geometry, Tel Aviv University
May 2021	"*Singularities of spectrahedra*", Mathematisches Kolloquium, Universität Osnabrück
March 2021	"*On minimality of determinantal varieties*", Geometric Structures Research Seminar, SISSA
January 2021	"*Nodes on quintic spectrahedra*", Oberseminar Reelle Geometrie und Algebra, Universität Konstanz
September 2020	"*Minimality of tensors of fixed multi-linear rank*", Online Algebra Seminar, TU Braunschweig, Braunschweig
May 2020	"*On minimality of determinantal varieties*", Nonlinear Algebra Seminar Online, MPI MiS, Leipzig
November 2019	"*On the number of critical points of a real form on the sphere*", algebra and geometry seminar, KTH, Stockholm
November 2019	"*On complete monotonicity of inverse powers of elementary symmetric polynomials*", combinatorics seminar, KTH, Stockholm
March 2019	"*Chebyshev polynomials and best rank-one approximation ratio*", Università degli Studi di Firenze, Florence
January 2018	"*On the condition number of the polynomial eigenvalueproblem with random inputs*", seminar on nonlinear algebra, MPI MiS, Leipzig
October 2017	"*On the expected number of singular points of a random spectrahedron*", Universidad de Cantabria, Santander

Editorial and organizational activities

— refereed for *IMRN*, *Arnold Mathematical Journal* (multiple times), *Linear and Multilinear Algebra* (multiple times), *SIAM Journal on Applied Algebra and Geometry* (multiple times), *Linear Algebra and Its Applications* (multiple times), *ISSAC'23* (conference proceedings) and for an *AMS Short Course*
— co-organizer of *"Random geometry and topology" minisymposium* at the *SIAM Conference on Applied Algebraic Geometry*, Bern, Summer 2019
— local co-organizer of the (online) *International Congress on Mathematical Software*, Braunschweig, Summer 2020
— co-organizer of the workshop *"Real Algebraic and Convex Geometry"*, Braunschweig, Summer 2021
— co-organizer of the *Applied Algebra and Analysis Online Seminar*, Braunschweig & Osnabrück, Fall 2020 – Summer 2022

Teaching experience

Spring 2023	*Praktische Optimierung* (Bachelor seminar), organizer, Fakultät für Mathematik und Informatik, Friedrich-Schiller-Universität Jena
Spring 2023	*Kontinuierliche Optimierung* (Master seminar), co-organizer, Fakultät für Mathematik und Informatik, Friedrich-Schiller-Universität Jena
Spring 2023	*Polynomial optimization* (Master course), lecturer and teaching assistant, Fakultät für Mathematik und Informatik, Friedrich-Schiller-Universität Jena
Fall 2022	*Machine learning with neural networks* (Master course), lecturer and teaching assistant, Carl-Friedrich-Gauß-Fakultät, TU Braunschweig
Fall 2021	*Lineare Algebra und analytische Geometrie* (Bachelor course), lecturer, Fachbereich Mathematik/Informatik, Universität Osnabrück
Fall 2021	*Algebraische Kurven* (Bachelor course), lecturer, Fachbereich Mathematik/Informatik, Universität Osnabrück
Spring 2021	*Differentialgeometrie* (Bachelor seminar), organizer, Fachbereich Mathematik/Informatik, Universität Osnabrück
Spring 2021	*Graphentheorie* (Bachelor seminar), organizer, Fachbereich Mathematik/Informatik, Universität Osnabrück
Spring 2021	*Applied algebra and geometry* (Master course), lecturer and teaching assistant, Fachbereich Mathematik/Informatik, Universität Osnabrück
Fall 2020	*Topology* (Bachelor course), lecturer and teaching assistant, Carl-Friedrich-Gauß-Fakultät, TU Braunschweig
Spring 2020	*Algebra* (Bachelor course), teaching assistant, Carl-Friedrich-Gauß-Fakultät, TU Braunschweig
Fall 2019	*Algebraic geometry* (Master course), lecturer and teaching assistant, Carl-Friedrich-Gauß-Fakultät, TU Braunschweig
Spring 2019	*Polynomial optimization and nonnegativity* (Master course), teaching assistant, Carl-Friedrich-Gauß-Fakultät, TU Braunschweig
Spring 2017	*Algebra 2* (Bachelor course), teaching assistant, Department of Mathematics and Geosciences, Università degli studi di Trieste
Spring 2016	*Algebra 1* (Bachelor course), teaching assistant, Department of Mathematics and Geosciences, Università degli studi di Trieste
Spring 2016	*General and algebraic topology* (Bachelor course), teaching assistant, Department of Mathematics and Geosciences, Università degli studi di Trieste
Spring 2013, Spring 2014	Preparation of high school students to the State Exam in Mathematics, Novosibirsk

Outreach activities

Spring and Fall 2013, Spring 2014	Teacher at the math circle *Sovyonok*, Novosibirsk
April 2022 - March 2023	Founder of and teacher at the math circle of *Teremok e.V.*, Braunschweig

Computer skills

Excellent knowledge of Python, Mathematica, LaTex

Good knowledge of C, Julia, Macaulay 2, HTML and CSS

Languages

Russian (mother tongue), English (fluent), German (fluent), Italian (fluent), Spanish (intermediate)