

Lorenzo Baldi

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Research Interests

Real Algebra, Real Algebraic Geometry and their Applications, in particular:

- Positive Polynomials
- Sums of Squares
- Polynomial Optimization
- Moment Problems

Current Position

1.6.2024– **Humboldt Postdoctoral Fellow**, *Universität Leipzig*, Algebra group
Mentor: Rainer Sinn

Past Positions

- 1.1–31.5.'24 **Postdoctoral researcher**, *Max Planck Institute for Mathematics in the Sciences*, Nonlinear Algebra group
Mentor: Rainer Sinn
- 2022–2023 **Postdoctoral researcher**, *Sorbonne University*, PolSys team
Mentors: Jérémy Berthomieu and Pierre Lairez

Education and Academic Habilitations

- 2024–2028 **Qualification for *Maître de Conférences* positions**, *Section 25 (Mathematics)*, French academic habilitation for MdC (assistant professor)
- 2024–2028 **Qualification for *Maître de Conférences* positions**, *Section 26 (Applied Math.)*, French academic habilitation for MdC (assistant professor)
- 2019–2022 **Ph. D. in Mathematics**, *Inria Sophia Antipolis – Université Côte d’Azur*, ESR9 of POEMA network. Title: Effective Representations in Real Algebraic Geometry and Polynomial Optimization, Advisor: B. Mourrain
Jury members: M-F. Roy (president), M. Laurent (reviewer), M. Schweighofer (reviewer), J-B. Lasserre, A. Parusiński and M. Putinar.
- 2017–2019 **Master Degree in Mathematics**, *Università di Trento*, *110/110 with honors*, Title: Real Tensors and Algebraic Geometry.
Supervisor: E. Ballico.
- 2014–2017 **Bachelor Degree in Mathematics**, *Università di Firenze*, *110/110 with honors*, Title: Introduzione ai gruppi di movimenti rigidi.
Supervisor: C. Casolo.

Grants and Academic Distinctions

- 2024–2026 **Humboldt Post-Doctoral Research Fellowship**, *Universität Leipzig*, awarded from the Alexander von Humboldt Foundation
Mentor: Rainer Sinn
- 12.8–16.8.-24 **IWOTA 2024**, *University of Kent*, *EMS Workshop funding*
- 30.10–2.11.2023 **Research School in Real Algebraic Geometry**, *SISSA, Trieste*, *Workshops funding*
- 12–25.3.2023 **Grant Oberwolfach Leibniz Graduate Students**, *Workshops funding*
- 2019–2022 **Ph. D. Scholarship in POEMA**, *European Union's H2020 research and innovation programme*, Marie Skłodowska-Curie Actions, grant n. 813211
- 2017–2019 **Path of Excellence for the Master in Mathematics**, *Università di Trento*, including extra academic assignments and awarded on merit base
- 2014–2017 **Prize for the Bachelor in Mathematics and Computer Science**, *Università di Firenze*, awarded to the four best Bachelor's students

Engagement in the Research System

- 2024 **Referee for SIAM Journal on Applied Algebra and Geometry; Numerical Algebra, Control and Optimization; Optimization Letters; Mathematics of Operations Research and International Symposium on Symbolic and Algebraic Computation**
- 3.8.2024 **Co-organizer** of BM60, satellite event of MEGA 2024, Leipzig
- 2023 **Referee for Journal of Algebra and SIAM Journal on Optimization**
- 2023– **Reviewer for zbMATH Open** (Zentralblatt für Mathematik)
- 11.2.2022 **Co-organizer** of the POEMA ESR Day, in POEMA Workshop 4, online

Research works

Preprints

- [7] L. Baldi, G. Blekherman and R. Sinn, Nonnegative Polynomials and Moment Problems on Algebraic Curves. *Submitted preprint*.
<https://arxiv.org/abs/2407.06017>
- [6] L. Baldi and B. Mourrain, Exact Moment Representation in Polynomial Optimization. *Submitted Preprint*.
<https://arxiv.org/abs/2012.14652>
- [5] L. Baldi, B. Mourrain and A. Parusiński, On Łojasiewicz Inequalities and the Effective Putinar's Positivstellensatz. *Submitted Preprint*.
<https://arxiv.org/abs/2212.09551>

Journal Publications

- [4] L. Baldi and L. Slot, Degree bounds for Putinar's Positivstellensatz on the hypercube. *SIAM J. Appl. Algebra Geom.*, 2024, pp. 1–25.
<https://epubs.siam.org/doi/10.1137/23M1555430>
- [3] L. Baldi and B. Mourrain, On the effective Putinar's Positivstellensatz and moment approximation. *Mathematical Programming* 200, 2023, pp. 71–103.
<https://doi.org/10.1007/s10107-022-01877-6>

Conference Papers

- [2] L. Baldi and B. Mourrain, Computing Real Radicals by Moment Optimization. *Proceedings of the 2021 on International Symposium on Symbolic and Algebraic Computation*. ISSAC '21. New York, NY, USA: Association for Computing Machinery, 2021, pp. 43–50.
<https://doi.org/10.1145/3452143.3465541>

Thesis

- [1] L. Baldi, Effective representations in real algebraic geometry and polynomial optimization. *Ph.D. Thesis*, 2022.
<https://theses.hal.science/tel-03937680>

Selected Research Visits

- 10–12.7.2024 Università di Trento, TensorDec Laboratory
- 18–20.6.2024 Technical University of Dresden, Real Algebraic Geometry Group
- 5–9.7.2023 Technical University of Dortmund, Algebra und Geometrie group
- 24–27.6.2023 Max Plank Institute Leipzig, Nonlinear Algebra group
- 19–23.6.2023 University of Magdeburg, Discrete, Convex and Toric Geometry group
- 8–10.6.2022 University of Konstanz, Research Group in Real Algebraic Geometry
- 30.5–3.6.'22 Max Plank Institute Leipzig, Nonlinear Algebra group

Teaching Activity

- 2023 Lecturer (with S. Debus) for the Ph. D. course *Semidefinite programming for Algebra, Geometry and Combinatorics*, University of Magdeburg, 30h
- 2019 *Informatica*, tutorial exercises (teaching professor: R. Zunino), Department of Mathematics, Trento
- 2018 *Geometria e algebra lineare*, tutorial exercises (teaching professors: A. Bernardi and S. Siboni), Department of Civil, Environmental and Mechanical Engineering, Trento

Programming Skills

Languages Julia, C, Singular, Magma, Maple, Macaulay2, Git, L^AT_EX
Packages MomentTools.jl, PMO.jl, MultivariateSeries.jl
developed

Selected Talks

- 8.2024 **(Planned) Truncated moment problems for genus one curves**, IWOTA, invited minisymposium speaker, University of Kent
- 30.7.2024 **(Planned) Effective Positivstellensatz over the Rational Numbers for Finite Semialgebraic Sets**, MEGA, contributed, Leipzig
- 11.7.2024 **Carathéodory Numbers: a Real point of view on Nonnegative Decompositions**, TensorDec Lab Seminar, invited, Università di Trento
- 25.6.2024 **Nonnegative Polynomials and Moment Problems on Algebraic Curves**, AROMATH seminar, invited, Inria Sophia Antipolis
- 18.6.2024 **Nonnegative Polynomials and Moment Problems on Algebraic Curves**, Geometry seminar, invited, TU Dresden
- 14.3.2024 **Carathéodory numbers and flat extension for measures supported on genus one curves**, Moments and Polynomials: Applications and Theory, contributed, Konstanz
- 8.2.2024 **Carathéodory numbers for measures supported on genus one curves**, Seminar on Nonlinear Algebra, invited, Leipzig
- 10.7.2023 **The Cone of Nonnegative Forms on Genus One Curves**, SIAM Conference on Applied Alg. Geom., invited minisymposium speaker, Eindhoven
- 6.7.2023 **The Effective Putinar's Positivstellensatz on the Hypercube**, Oberseminar Algebra und Geometrie, invited, TU Dortmund
- 22.6.2023 **Non-negative Polynomials on Real Plane Curves**, Math Oberseminar Universität Magdeburg, invited, University of Magdeburg
- 16.6.2023 **Complexity in Polynomial Optimization**, Foundations of Computational Mathematics, invited workshop speaker, Paris

- 2.6.2023 **Local Algebro-Geometric Properties for Complexity Estimates in Pol. Opt.**, *SIAM Conf. on Opt.*, invited minisymposium speaker, Seattle
- 20.3.2023 **Non-negative forms on cubic curves**, *New Directions in Real Algebraic Geometry*, contributed, Oberwolfach
- 13.3.2023 **Degree bounds for Putinar's Positivstellensatz on the hypercube**, *Real Algebraic Geometry with a View toward Koopman Operator Methods*, contributed, Oberwolfach
- 25.7.2022 **On Putinar's Positivstellensatz and Convergence Rates in Polynomial Opt.**, *ICCOPT*, invited minisymposium speaker, Lehigh University
- 24.6.2022 **On Łojasiewicz Inequalities and the Effective Positivstellensatz**, *MEGA 2022*, contributed, Krakow
- 10.6.2022 **Convergence Rates and Flat Truncation in Lasserre's Hierarchies**, *seminar Reelle Geometrie und Algebra*, invited, University of Konstanz
- 1.6.2022 **Flat Truncation in Polynomial Opt.: a Geometric and Algebraic Perspective**, *Seminar on Nonlinear Algebra*, invited, MPI Leipzig
- 3.2.2022 **On Finite Convergence and Convergence Rates in Polynomial Optimization**, *Joint PolSys-SpecFun Seminar*, invited, online
- 16.12.2021 **On Moment Approximation and the Effective Putinar's Positivstellensatz**, *POEMA Industrial Workshop*, invited, INRIA
- 20.8.2021 **Exact Moment Representation in Polynomial Optimization**, *SIAM Conference on Applied Alg. Geom.*, invited minisymposium speaker, online
- 20.7.2021 **Computing real radicals by moment opt.**, *ISSAC*, contributed, online
- 10.6.2021 **Exact Moment Representation in Polynomial Optimization**, *MEGA*, contributed, online