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

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

[6] L. Baldi et B. Mourrain, Exact Moment Representation in Polynomial Optimization. *Submitted Preprint.*
https://hal.science/hal-03082531v4

[5] L. Baldi, B. Mourrain and A. Parusiński, On Łojasiewicz Inequalities and the Effective Putinar's Positivstellensatz. *Submitted Preprint.*
https://hal.science/hal-03899373v1

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

18–20.6.2024	(Planned) 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, LaTeX

Packages developed   MomentTools.jl, PMO.jl, MultivariateSeries.jl

Selected Talks

8.2024   **(Planned) Effective Positivstellensatz over the Rational Numbers for Finite Semialgebraic Sets**, *MEGA*, contributed, Leipzig

18.6.2024   **(Planned) 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 Universitat 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