Rosa Lili Dora Preiß

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Research Interests

- Algebraic geometry of paths.
- Iterated-integral signatures, rough paths and regularity structures.
- Algebraic tools in stochastic analysis and mathematical physics.
- Renormalisation procedures and the amplituhedron.
- Invariant theory.
- Category theory and operads.
- Machine learning and data science.

Education

Technische Universität Berlin, Germany.

Dr.rer.nat. (PhD) in Mathematics. October 2021.

- Thesis topic: *Hopf algebras and non-associative algebras in the study of iterated-integral signatures and rough paths*.
- Supervisor: Professor Dr. Peter K. Friz.
- Reviewers: Professor Dr. Peter K. Friz, Professor Dr. Terry J. Lyons and Professor Dr. Kurusch Ebrahimi-Fard.

Technische Universität Berlin, Germany.

Master of Science (M. Sc.) in Mathematics, July 2016.

- Thesis Topic: *From Hopf Algebras to Rough Paths and Regularity Structures*.
- Supervisors: Professor Dr. Peter K. Friz and Professor Dr. Sylvie Paycha

Julius-Maximilians-Universität Würzburg, Germany.

Bachelor of Science (B. Sc.) in Mathematical Physics, January 2014.

- Thesis Topic: *On the Hydrodynamic Limit of a Symmetric Simple Exclusion Process*.
- Supervisor: Professor Dr. Christian Klingenberg

Academic Career

Since October 2023	**Researcher**, Nonlinear Algebra Group, Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany. Supervisor: Bernd Sturmfels.
November 2021 until September 2023	**Research Assistant**, AG Analysis, Institut für Mathematik, Universität Potsdam, Germany. Supervisor: Sylvie Paycha. Teaching activity: • Exercise class for mathematics for physicists III (winter term 2021/22) • Exercise class for mathematics for physicists IV (summer term 2022) • Exercise class for groupoids and applications in mathematical physics (summer term 2022) • Exercise class for mathematics for physicists I (winter term 2022/23) • Exercise class for distribution theory (winter term 2022/23) • Lecture on Stieltjes integration and iterated integrals (summer term 2023) • Exercise class for mathematics for physicists II (summer term 2023)
September 2016 until October 2021	**Research Assistant**, AG Stochastik und Finanzmathematik, Institut für Mathematik, Technische Universität Berlin, Germany. Supervisor: Peter K. Friz. Teaching activity: • Exercise class for insurance mathematics (winter term 2016/17) • Tutorial for linear algebra for engineers (winter term 2016/17) • Tutorial for probability theory (summer term 2017) • Preparing exercise sheets for analysis for engineers (winter term 2017/18) • Exercise class / tutorial for probability theory (summer term 2018)
Autumn 2018	**Research Assistant**, Nonlinear Algebra Group, Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany. Supervisor: Bernd Sturmfels.

Papers

Rosa Preß. **An algebraic geometry of paths via the iterated-integral signature**. arXiv:231.17886 [math.RA]. November 2023.

Cristopher Salvi, Joscha Diehl, Terry Lyons, Rosa Preiß and Jeremy Reizenstein. **A structure theorem for streamed information.** Journal of Algebra, Volume 634, November 2023.

Carlo Bellingeri, Peter K. Friz, Sylvie Paycha and Rosa Preiß. **Smooth rough paths, their geometry and algebraic renormalization.** Vietnam Journal of Mathematics, Volume 50, June 2022.

Joscha Diehl, Rosa Preiß, Michael Ruddy and Nikolas Tapia. **The moving frame method for iterated-integrals: orthogonal invariants.** Foundations of Computational Mathematics, Volume 23, June 2022.

Joscha Diehl, Terry Lyons, Rosa Preiß and Jeremy Reizenstein. **Areas of areas generate the shuffle algebra.**. arXiv:2002.02338 [math.RA]. July 2021.

Laura Colmenarejo and Rosa Preiß. **Signatures of paths transformed by polynomial maps.** Beiträge zur Algebra und Geometrie / Contributions to Algebra and Geometry, Volume 61, Issue 4, April 2020.

Yvain Bruned, Ilya Chevyrev, Peter K. Friz and Rosa Preiß. **A Rough Path Perspective on Renormalization.** Journal of Functional Analysis, Volume 277, Issue 11, December 2019.

Conferences attended

Mathematics of data streams: signatures, neural differential equations, and diffusion models. Greifswald, Germany, April 8-13, 2024.

Recent Developments in Rough Paths. BI Norwegian Business School, Oslo, Norway, March 3-8, 2024.

12^{th} *BMS Student Conference.* Technische Universität Berlin, Germany, February 21-23, 2024.

A day of Algebraic Geometry. Humboldt Universität zu Berlin, February 22, 2024.

Positive Geometry in Particle Physics and Cosmology. Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany, February 12-16, 2024.

18^{th} *Oxford-Berlin Young Researchers Meeting on Applied Stochastic Analysis.* University of Oxford, United Kingdom, January 4-6, 2024. I gave a talk on **An algebraic geometry of paths via the iterated-integals signature**.

Mini-Workshop: Combinatorial and Algebraic Structures in Rough Analysis and Related Fields. Mathematisches Forschungsinstitut Oberwolfach, Germany, November 26-December 2, 2023. I have been an organizer and gave a talk on **An algebraic geometry of (rough) paths.**

Structural Aspects of Signatures and Rough Paths. Center for Advanced Study, Oslo, Norway, August 28-September 1. I gave a talk on **An algebraic geometry of paths**.

17^{th} *Annual Berlin-Oxford Young Researchers Meeting on Applied Stochastic Analysis.* Weierstrass Institute, Berlin, April 27-29, 2023.

16^{th} *Oxford-Berlin Young Researchers Meeting on Applied Stochastic Analysis.* University of Oxford, United Kingdom, December 8-10, 2022. I gave a talk on **Smooth rough paths** (joint work with Carlo Bellingeri, Peter Friz and Sylvie Paycha).

Rough Paths, Algebraic Structures and Machine Learning. University of Adger, Kristiansand, Norway, October 20-21, 2022. I gave a talk on **Orthogonal and special linear invariants of paths via the iterated integral signature** (joint work with Joscha Diehl, Terry Lyons, Hao Ni, Micheal Ruddy, Jeremy Reizenstein and Nikolas Tapia).

New interfaces of Stochastic Analysis and Rough Paths. Banff International Research Station, Canada, September 4-9, 2022. I gave a talk on **Smooth rough paths** (joint work with Carlo Bellingeri, Peter Friz and Sylvie Paycha).

SciCADE 2022. University of Iceland, Reykjavík, July 25-29, 2022. I gave a talk on **Orthogonal and special linear invariants of paths via the iterated-integral signature** (joint work with Joscha Diehl, Terry Lyons, Hao Ni, Micheal Ruddy, Jeremy Reizenstein and Nikolas Tapia) in the minisymposium on *Geometric and algebraic perspectives in numerical integration*.

15^{th} *Annual ERC Berlin-Oxford Young Researchers Meeting on Applied Stochastic Analysis.* Technische Universität Berlin and Humboldt Universität zu Berlin, Germany, May 12-14, 2022. I gave a talk on **Orthogonal and special linear invariants of paths via the iterated-integral signature: Overview and new developments** (joint work with Joscha Diehl, Micheal Ruddy, Jeremy Reizenstein and Nikolas Tapia).

Rough algebra day. Technische Universität Berlin, Germany, March 31, 2022. I gave a talk on **An algebraic geometry of paths via the iterated-integral signature**.

Higher Structures Emerging from Renormalisation. Erwin Schrödinger International Institute for Mathematics and Physics, Vienna, Austria, November 08 - 19, 2021. I gave a talk on **Adding rough paths: no problem as long as they are smooth** (joint work with Carlo Bellingeri, Peter K. Friz and Sylvie Paycha) and contributed a discussion of Felix Otto's talk on 'The structure group in regularity structures: avoiding trees'.

Noncommutative algebra, probability and analysis in action. Greifswald, Germany, September 20 - 25, 2021.

The amplituhedron: algebra, combinatorics, and physics. Zoom, April 08, 2021.

Pathwise Stochastic Analysis and Applications. Zoom, March 08 - 12, 2021.

Cumulants in Stochastic Analysis. Zoom, February 25 - 26, 2021.

14^{th} *Annual ERC Oxford-Berlin Young Researchers Meeting on Applied Stochastic Analysis.* Zoom, February 10 - 12, 2021. I gave a talk on **Rotation-Reflection invariants of paths through signatures and moving frames** (joint work with Joscha Diehl, Michael Ruddy and Nikolas Tapia).

Oberwolfach workshop: New Directions in Rough Path Theory (online meeting).. Zoom, December 06 - 12, 2020. I gave a talk on **Areas of Areas generate the shuffle algebra** (joint work with Joscha Diehl, Terry Lyons and Jeremy Reizenstein).

13^{th} *Annual ERC Berlin-Oxford Young Researchers Meeting on Applied Stochastic Analysis.* Zoom, June 08 - 10, 2020. I gave a talk on **Rotation Invariants of Paths Through Iterated Integral Signatures** (joint work with Joscha Diehl, Michael Ruddy and Nikolas Tapia).

Young researchers between geometry and stochastic analysis. Bergen, Norway, February 12-14, 2020.

Workshop: Problems of roughness, geometry and random fluctuations. Hausdorff Research Institute for Mathematics, Bonn, Germany, December 09 - 12, 2019. I gave a talk on **A Rough Path Perspective on Renormalization** (joint work with Yvain Bruned, Ilya Chevyrev and Peter K. Friz).

12^{th} *Annual ERC Oxford-Berlin Young Researchers Meeting on Applied Stochastic Analysis.* University of Oxford, United Kingdom, December 04 - 06, 2019. I gave a talk on **Signatures of paths transformed by polynomial maps** (joint work with Laura Colmenarejo).

Algebraic and Analytic Perspectives in the Theory of Rough Paths and Signatures. Department of Mathematics, University of Oslo, Norway, November 14 - 15, 2019. I gave a talk on **Algebraic Methods for Signatures of Paths: Hopf, Zinbiel and Tortkara** (joint work with Laura Colmenarejo, Joscha Diehl, Terry Lyons and Jeremy Reizenstein).

Opening Conference - Varieties, Polyhedra, Computation. Freie Universität Berlin, Germany, October 07 - 11, 2019. Attended October 08 and 10.

First Berlin-Leipzig workshop on Fluctuating Hydrodynamics. Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany, and Institute of Mathematics, Freie Universität Berlin, Germany, August 26 - 30, 2019. Attended August 27 - 30.

11^{th} *Annual ERC Berlin-Oxford Young Researchers Meeting on Applied Stochastic Analysis.* Weierstraß-Institut, Berlin, Germany, May 23 - 25, 2019.

New Directions in Stochastic Analysis: Rough Paths, SPDEs and Related Topics - On the occasion of Professor Terry Lyons' 65th Birthday. Zuse Institute Berlin, Germany, March 18 - 22, 2019.

Berlin-Leipzig workshop in analysis and stochastics. Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany, January 16 - 18, 2019. Attended January 17 - 18.

Rough paths, regularity structures and combinatorial Hopf algebras. University of Bergen, Norway, August 31 - September 01, 2018.
During the research seminar, I gave a talk on **Monoid Graded Rough Paths** (joint work with Alexander Schmeding).

Summer School on Numerical Computing in Algebraic Geometry. Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany, August 13 - 17, 2018. Attended August 13 - 15.

Algebraic and geometric aspects of numerical methods for differential equations. Institut Mittag-Leffler, Djursholm, Sweden, July 2 - 6, 2018.

9^{th} *Annual ERC Berlin-Oxford Young Researchers Meeting on Applied Stochastic Analysis.* Weierstraß-Institut, Berlin, Germany, June 14 - 16, 2018.

IST Austria Summer School in Probability and Mathematical Physics. Institute of Science and Technology Austria, Klosterneuburg, Austria, June 4 - 8, 2018.
Minicourses:

- Sharp threshold phenomena via randomized algorithms, by Hugo Duminil-Copin.
- A BPHZ theorem for stochastic PDEs, by Martin Hairer.
- The Gaussian free field and Liouville quantum gravity, by Jason Miller.

Berlin-Leipzig workshop in analysis and stochastics. Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany, November 29 - December 01, 2017.

18^{th} *Lluís Santaló Research Summer School: Algebraic and Combinatorical Methods in Stochastic Calculus.* Universidad Internacional Menéndez Pelayo, Santander, Spain, July 17 - 21, 2017.
Minicourses:

- Algebraic and combinatorial aspects in stochastic calculus, by Kurusch Ebrahimi-Fard and Frédéric Patras.
- Fluctuations of chaotic random variables: theoretical foundations and geometric applications, by Giovanni Peccati.
- Combinatorial Aspects of Free Probability and Free Stochastic Calculus, by Roland Speicher.
- Rough paths, regularity structures and renormalisation, by Lorenzo Zambotti.

7^{th} *Annual ERC Berlin-Oxford Young Researchers Meeting on Applied Stochastic Analysis.* Weierstraß-Institut, Berlin, Germany, May 18 - 20, 2017.

Workshop on Algebraic Renormalisation of Regularity Structures. Department of Mathematics, University of Bergen, Norway, April 03 - 07, 2017. I contributed a short summary talk on the subsections *Algebraic renormalisation* and *Recursive Formulae* of the paper *Algebraic renormalisation of regularity structures* by Yvain Bruned, Martin Hairer and Lorenzo Zambotti.

Analytic Aspects of Renormalization. Minicourse given by Ajay Chandra (University of Warwick). Technische Universität Berlin, Germany, September 26 - 29, 2016.

Meeting on Applied Stochastic Analysis. Mathematics Department, University of Oxford, United Kingdom, December 8 - 10, 2016.
I gave a talk on **A Rough Path Perspective on Renormalization** (joint work with Yvain Bruned, Ilya Chevyrev and Peter K. Friz).

5^{th} *Annual ERC Berlin-Oxford Young Researchers Meeting on Applied Stochastic Analysis.* Weierstraß-Institut & Technische Universität Berlin, Berlin, Germany, August 12 - 15, 2016.

Paths to, from and in renormalization. At the confluence of rough paths, algebra, analysis and geometry. Universität Potsdam, Germany, February 8 - 12, 2016.

4^{th} *Annual ERC Berlin-Oxford Young Researchers Meeting on Applied Stochastic Analysis.* Weierstraß-Institut, Berlin, Germany, December 7 - 9, 2015.

Language Skills

German (native), English (advanced), French (elementary).

Berlin, 12 May 2024