





Experience


 **Postdoc, WIAS, Germany**
2022–2024 Postdoc position at WIAS, as part of the BMS MATH+ AA4-2 project “Optimal Control in Energy Markets Using Rough Analysis and Deep Networks”.


 **Postdoc, WIAS & TU Berlin, Germany**
2021–2022 Joint postdoc position at WIAS (50%) and TU Berlin (50%), as part of the BMS MATH+ EF1-13 project “Stochastic and Rough Aspects in Deep Neural Networks”.

 **Postdoc, WIAS & TU Berlin, Germany**
2019–2020 Joint postdoc position at WIAS (50%) and TU Berlin (50%), as part of the BMS MATH+ EF1-5 project “On robustness of deep neural networks”.


 **Postdoc, NTNU Trondheim, Norway**
2018–2019 ERCIM postdoc position at the Norwegian University of Science and Technology, hosted by K. Ebrahimi-Fard.


Academic Formation


 **PhD in Mathematics, U. de Chile and Sorbonne Université, Chile and France**
2014–2018 Joint diploma under the direction of D. Remenik (UCh) and L. Zambotti (SU).
Thesis: *Directed Polymers and Rough Paths*.


 **MSc. Mathematical Engineering, U. de Chile, Chile**
2014 Thesis: *Exponential ergodicity for AIMD Markov processes*


Teaching Experience


 **Lecturer, Technische Universität Berlin, Germany, taught in German**
2024 Stochastik für Informatik.

 **Lecturer, Universidad de Chile, Chile**
2018 Multivariate Calculus.

 **Undergrad. teaching assistant, Sorbonne Université, France, taught in French**
2015–2016 Multivariate calculus, Linear algebra, Calculus.

 **Lecturer, Universidad de Los Andes, Chile**
2014 Advanced calculus.

 **Undergrad. teaching assistant, Universidad de Los Andes, Chile**
2011–2014 Probability theory, Linear algebra, Ordinary differential equations, Advanced Calculus, Applied statistics.

 **Undergrad. teaching assistant, Universidad de Chile, Chile**
2009–2014 Introduction to Calculus, Multivariate calculus, Ordinary differential equations, Advanced Calculus, Real analysis, Functional analysis, Stochastic calculus, Probability and statistics, Stochastic simulation: theory and laboratory.

Languages

Spanish Native
English Advanced
French B2+
German B1+

Computer skills

Python Advanced

L^AT_EX Advanced

C++ Intermediate

Ruby, Haskell, Intermediate

Julia, Rust

Research keywords

Residual Neural Networks, Rough Paths, Signatures, Numerical Analysis, Hopf algebras.

Main collaborators

Christian Bayer, Carlo Bellingeri, Joscha Diehl, Ana Djurdjevac, Kurusch Ebrahimi-Fard, Peter K. Friz, Emilio Ferrucci, Rosa Preiß, Sebastian Riedel, Cristopher Salvi, Alexander Schmeding.

Publications and preprints

- [1] C. Bayer, P. K. Friz, and N. Tapia, *Stability of deep neural networks via discrete rough paths*, *SIAM J. Math. Data Sci.* **5** (2023), no. 1, 50–76.
- [2] C. Bellingeri, A. Djurdjevac, P. K. Friz, and N. Tapia, *Transport and continuity equations with (very) rough noise*, *Partial Differ. Equ. Appl.* **2** (2021), no. 4, Paper No. 49, 26.
- [3] C. Bellingeri, E. Ferrucci, and N. Tapia, *Branched itô formula and natural itô-stratonovich isomorphism*, 2023, [arXiv:2312.04523 \[math.PR\]](#).
- [4] E. Celledoni, P. I. E. Lystad, and N. Tapia, *Signatures in shape analysis: an efficient approach to motion identification*, Geometric science of information, Lecture Notes in Comput. Sci., vol. 11712, Springer, Cham, 2019, pp. 21–30.
- [5] J. Diehl, K. Ebrahimi-Fard, and N. Tapia, *Iterated-sums signature, quasisymmetric functions and time series analysis*, *Sém. Lothar. Combin.* **84B** (2020), Art. 86, 12.
- [6] ———, *Time-warping invariants of multidimensional time series*, *Acta Appl. Math.* **170** (2020), 265–290.
- [7] ———, *Tropical time series, iterated-sums signatures, and quasisymmetric functions*, *SIAM J. Appl. Algebra Geom.* **6** (2022), no. 4, 563–599.
- [8] ———, *Generalized iterated-sums signatures*, *J. Algebra* **632** (2023), 801–824.
- [9] J. Diehl, R. Preiß, M. Ruddy, and N. Tapia, *The moving-frame method for the iterated-integrals signature: Orthogonal invariants*, *Foundations of Computational Mathematics* **23** (2023), no. 4, 1273–1333.
- [10] K. Ebrahimi-Fard, F. Patras, N. Tapia, and L. Zambotti, *Hopf-algebraic deformations of products and Wick polynomials*, *Int. Math. Res. Not. IMRN* (2020), no. 24, 10064–10099.
- [11] ———, *Wick polynomials in noncommutative probability: a group-theoretical approach*, *Canad. J. Math.* **74** (2022), no. 6, 1673–1699.
- [12] ———, *Shifted substitution in non-commutative multivariate power series with a view toward free probability*, *SIGMA Symmetry Integrability Geom. Methods Appl.* **19** (2023), Paper No. 038, 17.
- [13] P. K. Friz, P. P. Hager, and N. Tapia, *Unified signature cumulants and generalized Magnus expansions*, *Forum Math. Sigma* **10** (2022), Paper No. e42, 60.
- [14] N. Tapia and L. Zambotti, *The geometry of the space of branched rough paths*, *Proc. Lond. Math. Soc.* (3) **121** (2020), no. 2, 220–251.
- [15] M. G. Varzaneh, S. Riedel, A. Schmeding, and N. Tapia, *The geometry of controlled rough paths*, 2022, [2203.05946 \[math.PR\]](#).

Funding

January 2023–September 2024, MATH+ Excellence Cluster

Research grant. Application Areas “Energy Transition”. Project no. 2 “Optimal Control in Energy Markets Using Rough Analysis and Deep Networks”.

January 2021–December 2022, MATH+ Excellence Cluster

Research grant. Emerging Fields “Extracting dynamical laws from complex data”. Project no. 13 “Stochastic and rough aspects in deep neural networks”.

May 2019–December 2020, MATH+ Excellence Cluster

Research grant. Emerging Fields “Extracting dynamical laws from complex data”. Project no. 5 “On robustness of deep neural networks”.

October 2018–April 2019, European Research Consortium for Informatics and Mathematics (ERCIM)

Alain Bensoussan postdoctoral fellowship

March 2014–September 2018, Chilean National Council for Research and Development

Doctoral scholarship

Seminars and Workshops

Top 10 talks

November 7, 2023, *Imperial College London*

Branched Itô formula and natural Itô-Stratonovich isomorphism

July 25, 2022, *SciCADE 2022*

Signatures in numerical analysis

October 28, 2021, *Funktionalanalysis Oberseminar*, Universität des Saarlandes, Saarbrücken, Germany

Robustness of Residual Neural Networks

August 23, 2021, *LMMS Summer School: Mathematical Methods in Machine Learning*, Schloss Dagstuhl, Germany

Iterated sums for time series classification

July 20, 2021, *10th World Congress in Probability and Statistics*

Transport and continuity equations with (very) rough noise

March 31, 2021, *Seminario Chileno de Probabilidades*

Iterated sums for time series classification

December 7, 2020, *MFO Meeting “New directions in rough paths theory”*

Signature cumulants and generalized Magnus expansions

August 24, 2020, *Bernoulli–IMS One World Symposium*

Time-warping invariants of multidimensional time series

August 27, 2019, *Geometric Science of Information 2019*

Signatures in Shape Analysis

July 23, 2019, *SciCADE 2019*

Algebraic aspects of signatures

Organization

Workshop **April 27–29, 2023**, *Berlin*, Germany

17th Annual Berlin-Oxford Young Researchers Meeting on Applied Stochastic Analysis

Workshop **September 20–25, 2021**, *Greifswald*, Germany

Noncommutative algebra, probability and analysis in action

Workshop **June 15–19, 2021**, *Online*

Summer school for researchers between geometry and stochastic analysis

Workshop **May 31–June 2, 2021**, *Online*

SPDEs & their Friends

Workshop **February 25–26, 2021**, *Online*

Cumulants in Stochastic Analysis

Seminar **March 2020 – Ongoing**, *Online*

Algebraic and Combinatorial Perspectives in the Mathematical Sciences

- Workshop **November 14–15, 2019**, *Oslo*, Norway
Algebraic and Analytic Perspectives in the theory of Rough Paths and Signatures
- Seminar **October 2018–May 2019**, *NTNU Trondheim*, Norway
Mathematical Perspectives in Machine Learning
- Workshop **May 8–11, 2019**, *Trondheim*, Norway
Non-commutative Stochastic Calculus