

# Nikolas TAPIA


## Curriculum Vitae


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## Experience


 **Postdoc, WIAS, Germany**  
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**  
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**  
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, (6 months)**  
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**  
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**  
Thesis: *Exponential ergodicity for AIMD Markov processes*

## Teaching Experience

 **Lecturer, Technische Universität Berlin, Germany, taught in German**  
Stochastik für Informatik(er).

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

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

## Languages

Spanish Native

English Advanced

French B2+

German B1+

## Computer skills

Python Advanced

C++ Intermediate

LaTeX Advanced

Julia, Rust Intermediate

## 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, Cristopher Salvi, Alexander Schmeding.

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## 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] I. Chevyrev, J. Diehl, K. Ebrahimi-Fard, and N. Tapia, *A multiplicative surface signature through its magnus expansion*, 2024, [arXiv:2406.16856 \[math.RA\]](#).
- [6] 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.
- [7] ———, *Time-warping invariants of multidimensional time series*, *Acta Appl. Math.* **170** (2020), 265–290.
- [8] ———, *Tropical time series, iterated-sums signatures, and quasisymmetric functions*, *SIAM J. Appl. Algebra Geom.* **6** (2022), no. 4, 563–599.
- [9] ———, *Generalized iterated-sums signatures*, *J. Algebra* **632** (2023), 801–824.
- [10] 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.
- [11] 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.
- [12] ———, *Wick polynomials in noncommutative probability: a group-theoretical approach*, *Canad. J. Math.* **74** (2022), no. 6, 1673–1699.
- [13] ———, *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.
- [14] 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.
- [15] L. Schmitz and N. Tapia, *Free generators and hoffman's isomorphism for the two-parameter shuffle algebra*, 2024, [arXiv:2401.06691 \[math.RA\]](#).
- [16] 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.
- [17] M. G. Varzaneh, S. Riedel, A. Schmeding, and N. Tapia, *The geometry of controlled rough paths*, 2022, [2203.05946 \[math.PR\]](#).

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## Scholarships and Grants

**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

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## 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*