

Nikolas TAPIA

Curriculum Vitae

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Experience



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.

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, Universidad de Chile, Chile.

Multivariate Calculus.



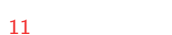
Undergrad. teaching assistant, Sorbonne Université, France, taught in French.

Multivariate calculus, Linear algebra, Calculus.



Lecturer, Universidad de Los Andes, Chile.

Advanced calculus.



Undergrad. teaching assistant, Universidad de Los Andes, Chile.

Probability theory, Linear algebra, Ordinary differential equations, Advanced Calculus, Applied statistics.



Undergrad. teaching assistant, Universidad de Chile, Chile.

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 A1+

Computer skills

Python Advanced

LaTeX Advanced

C++ Intermediate

Ruby, Haskell, Beginner

Julia, Rust

Research Synopsis

The main focus of my research is on the applications of signatures and rough paths theory to Data Analysis, both from the applied and theoretical point of view. My recent collaborations [3–8] take these techniques and apply them to time series analysis and motion recognition in computer vision. My current projects include the analysis of Residual Neural Networks using the framework of rough paths theory [1] and investigating the rôle Chen’s iterated integrals signature plays in learning dynamical laws for diffusion processes.

I consider myself to be an adept coder, with good knowledge of Python in general and Tensorflow in particular, C++ and \LaTeX . I have also some experience with Ruby, Haskell and Julia.

Publications

- [1] C. Bayer, P. Friz, and N. Tapia, *Stability of deep neural networks via discrete rough paths*, [WIAS Preprint 2732 \(2020\)](#).
- [2] C. Bellingieri, A. Djurdjevac, P. K. Friz, and N. Tapia, *Transport and continuity equations with (very) rough noise*, 2020, [arXiv:2002.10432 \[math.AP\]](#).
- [3] E. Celledoni, P. E. Lystad, and N. Tapia, *Signatures in shape analysis: An efficient approach to motion identification*, GSI 2019: Geometric Science of Information (Cham) (F. Nielsen and F. Barbaresco, eds.), Lecture Notes in Computer Science, no. 11712, Springer International Publishing, 2019, pp. 21–30.
- [4] J. Diehl, K. Ebrahimi-Fard, and N. Tapia, *Generalized iterated-sums signatures*, 2020, [arXiv:2012.04597 \[math.RA\]](#).
- [5] ———, *Iterated-sums signature, quasisymmetric functions and time series analysis*, *Sém. Lothar. Combin.* **84B.86** (2020), 12 pp.
- [6] ———, *Time-warping invariants of multidimensional time series*, *Acta Appl. Math.* **170** (2020), 265–290.
- [7] J. Diehl, K. Ebrahimi-Fard, and N. Tapia, *Tropical time series, iterated-sums signatures and quasisymmetric functions*, 2020, [arXiv:2009.08443 \[math.RA\]](#).
- [8] J. Diehl, R. Preiß, M. Ruddy, and N. Tapia, *The moving frame method for iterated-integrals: orthogonal invariants*, 2020, [arXiv:2012.05880 \[math.DG\]](#).
- [9] K. Ebrahimi-Fard, F. Patras, N. Tapia, and L. Zambotti, *Wick polynomials in non-commutative probability*, 2020, [arXiv:2001.03808 \[math.PR\]](#).
- [10] K. Ebrahimi-Fard, F. Patras, N. Tapia, and L. Zambotti, *Hopf-algebraic Deformations of Products and Wick Polynomials*, *Int. Math. Res. Not.* **2020** (2020), no. 24, 10064–10099.
- [11] P. K. Friz, P. Hager, and N. Tapia, *Unified signature cumulants and generalized magnus expansions*, 2021, [arXiv:2102.03345 \[math.PR\]](#).
- [12] 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.

Seminars and Workshops

Talks

- March 12, 2021**, *DNA Seminar*, NTNU Trondheim.
Numerical schemes for rough Partial Differential Equations
- March 11, 2021**, *Pathwise stochastic analysis and applications*.
Signature cumulants and generalized Magnus expansions
- March 1, 2021**, *Seminario Hispanohablante de Probabilidades*.
Transport and continuity equations with (very) rough noise
- February 10, 2021**, *14th Berlin-Oxford meeting*.
Approximation of controlled rough paths
- December 11, 2020**, *Rough paths and SPDEs*.
Transport and continuity equations with (very) rough noise
- December 7, 2020**, *MFO Meeting "New directions in rough paths theory"*.
Signature cumulants and generalized Magnus expansions
- October 23, 2020**, *Brasilian Stochastic Analysis Seminar*.
Transport and continuity equations with (very) rough noise
- October 15, 2020**, *Higher algebraic structures emerging from renormalization*.
Unified signature cumulants and generalised Magnus expansions
- August 24, 2020**, *Bernoulli-IMS One World Symposium*.
Time-warping invariants of multidimensional time series
- August 14, 2020**, *Geometry of curves in time series and shape analysis*.
Signatures in Shape Analysis
- June 10, 2020**, *13th Berlin-Oxford meeting*.
Stability of Deep ResNets via discrete rough paths
- April 24, 2020**, *Potsdam Analysis Seminar*.
Free Wick polynomials
- April 22, 2020**, *Oxford DataSig Seminar*.
Higher-order iterated-sums signature
- November 7, 2019**, *Seminar of the FOR2402 Research Group*.
Strong solutions for the rough transport equation with any Hölder regularity
- October 3, 2019**, *Rencontre GDR Renormalisation*.
Non-commutative Wick polynomials
- August 27, 2019**, *Geometric Science of Information 2019*.
Signatures in Shape Analysis
- July 23, 2019**, *SciCADE 2019*.
Algebraic aspects of signatures
- May 25, 2019**, *11th Berlin-Oxford meeting*.
Signatures in Shape Analysis
- May 8, 2019**, *Non-commutative stochastic analysis*.
Non-commutative Wick polynomials
- April 26, 2019**, *FCFM Universidad de Chile*.
The signature method
- February 26, 2019**, *MAGiC 2019*.
An introduction to signatures
- February 6, 2019**, *MPI MiS Leipzig*.
The geometry of the space of branched Rough Paths

January 3, 2019, NTNU Trondheim.

Modification of branched Rough Paths

November 13, 2018, Rencontre GDR Renormalisation.

The geometry of the space of branched Rough Paths

January 17, 2018, III Summer School on Probability and Stochastic Processes.

Construction of geometric rough paths

Organization

- Workshop **September 20–25, 2021, Greifswald, Germany.**
Noncommutative algebra, probability and analysis in action
- Workshop **June 15–19, 2021, Kristiansand, Norway.**
Summer school for researchers between geometry and stochastic analysis
- 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