CV

Josef Teichmann
Current position(s): Full professor or similar
Academic age: 22 year(s) 6 month(s)

Education

Degree	Organisation	Duration
PhD / Dr.: PhD Mathematics Prof Peter Michor	University of Vienna, AT mathematics	09.1996 - 05.1999 2 year(s) 9 month(s)
Master: Master Mathematics	University of Graz, AT mathematics	09.1995 - 06.1996 10 month(s)
Master: DEA Mathematiques	Université Bourgogne Franche-Comté, FR mathematiques	09.1994 - 06.1995 10 month(s)

Employment

Role	Organisation	Duration
Full professor or similar	ETH Zürich - ETHZ, CH D-MATH	06.2009 - Present 13 year(s) 5 month(s)
Associate professor or similar	TU Wien, AT Mathematik	03.2003 - 05.2009 6 year(s) 3 month(s)
Assistant professor with tenure track or similar	TU Wien, AT Mathematik	08.2001 - 02.2003 1 year(s) 7 month(s)

Role	Organisation	Duration
Junior researcher / Postdoc	TU Wien, AT Mathematik	06.2000 - 07.2001 1 year(s) 2 month(s)

Major achievements

Achievement 1

Witnessing the tremendous successes of machine learning technology in areas like board games, protein foldings, language or image recognition, we have started to investigate the implications of machine learning and artificial intelligence for financial industry and mathematical finance. So far we have analyzed fundamental tasks like pricing, hedging, calibration or simulation from this new perspective in a series of papers on Deep Hedging, Deep Calibration, or Deep Simulation. We have put emphasis on solving fully realistic models with low numerical complexity by mostly provable techniques. We have also worked on industry applications, like Deep Asset liability management, where large scale Markov decision processes of crucial importance in Risk management are solved in a satisfying manner by machine learning technology.

Mathematical Finance is an ongoing central theme in our working group. We believe that technological progress in financial industry, e.g.~in view of Machine Learning, is enabled by profound theoretical analysis. We have continued working on affine models in infinite dimension with applications to rough volatility models, on term structure models in view of a consistent dynamics of volatility surface models, and on fundamental theorems in large financial markets or under two filtrations. This domain knowledge leads to better working machine learning algorithms.

[1] journal-article. Hans Buehler, Lukas Gonon, Josef Teichmann, Ben Wood: Deep Hedging, Quantiative Finance 19 (8), 2019. . .
[2] journal-article. Blanka Horvath, Josef Teichmann, Zan Zuric: Deep Hedging under Rough Volatility, Risks 9, no. 7, 2021.
[3] journal-article. Nicolas Curin, Michael Kettler, Xi Kleisinger-Yu, Vlatka Komaric, Thomas Krabichler, Josef Teichmann, Hannah Wutte: A deep learning model for gas storage optimization. Decisions in Economics and Finance (2021).

Achievement 2

Rough Analysis has gained a lot of attention recently as a feasible alternative (and extension) of stochastic analysis in systems driven by rough signals. In a series of papers we have been analyzing Besov type topologies on rough path spaces to allow for solvability of certain important optimization algorithms. Rough analysis allows to build solutions of complex dynamical systems driven by rough

signals upon fundamental quantities characteristic for the rough signal and the dynamics. This point of view has found several deep applications in machine learning, when learning technology for path space functionals, for strategies in financial industry, or for time series analysis is concerned. It also an important bridge to the field of reservoir computing, where randomized recurrent neural networks are considered as approximately universal objects in the set of all recurrent neural networks.

[1] journal-article. Chong Liu, David Proemel, Josef Teichmann: Characterization of non-linear Besov spaces, Trans. Amer. Math. Soc., Vol. 373(1), 529-550, 2020.
[2] journal-article. Christa Cuchiero, Lukas Gonon, Lyudmila Grigoryeva, Juan-Pablo Ortega, Josef Teichmann: Discrete-time signatures and randomness in reservoir computing, EEE Transactions on Neural Networks and Learning Systems (2021).
[3] journal-article. Christa Cuchiero, Martin Larsson, Josef Teichmann: Deep neural networks, generic universal interpolation, and controlled ODEs, SIAM Journal on Mathematics of Data Science, 2 (3), 901-919, 2020.

Achievement 3

Mathematical finance has developed fine techniques for non-linear high dimensional decision problems, which might shed new light on some foundations of machine learning. We have started to work on the role of randomness in training algorithms or how to use ideas from compressed sensing in constructing provable machine learning algorithms. We strongly believe that this interplay between stochastic finance and foundations of machine learning is a fruitful area of research. On the other hand from a regulatory perspective it is pivotal to have provable machine learning techniques in production, i.e. theoretical arguments justifying the techniques applied in financial industry. We believe that the perspective of mathematical finance will contribute to the important field of provable techniques. Several first steps have been made by investigating randomized structures in the spirit of reservoir computing.

[1] journal-article. Christa Cuchiero, Irene Klein, Josef Teichmann: A fundamental theorem of asset pricing for continuous time large financial markets in a two filtration setting, ``Theory of Probability and its Applications'' -- special issue on occasion of the 70th birthday of Yuri Kabanov, 2019.
[2] journal-article. Anja Richter, Josef Teichmann: Discrete Time Term Structure Theory and Consistent Recalibration Models, SIAM Journal of Financial Mathematics 8 (1), 2017.
[3] journal-article. Christa Cuchiero, Wahid Khosrawi-Sardroudi, Josef Teichmann: A generative adversarial network approach to calibration of local stochastic volatility models, Risks 8, no. 4, 101, 2020.

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