Nathanael Bosch

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nathanaelbosch

Research Interests

Probabilistic machine learning *for* and *with* dynamical systems: state-space models and differential equations, Bayesian filtering and smoothing, scientific machine learning, probabilistic numerics, Gaussian processes, control.

Professional Experience

École polytechnique fédérale de Lausanne (EPFL) **Lausanne, Switzerland**
Postdoctoral Researcher *2025/10 – today*
Supervised by Michael Herbst, in the Mathematics for Materials Modelling group.
Gradient-accelerated Bayesian optimization for inverse materials design.

Amazon Web Services **Berlin, Germany**
Applied Scientist Intern *2024/08 – 2025/01*
Automatic machine learning for time series forecasting. With Oleksandr Shchur and Caner Türkmen.

University of Tübingen **Tübingen, Germany**
Research Assistant *2020/05 – 2024/06*
Supervised by Philipp Hennig, in the Methods of Machine Learning group.
Researching and developing probabilistic numerical solvers for differential equations.

Max Planck Institute for Intelligent Systems, Embodied Vision Group **Tübingen, Germany**
Student Assistant *2019/03 – 2019/10*
Master's thesis project on "Learning Gaussian Process Dynamics Models from Visual Observations for Control".
Supervised by Jörg Stückler.

Horváth&Partners **Munich, Germany**
Data Science Intern *2016/05 – 2016/07*
Basket analysis of a large quantity of real-world retail sales data. Methods and results were published as part of a german business analytics book ("Strategische Unternehmensführung mit Advanced Analytics").

Education

University of Tübingen **Tübingen, Germany**
Ph.D. Computer Science *2020/05 – 2025/02*
International Max Planck Research School for Intelligent Systems (IMPRS-IS)
Passed *Magna Cum Laude* (with great distinction).
Doctoral thesis: "A Flexible and Efficient Framework for Probabilistic Numerical Simulation and Inference".
Advisor: Philipp Hennig.

Technical University of Munich **Munich, Germany**
M.Sc. Data Engineering and Analytics *2018/04 – 2019/10*
Passed with Distinction. German Grade 1.3, American GPA 3.7
Master thesis: "Learning Gaussian Process Dynamics Models from Visual Observations for Control".

Technical University of Munich **Munich, Germany**
M.Sc. Mathematics *2016/10 – 2018/10*
Passed with High Distinction. German Grade 1.2, American GPA 3.8.
Master thesis: "Evolutionary Games for Global Function Minimization".

Technical University of Munich **Munich, Germany**
B.Sc. Mathematics *2012/10 – 2016/06*
Passed with Distinction. German Grade 1.8, American GPA 3.2.
Bachelor thesis: "Different Noise Models in Variable Density Compressed Sensing".

Landesgymnasium für Hochbegabte **Schwäbisch Gmünd, Germany**
Abitur *2007/09 – 2012/06*
German Grade 1.4, American GPA 3.6.

Publications

NB, Oleksandr Shchur, Nick Erickson, Michael Bohlke-Schneider, and Ali Caner Turkmen. *"Multi-layer Stack Ensembles for Time Series Forecasting"*. International Conference on Automated Machine Learning, **AutoML**, 2025.

Ori Press et al. *"AlgoTune: Can Language Models Speed Up General-Purpose Numerical Programs?"* Conference on Neural Information Processing Systems, **NeurIPS**, 2025.

Dingling Yao, Filip Tronarp, and NB. *"Propagating Model Uncertainty through Filtering-based Probabilistic Numerical ODE Solvers"*. International Conference on Probabilistic Numerics, **ProbNum**, 2025.

Jonas Beck, NB, Michael Deistler, Kyra L. Kadhim, Jakob H. Macke, Philipp Hennig, and Philipp Berens. *"Diffusion Tempering Improves Parameter Estimation with Probabilistic Integrators for Ordinary Differential Equations"*. International Conference on Machine Learning, **ICML**, 2024.

Amon Lahr, Filip Tronarp, NB, Jonathan Schmidt, Philipp Hennig, and Melanie N. Zeilinger. *"Probabilistic ODE Solvers for Integration Error-aware Numerical Optimal Control"*. Learning for Dynamics & Control Conference, **L4DC**, 2024.

NB. *"ProbNumDiffEq.jl: Probabilistic Numerical Solvers for Ordinary Differential Equations in Julia"*. Journal of Open Source Software, **JOSS**, 2024.

NB, Adrien Corenflos, Fatemeh Yaghoobi, Filip Tronarp, Philipp Hennig, and Simo Särkkä. *"Parallel-in-Time Probabilistic Numerical ODE Solvers"*. Journal of Machine Learning Research, **JMLR**, 2024.

NB, Philipp Hennig, and Filip Tronarp. *"Probabilistic Exponential Integrators"*. Conference on Neural Information Processing Systems, **NeurIPS**, 2023.

Nicholas Krämer*, NB*, Jonathan Schmidt*, and Philipp Hennig. *"Probabilistic ODE Solutions in Millions of Dimensions"*. International Conference on Machine Learning, **ICML**, 2022.

NB, Filip Tronarp, and Philipp Hennig. *"Pick-and-Mix Information Operators for Probabilistic ODE Solvers"*. International Conference on Artificial Intelligence and Statistics, **AISTATS**, 2022.

Filip Tronarp*, NB*, and Philipp Hennig. *"Fenrir: Physics-Enhanced Regression for Initial Value Problems"*. International Conference on Machine Learning, **ICML**, 2022.

NB, Philipp Hennig, and Filip Tronarp. *"Calibrated Adaptive Probabilistic ODE Solvers"*. International Conference on Artificial Intelligence and Statistics, **AISTATS**, 2021.

NB*, Jan Achterhold*, Laura Leal-Taixé, and Jörg Stückler. *"Planning from Images with Deep Latent Gaussian Process Dynamics"*. Learning for Dynamics & Control Conference, **L4DC**, 2020.

Preprints

Joanna Sliwa, Frank Schneider, NB, Agustinus Kristiadi, and Philipp Hennig. *"Efficient Weight-Space Laplace-Gaussian Filtering and Smoothing for Sequential Deep Learning"*. arXiv, 2024.

* indicates equal contribution.

Software

`ProbNumDiffEq.jl`

Maintainer

Probabilistic Numerical Differential Equation solvers via Bayesian filtering and smoothing in Julia; compatible with the popular DifferentialEquations.jl / SciML ecosystem. Package presented at the JuliaCon 2024 in Eindhoven.

`TuePlots.jl`

Maintainer

A light-weight library to help create better plots for scientific publications, by taking care of the annoying bits like figure size, font size, and setting the correct font, with minimal overhead.

Teaching Experience

University of Tübingen **Tübingen, Germany**
Teaching assistant / Co-lecturer: "Probabilistic Machine Learning" *2023*
Course mainly taught by Philipp Hennig. In addition to the regular teaching assistant duties, I gave one full M.Sc.-level lecture on "Hidden Markov Models".

University of Tübingen **Tübingen, Germany**
Co-lecturer: "Numerics of Machine Learning" *2022 / 2023*
Gave two full M.Sc.-level lectures on "Ordinary Differential Equations" and "Probabilistic Numerical ODE Solvers", as part of a course taught by Philipp Hennig and multiple other PhD students from the Methods of Machine Learning group. This also included preparing and grading homework assignments.

Uppsala University **Uppsala, Sweden**
Guest lecturer: "Probabilistic Numerics for Ordinary Differential Equations" *2022*
Gave a single guest lecture as a part of a seminar on "A computational introduction to stochastic differential equations", organized and taught by Zheng Zhao.

University of Tübingen **Tübingen, Germany**
Teaching assistant: "Data Literacy" *2021 / 2022*
Course taught by Philipp Hennig.

University of Tübingen **Tübingen, Germany**
Seminar: "Machine learning for and with dynamical systems" *2021*
Jointly organized with Nicholas Krämer and Philipp Hennig.

University of Tübingen **Tübingen, Germany**
Teaching assistant: "Time Series" *2020 / 2021*
Course taught by Filip Tronarp.

Technical University of Munich **Munich, Germany**
Teaching assistant: "Principles of Mathematics 2" *2017*
Mathematics course, aimed at B.Sc. Engineering Science students.

abiturma GbR **Munich and Stuttgart, Germany**
Course instructor *2016 & 2017*
Intensive five-day preparation course for the german Abitur in mathematics.

Supervision

Fabrice van der Lehr, Master's thesis 2024
"Bayesian Filtering for Black Box Simulators"; co-supervised with Tobias Weber.

Sofiya Garkot, Essay rotation 2023 / 2024
"Exploring Probabilistic Solvers for Hodgkin-Huxley Models"; co-supervised with Jonas Beck.

Thomas Albrecht, Master's thesis 2021 / 2022
"Bayesian Physics-Informed Neural Networks via Laplace Approximations".

Felix Böhm, Bachelor's thesis 2021 / 2022
"Inferring ODE Parametric Latent Forces via Neural ODEs".

Dingling Yao, Master's thesis 2021
"Uncertainty Propagation in Probabilistic Ordinary Differential Equation Solvers"; co-supervised with Filip Tronarp.

Joanna Sliwa, Essay rotation 2021
"Physics-Informed Neural Networks"; co-supervised with Nicholas Krämer.

Invited talks

Probabilistic Numerics Workshop (ProbNum24) **London, United Kingdom**
Talk: "Robust Parameter Inference in ODEs via Physics-Enhanced Gaussian Process Regression" *2024/07*

Probabilistic Numerics Spring School **Southampton, United Kingdom**
Practical session: "Probabilistic Numerics for ODEs" *2024/04*

International Conference on Scientific Computing and Machine Learning **Kyoto, Japan**
Talk: "Probabilistic Numerical Solvers for Differential Equations" *2024/03*

SIAM Conference on Uncertainty Quantification **Trieste, Italy**
Talk: "Probabilistic Numerics for Ordinary Differential Equations" *2024/02*

Statistics PhD seminar, University of Edinburgh **Edinburgh, United Kingdom (virtual)**
Talk: "Probabilistic Numerics for Ordinary Differential Equations" *2023/05*

Probabilistic Numerics Spring School **Tübingen, Germany**
Practical session: "Probabilistic Numerics for ODEs" *2023/03*

Institute for Dynamic Systems and Control, ETH Zurich **Zurich, Switzerland**
Talk: "ODE Solvers as Gauss–Markov Regression" *2023/01*

Sensor informatics and medical technology group, Aalto University **Aalto, Finnland**
Talk: "Solving Differential Equations with Bayesian Filtering and Smoothing" *2022/05*

Dagstuhl Seminar on Probabilistic Numerical Methods **Wadern, Germany**
Talk: "ProbNumDiffEq.jl: Fast and Practical ODE Filters in Julia" *2021/10*

Review services

International Conference on Machine Learning (ICML)	2022, 2023, 2024
Conference on Neural Information Processing Systems (NeurIPS)	2021, 2022, 2023
International Conference on Artificial Intelligence and Statistics (AISTATS)	2021, 2022, 2023, 2024
Transactions on Machine Learning Research (TMLR)	2022 – 2023
International Conference on Probabilistic Numerics (ProbNum)	2025
AI4DifferentialEquations in Science (ICLR workshop)	2024

Technical skills

Working knowledge: Julia, Python, jax, NumPy/SciPy, PyTorch, git/GitHub, LaTeX, Unix, GNU Emacs.
Basic knowledge: C/C++, SLURM, MATLAB, R, SQL.

Language skills

German: Native speaker
French: Near native
English: Fluent
Spanish: Good working knowledge
Russian: Basic communication skills

Scholarships

Leadership Talent Academy 2025
Selected participant in the University of Tübingen's Leadership Talent Academy, a 3-month program of intensive weekend modules and coaching sessions focused on developing leadership skills and personal growth.

German Academic Scholarship Foundation 2013 – 2019
Recipient of the German Academic Scholarship Foundation, providing financial and academic support to selected students.

Siemens Mentoring Program 2017 – 2018
Selected participant in the Siemens Mentoring Program, pairing students with Siemens professionals for career development and mentorship.