# Torben Berndt

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## Education

**Heidelberg Institute for Theoretical Studies** Oct 2024 – Present
*PhD Candidate and Researcher in Machine Learning* *Heidelberg, Germany*

- Research Interests: Geometric Deep Learning, (Approximate) Equivariance
- Supervisor: Jun.-Prof. Jan Stühmer (MLI Group)

**Exeter College, University of Oxford** Oct 2023 – June 2024
*MSc Mathematical Sciences* *Oxford, UK*

- Grade: Distinction (Average: 75.0, ranked 7th out of 59 students)
- Modules: *Geometric Deep Learning, Graph Representation Learning, Theories of Deep Learning, Advanced Topics in Statistical Machine Learning, Computational Algebraic Topology*

**University of Warwick** Oct 2020 – July 2023
*BSc Mathematics* *Coventry, UK*

- Grade: First Class Honours (Average: 89.3, ranked in top 5 out of 200+ students)
- Winner of Warwick Data Science Hackathon 2023

## Publications & Theses

**Universal Time Series Generation with Neural Controlled Differential Equations** ArXiv Preprint
**T. Berndt***, E Farjallah*, L. Seute, R. Saqur, B. Walker†, J. Stühmer†

- Formulate flow matching on path space using maximally expressive Structured Linear CDE backbones.
- Show that pathwise expressivity implies universality for continuous causal pushforwards of compactly supported latent path laws, linking discriminative expressivity of causal path-to-path models to generative capabilities.
- Instatiate theory introducing G-SLiCEs and show they are state-of-the-art on probabilistic forecasting benchmarks.

**Approximate Equivariance via Projection-Based Regularisation** ICML 2026
**T. Berndt**, J. Stühmer

- Proposed a theoretically-grounded approach to regularise general machine learning models towards exact equivariance.
- Utilised orthogonal decomposition of functions to penalise non-equivariance on an operator level over the whole group orbit.
- Demonstrated efficient calculation of closed-form projections for continuous groups such as $SO(n)$.

**Permutation Equivariant Neural Controlled Differential Equations for Dynamic Graph Representation Learning** NeurIPS 2025
**T. Berndt**, B. Walker, T. Qin, J. Stühmer, A. Kormilitzin

- Developed PENG-CDEs to model complex dynamic graph data with significant parameter reduction.
- Proved equivariance under both time reparametrisations and permutations of the node set.
- Demonstrated improved performance over Graph Neural CDE baselines in both simulated and real-world tasks.

## Teaching Experience

**Karlsruhe Institute of Technology** Sep 2025 – Present
*Lead Instructor – Geometric Deep Learning* *Heidelberg, Germany*

- Conceptualized and created comprehensive exercise sheets to deepen understanding and supplement lectures.
- Held tutorials and supervised practical sessions for a cohort of roughly 30 students.

## Invited and Contribute Talks

**Permutation Equivariant Graph Neural Controlled Differential Equations for Dynamic Graph Representation Learning** June 2026
*Networks Seminar, Mathematical Institute* *Oxford, UK*

**Approximate Equivariance via Projection-based Regularisation** May 2026
*SIMPLAIX Workshop on Machine Learning for Multiscale Molecular Modeling* *Heidelberg, Germany*

**Permutation Equivariance in Graph Neural Controlled Differential Equations** April 2026
*Rough Path Interest Group Seminar, Alan Turing Institute* *London, UK (virtual)*

**Approximate Equivariance via Projection-based Regularisation** February 2026
*Modern Numerics for Theoretical Physics Seminar, Heidelberg University* *Heidelberg, Germany*

## Professional Experience

**Ventus Technologies GmbH** Jul 2024 – Aug 2024
*Research Intern* *Stuttgart, Germany*

- Developed MVP implementation for a precipitation nowcasting pipeline based on Google's MetNet 2.
- Designed data-loading and processing pipelines for handling multimodal data from various meteorological sources.

**Ventus Technologies GmbH** Jun 2023 – Aug 2023
*Research Intern* *Stuttgart, Germany*

- Designed and implemented a physics-inspired GRU-based model for solar irradiance forecasting using PyTorch.
- Attained model performance aligning with current research standards in the field.

**VICO Research & Consulting Ltd.** Jul 2022 – Sep 2022
*Data Engineer Intern* *Echterdingen, Germany*

- Developed and maintained parsers and web crawlers to collect social media data using Python and Java.
- Built pipelines to process and enhance collected data for market research.

**Christian Mission Service** Sep 2019 – Mar 2020
*Voluntary Social Worker* *Naic, Philippines*

- Worked in a children's village for financially disadvantaged children as a guardian and house father.