

Philipp Becker

PH.D. STUDENT FOCUSING ON REPRESENTATION AND MODEL-LEARNING FOR RL AND BEYOND

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Education

Ph.D. in Computer Science, Machine Learning

Karlsruhe

KARLSRUHE INSTITUTE OF TECHNOLOGY, AUTONOMOUS LEARNING ROBOTS - ADVISOR: PROF. GERHARD NEUMANN

01/2020 - 06/2025 (Expected)

- **World modeling** and representation learning for **reinforcement learning** from **multimodal observations**
- Uncertainty in deep **state space models** for model-based reinforcement learning and **Bayesian methods**
- Combining recurrent neural networks and Kalman filters for **uncertainty modeling** in sequential data
- **Variational inference** for time-series, meta-learning, and reinforcement learning

Master of Science in Autonomous Systems (Computer Science)

Darmstadt, Germany

TECHNICAL UNIVERSITY DARMSTADT, WITH DISTINCTION

11/2016 - 04/2019

- Thesis: Expected Information Maximization: Using the I-Projection for Mixture Density Estimation

Bachelor of Science in Computer Science

Darmstadt, Germany

TECHNICAL UNIVERSITY DARMSTADT

04/2014 - 10/2016

- Thesis: Learning Deep Feature Spaces for Nonparametric Inference

Summer Schools

- Nordic Probabilistic AI School, Trondheim, Norway, June 2023
- Machine Learning Summer School, Virtual (Tübingen, Germany), July 2020

Experience

Doctoral Researcher

Karlsruhe, Germany

KARLSRUHE INSTITUTE OF TECHNOLOGY, AUTONOMOUS LEARNING ROBOTS

01/2020 - Present

- Supervision of **25+ student** theses and projects. Selection:
 - Investigating the Amortization Gap in Variational Inference for State Space Models (M.Sc.)
 - Multimodal Transformer for Zero-Shot Optimization of Robot Manipulation Tasks Across Environments (M.Sc.)
 - Improving the Soft Actor-Critic with Information Theoretic Trust Regions (M.Sc.)
 - Deep Reinforcement Learning under Partial Observability using Kalman Filtering (M.Sc.)
- Head **teaching assistant** over 6 semesters for the lecture "Machine Learning - Foundations and Algorithms"
- Guest **lectures on model-based reinforcement learning** at KIT
- Setup and administration of **IT infrastructure**, including Slurm-based HPC

Research Scientist

Karlsruhe, Germany

FZI RESEARCH CENTER FOR INFORMATION TECHNOLOGY, (FZI FORSCHUNGSZENTRUM INFORMATIK)

04/2023 - 07/2024

- Establishing a **new research group** under the direction of Prof. Gerhard Neumann
- **Grant writing** for European and German national research calls with **academic** and **industrial** partners.
- Structured reinforcement learning for control applications of an **industrial customer**.

Doctoral Researcher

Tübingen, Germany

BOSCH CENTER FOR ARTIFICIAL INTELLIGENCE, ROBERT-BOSCH-GMBH

05/2019-12/2019

- Research on versatile imitation learning
- Followed advisor to KIT after 8 months

Student Research Assistant

Darmstadt, Germany

TECHNISCHE UNIVERSITÄT DARMSTADT, INTELLIGENT AUTONOMOUS SYSTEMS

04/2016 - 04/2019

- Various **manipulation robotics** projects on **real robots** and in simulation

Internship

Munich, Germany

VOLKSWAGEN GROUP, DATA LAB

09/2017

- **Deep Learning and Robotics Challenge:** Sorting Lego bricks using a Lego robot controlled by deep learning

Publications (Selected)

MuTT: A Multimodal Trajectory Transformer for Robot Skills	<i>IROS</i>
KIENLE C., ALT B., CELIK O., BECKER P. , KATIC D., JÄKEL R., NEUMANN G.	2024
KalMamba: Towards Efficient Probabilistic State Space Models for RL under Uncertainty	<i>Workshop, ICML</i>
BECKER, P. , FREYMUTH N., NEUMANN, G.	2024
Iterative Sizing Field Prediction for Adaptive Mesh Generation From Expert Demonstrations	<i>Workshop, ICML</i>
FREYMUTH N., DAHLINGER P., WÜRTH T., BECKER P. , TARANOVIC A., GRÖNHEIM O., KÄRGER L., NEUMANN G.	2024
Combining Reconstruction and Contrastive Methods for Multimodal Representations in RL	<i>RLC</i>
BECKER, P. , MOSSBURGER, S., OTTO, F., NEUMANN, G.	2024
PointPatchRL - Masked Reconstruction Improves Reinforcement Learning on Point Clouds	<i>Under Review</i>
GYENES, B., FRANKE, N., BECKER, P. , NEUMANN G.	2024
Vlearn: Off-Policy Learning with Efficient State-Value Function Estimation	<i>Under Review</i>
OTTO, F., BECKER, P. , ANH NGO, V., NEUMANN, G.	2024
Beyond Deep Ensembles: A Large-Scale Evaluation of Bayesian Deep Learning under Distribution Shift	<i>NeurIPS</i>
SELIGMANN, F., BECKER, P. , VOLPP, M., NEUMANN, G.	2023
Accurate Bayesian Meta-Learning by Accurate Task Posterior Inference	<i>ICLR</i>
VOLPP, M., DAHLINGER, P., BECKER, P. , DANIEL, C., NEUMANN, G.	2023
On Uncertainty in Deep State Space Models for Model-Based Reinforcement Learning	<i>TMLR</i>
BECKER, P. , NEUMANN, G.	2022
Inferring Versatile Behavior from Demonstrations by Matching Geometric Descriptors	<i>CoRL</i>
FREYMUTH, N., SCHREIBER, N., BECKER, P. , TARANOVIC, A., NEUMANN, G.	2022
Hidden Parameter Recurrent State Space Models For Changing Dynamics Scenarios	<i>ICLR</i>
SHAJ, V., BÜCHLER, D., SONKER, R., BECKER, P. , NEUMANN, G.	2022
Specializing Versatile Skill Libraries using Local Mixture of Experts	<i>CoRL</i>
CELIK, O., ZHOU, D., LI, G., BECKER, P. , NEUMANN, G.	2021
Differentiable Trust Region Layers for Deep Reinforcement Learning	<i>ICLR</i>
OTTO, F., BECKER, P. , NGO, A.V., ZIESCHE, H., NEUMANN, G.	2021
Action-Conditional Recurrent Kalman Networks For Forward and Inverse Dynamics Learning	<i>CoRL</i>
SHAJ, V., BECKER, P. , BUCHLER, D., PANDYA, H., VAN DUIJKEREN, N., TAYLOR, J., HANHEIDE M., NEUMANN, G.	2020
Expected Information Maximization: Using the I-Projection for Mixture Density Estimation	<i>ICLR</i>
BECKER, P. , ARENZ, O., NEUMANN, G.	2020
Recurrent Kalman Networks: Factorized Inference in High-Dimensional Deep Feature Spaces	<i>ICML</i>
BECKER, P. , PANDYA, H., GEBHARDT, G., ZHAO, C., TAYLOR, J., NEUMANN, G.	2019

Reviewing

Machine Learning	NeurIPS, ICML, CoRL, RLC
Robotics	RA-L, IROS, ICRA

Skills

Languages	German (native), English (fluent)
Programming	Python, Java, C++, C, Matlab
ML Libraries	Pytorch, Tensorflow, Numpy, Scipy, Optuna, Hydra, Scikit-Learn, Jax
Tools	Linux, Git, Slurm, \LaTeX , Microsoft Office
Robotics	Mitsubishi PA10, KUKA LBR iiwa, Franka Emika Panda