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 — *2020 - **2025 (March, 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

TECHNISCHE UNIVERSITÄT DARMSTADT, WITH DISTINCTION — *2016 - 2019*

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

Bachelor of Science in Computer Science

Darmstadt, Germany

TECHNISCHE UNIVERSITÄT DARMSTADT — *2014 - 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 — *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) — *2023 - Present*

- 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 — *2019*

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

Student Research Assistant

Darmstadt, Germany

TECHNISCHE UNIVERSITÄT DARMSTADT, INTELLIGENT AUTONOMOUS SYSTEMS — *2016 - 2019*

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

Internship

Munich, Germany

VOLKSWAGEN GROUP, DATA LAB — *2017*

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

Publications (Selected)

Combining Reconstruction and Contrastive Methods for Multimodal Representations in RL *RLC*

Becker, P. , Markgraf, S., Otto, F., Neumann, G. *2024*

PointPatchRL - Masked Reconstruction Improves Reinforcement Learning on Point Clouds *Under Review*

Gyenes, B., Franke, N., **Becker, P.**, Neumann G. *2024*

Vlearn: Off-Policy Learning with Efficient State-Value Function Estimation *Under Review*

Otto, F., **Becker, P.**, Anh Ngo, V., Neumann, G. *2024*

Beyond Deep Ensembles: A Large-Scale Evaluation of Bayesian Deep Learning under Distribution Shift *NeurIPS*

Seligmann, F., **Becker, P.**, Volpp, M., Neumann, G. *2023*

Information-Theoretic Trust Regions for Stochastic Gradient-Based Optimization *Workshop, NeurIPS*

Dahlinger, P., **Becker, P.**, Hüttenrauch, M., Neumann, G. *2023*

Accurate Bayesian Meta-Learning by Accurate Task Posterior Inference *ICLR*

Volpp, M., Dahlinger, P., **Becker, P.**, Daniel, C., Neumann, G. *2023*

On Uncertainty in Deep State Space Models for Model-Based Reinforcement Learning *TMLR*

Becker, P., Neumann, G. *2022*

Inferring Versatile Behavior from Demonstrations by Matching Geometric Descriptors *CoRL*

Freymuth, N., Schreiber, N., **Becker, P.**, Taranovic, A., Neumann, G. *2022*

Hidden Parameter Recurrent State Space Models For Changing Dynamics Scenarios *ICLR*

Shaj, V., Büchler, D., Sonker, R., **Becker, P.**, Neumann, G. *2022*

Specializing Versatile Skill Libraries using Local Mixture of Experts *CoRL*

Celik, O., Zhou, D., Li, G., **Becker, P.**, Neumann, G. *2021*

Differentiable Trust Region Layers for Deep Reinforcement Learning *ICLR*

Otto, F., **Becker, P.**, Ngo, A.V., Ziesche, H, Neumann, G. *2021*

Switching Recurrent Kalman Networks *Workshop, NeurIPS*

Nguyen-Quynh, G., **Becker, P.**, Qiu, C., Rudolph, M., Neumann, G. *2021*

Action-Conditional Recurrent Kalman Networks For Forward and Inverse Dynamics Learning *CoRL*

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 *ICLR*

Becker, P., Arenz, O., Neumann, G. *2020*

Recurrent Kalman Networks: Factorized Inference in High-Dimensional Deep Feature Spaces *ICML*

Becker, P., Pandya, H., Gebhardt, G., Zhao, C., Taylor, J., Neumann, G. *2019*

Reviewing

Machine Learning

- Conference on Neural Information Processing Systems (NeurIPS)
- International Conference on Machine Learning (ICML)
- Conference on Robot Learning (CoRL)
- Reinforcement Learning Conference (RLC)

Robotics

- IEEE Robotics and Automation Letters (RA-L)
- International Conference on Intelligent Robots and Systems (IROS)
- International Conference on Robotics and Automation (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