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 - **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

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 *IROS*

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 *Workshop, ICML*

Becker, P., Freymuth N., Neumann, G. *2024*

Iterative Sizing Field Prediction for Adaptive Mesh Generation From Expert Demonstrations *Workshop, ICML*

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 *RLC*

Becker, P. , Mossburger, 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*

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*

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 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