Christopher **Diehl**

Doctoral Candidate · Fast Learner · Machine Learning for Behavior Prediction and Planning · Seven Years of Research Experience for Autonomous Vehicles

Dortmund, Germany

christopher.diehl@tu-dortmund.de | christopher-diehl- | Christopher Diehl | Personal Website

Experience

Institute of Control Theory and Systems Engineering, TU Dortmund University — *Dortmund, Germany*

Research Assistant and Doctoral Candidate — *Oct. 2019 - Present*

- Innovated research in offline reinforcement learning (RL) within multi-agent environments [4, 11] and the integration of nonlinear safety constraints in imitation learning (IL) approaches [5]. Developed the first uncertainty-aware offline RL approach for autonomous driving in dense traffic, which earned a Best Paper Award (NeurIPS ML4AD W.) and outperformed various offline RL and IL approaches.
- Developed a differentiable game-theoretic motion planner [2, 3] running parallel joint optimizations on the GPU, integrated into different state-of-the-art neural network architectures for behavior prediction. Resulted in a 15% improvement over various baselines in joint distance-based metrics using the Waymo Open Motion Dataset.
- Spearheaded the development of deep learning-based behavior prediction methods in a joint project with industry partners (e.g., ZF Group) and using industry-scale datasets (200,000 km).
- Developed a novel motion planning and control stack [8, 12] for an automated valet parking project, which was continually tested in the real-world vehicle of an industry partner. Used ML to identify the vehicle dynamics, reducing prediction errors by 62% - 77% and improving control performance.

Hella Aglaia Mobile Vision GmbH (Department acquired by Volkswagen's CARIAD SE) — *Berlin, Germany*

Perception Research Intern and Master Thesis — *Jan. 2019 - Jul. 2019*

- Developed a multi sensor fusion algorithm for multi-object detection, tracking and grid mapping [14].
- Achieved the best possible grade of 1.0[1] and received recognition for outstanding performance without additional training period and prior knowledge.

Institute of Control Theory and Systems Engineering, TU Dortmund University — *Dortmund, Germany*

Student Research Assistant — *Apr. 2017 - Sep. 2018*

- Developed a interaction-aware motion game-theoretic planning algorithm (project in corporation with ZF Group).
- Applied deep learning algorithms for AV perception and behavior prediction.

Bertrandt Group — *Cologne, Germany*

Simulation Software Engineering Intern — *Mar. 2016 - Jun. 2016*

- Implemented control strategies for a 5-DOF driving simulator.

Education

TU Dortmund University — *Dortmund, Germany*

Doctor of Engineering — *Okt. 2019 - Present*

- Thesis: Learning Interactive Multi-Agent Behavior for Prediction and Decision-Making
- Proven track record of scientific innovations by publishing research work in high-influence journals (e.g., IEEE Robotics and Automation Letters), conferences (e.g., CoRL, IEEE IROS), and workshops (e.g., NeurIPS W., ICML W.).

M.Sc. in Electrical Engineering and IT, Focus: Robotics/ Automotive, Grade: 1.1[1] (Graduated with Distinction) / ECTS: A — *Oct. 2016 - Oct. 2019*

- Master thesis in cooperation with HELLA Aglaia Mobile Vision GmbH (now CARIAD SE) focused on environment perception.
- Successfully completed multiple motion planning projects using imitation learning and model predictive control with evaluation on real-world robots (mobile robots, manipulation).
- Relevant Coursework: Learning for Robotics, Mobile Robots, Networked Mobile Robots, Data-based Modeling, 3D Computer Vision, Optimal Control.

B.Sc. in Electrical Engineering and IT, Grade: 2.4[1] (good) / ECTS: B — *Oct. 2013 - Oct. 2016*

- Bachelor thesis focused on sampling-based motion planning for automated vehicles.

Skills

Programming Languages	Python, C++, MATLAB
Tools/Libraries	PyTorch, Theseus, Weights&Biases, Einops, NumPy, Git, Matplotlib, Tensorboard, OpenCV, LaTeX, ROS, Obsidian
Theoretical Knowledge	Reinforcement Learning, Learning from Demonstrations, Generative Models (EBM, VAE, GAN), Deep Learning, Differentiable Optimization, Computer Vision, Optimal Control, Game Theory
Languages	German (Native), English (Full professional proficiency)

Honors & Awards

2022	**Young-Author Award 2022**, VDI expert committee 5.14 Computational Intelligence	*Berlin, Germany*
2021	**Best Paper Award**, Neural Information Processing Systems, Machine Learning for Autonomous Driving Workshop (NeurIPS ML4AD)	*Virtual Conference*
2019	**Master Graduation with Distinction**, TU Dortmund University	*Dortmund, Germany*
2013-2017	***Deutschlandstipendium* of the Wilo-Foundation**, TU Dortmund University	*Dortmund, Germany*
2013	**Award for Outstanding Results in Physics**, German Physics Association	*Dortmund, Germany*

[1] Passing grades in Germany range from 1 (best) to 4.

Invited Talks & Services

Invited Talks: Wayve Technologies Ltd (Jul. 2022), Zeta Alpha (Jan. 2022), Dortmunder Vehicle Day (Sep. 2020/2022/2023)
Review Services: NeurIPS W., ICML W., IEEE RA-L, IEEE ICRA, IEEE IROS, IEEE IV, IEEE ITSC, IEEE T-ITS, IEEE T-IV, IEEE AIM
Program Committee: NeurIPS W. ML4AD (2022), ML4AD Symposium co-located to NeurIPS (2023)

Teaching Experience and Student Monitoring

Teaching Experience Gave lectures and supervised classes in Learning for Robotics, Optimal Control, Environment Perception, Motion Planning, and Data-Driven Decision-Making.
Student Monitoring Supervised the thesis and research projects of 26 students.

References

[1] C. Diehl, T. Bertram: ”INIT-ME: Initialization Strategies for Energy-based Multi-Agent Motion Forecasting”, 2023 (In Preparation)

[2] C. Diehl, T. Klosek, M. Krüger, N. Murzyn, T. Osterburg, T. Bertram: ”Energy-based Potential Games for Joint Motion Forecasting and Control”, *Conference on Robot Learning (CoRL)*, 2023

[3] C. Diehl, T. Klosek, M. Krüger, N. Murzyn, T. Bertram: ”On a Connection between Differential Games, Optimal Control, and Energy-based Models for Multi-Agent Interactions”, *International Conference on Machine Learning (ICML) F4LCD Workshop*, 2023

[4] C. Diehl, T. Sievernich, M. Krüger, F. Hoffmann, T. Bertram: ”Uncertainty-Aware Model-Based Offline Reinforcement Learning for Automated Driving”, *IEEE Robotics and Automation Letters (RA-L) / International Conference on Intelligent Robots and Systems (IROS)*, 2023

[5] C. Diehl, J. Adamek, M. Krüger, F. Hoffmann, T. Bertram: ”Differentiable Constrained Imitation Learning for Robot Motion Planning and Control”, *IEEE International Conference on Intelligent Robots and Systems Workshop (IROS)*, 2023

[6] T. Osterburg, C. Diehl, M. Krüger, F. Hoffmann, T. Bertram: ”Social Behavior Prediction for Automated Vehicles Using Contrastive Learning”, *International Federation for the Promotion of Mechanism and Machine Science (IFToMM D-A-CH)*, 2023

[7] M. Krüger, P. Palmer, C. Diehl, T. Osterburg, T. Bertram: ”Recognition Beyond Perception: Environmental Model Completion by Reasoning for Occluded Vehicles”, *IEEE Robotics and Automation Letters (RA-L)*, 2022.

[8] C. Diehl, A. Makarow, C. Rösmann, T. Bertram: ”Time-Optimal Nonlinear Model Predictive Control for Radar-based Automated Parking”, *IFAC Symposium on Intelligent Autonomous Vehicles (IAV)*, 2022

[9] C. Diehl, T. Osterburg, N. Murzyn, G. Schneider, F. Hoffmann, T. Bertram: ”Conditional Behavior Prediction for Automated Driving on Highways”, *Proc. 32. Workshop Computational Intelligence*, 2022

[10] A. S. Novo, M. Stolpe, C. Diehl, T. Osterburg, T. Bertram, V. Parsi, N. Murzyn, F. Mualla, G. Schneider, P. Töws: ”Mid-term status report on KISSaF: AI-based Situation Interpretation for Automated Driving”, *Automotive meets Electronics*, 2022

[11] C. Diehl, T. Sievernich, M. Krüger, F. Hoffmann, T. Bertram: ”Uncertainty-Aware Model-Based Offline Reinforcement Learning Leveraging Planning”, *Neural Information Processing Systems (NeurIPS) ML4AD Workshop*, 2021

[12] C. Diehl, N. Stannartz, T. Bertram: ”Navigation with Uncertain Map Data for Automated Vehicles”, *Automated Driving*, 2021

[13] C. Diehl, T. Waldeyer, F. Hoffmann, T. Bertram: ”VectorRL: Interpretable Graph-based Reinforcement Learning for Automated Driving”, *Proc. 31. Workshop Computational Intelligence*, 2021

[14] C. Diehl, E. Feicho, A. Schwambach, T. Dammeier, E. Mares, T. Bertram: ”Radar-based Dynamic Occupancy Grid Mapping and Object Detection”, *IEEE International Conference on Intelligent Transportation Systems (ITSC)*, 2020