

## Experience

### Research Assistant and Doctoral Candidate

*Dortmund, Germany*

INSTITUTE OF CONTROL THEORY AND SYSTEMS ENGINEERING, TU DORTMUND UNIVERSITY

*Oct. 2019 - Present*

- **Planning with World Models:** Innovated a model-based offline reinforcement learning (RL) approach for autonomous driving in dense traffic [4, 11]. The method plans with a learned world model and earned a Best Paper Award. It outperformed various offline RL and IL baselines using the CARLA simulator and a real-world driving dataset, surpassing the success rate of the strongest baseline by up to 15%.
- **Multi-Agent Reward Learning:** Developed a differentiable multi-agent motion planner [2, 3] running parallel joint optimizations on the GPU. Integration into different state-of-the-art neural network architectures allowed multi-agent reward learning. Resulted in a 10% - 74% improvement in standard distance-based joint metrics for behavior prediction compared to various baselines across multiple driving datasets (e.g., Waymo Open Dataset).
- **Behavior Prediction:** Spearheaded the development of behavior prediction methods using deep imitation learning in a joint project with several partners (e.g., ZF Friedrichshafen AG) and using in-house industry-scale datasets (200,000 km). Innovated an approach for the integrating safety constraints in imitation learning (IL) [5].
- **Motion Planning and Control:** 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 vehicle dynamics, reducing prediction errors by 62% - 77% and improving control performance.

### Research Intern and Master Thesis (Perception)

*Berlin, Germany*

HELLA AG/IA MOBILE VISION GMBH (DEPARTMENT ACQUIRED BY VOLKSWAGEN'S CARIAD SE)

*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<sup>1</sup> and received recognition for outstanding performance without additional training period and prior knowledge.

### Student Research Assistant

*Dortmund, Germany*

INSTITUTE OF CONTROL THEORY AND SYSTEMS ENGINEERING, TU DORTMUND UNIVERSITY

*Apr. 2017 - Sep. 2018*

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

### Software Engineering Intern (Simulation)

*Cologne, Germany*

BERTRANDT AG

*Mar. 2016 - Jun. 2016*

- Implemented control algorithms 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 Control
- 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<sup>1</sup> (GRADUATED WITH DISTINCTION) / ECTS: A*Oct. 2016 - Oct. 2019*

- Successfully completed multiple motion planning projects using imitation learning and model predictive control with evaluation using 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<sup>1</sup> (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, Weights&amp;Biases, Theseus, Einops, NumPy, Git, Matplotlib, Tensorboard, OpenCV, ROS, Obsidian, Linux

### Theoretical Knowledge

Reinforcement Learning, Learning from Demonstrations, Generative Models, Deep Learning, Differentiable Optimization, Computer Vision, Optimal Control, Game Theory

### Languages

German (Native), English (Full professional proficiency)

## Honors & Awards

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

<sup>1</sup>Passing grades in Germany range from 1 (best) to 4.

## Invited Talks & Services

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

## Teaching Experience & Student Monitoring

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**Teaching Experience** Gave lectures and supervised classes in Learning for Robotics, Optimal Control, 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**, 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