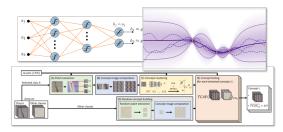# Safe Reinforcement Learning and Learning-based Control for Autonomous Vehicles and Machines

Open PhD and PostDoc Positions at RWTH Aachen University (Prof. Sebastian Trimpe)

The Institute for Data Science in Mechanical Engineering (DSME) at RWTH Aachen University is looking for outstanding and highly motivated PhD and Postdoctoral researchers in **machine learning** and **control**. The fully funded positions are to be filled **as soon as possible** and with employment contract according to the rules of RWTH Aachen University. A core goal of DSME in general, and theses projects in particular, is to develop novel machine learning algorithms for the control of real-world machines. A special focus is on methods and architectures for learning with safety guarantees, including safe reinforcement learning and explainable AI. The developed methods shall be published at top-tier international conferences of the respective fields. At the same time, results will be implemented on real engineering systems, possibly in collaboration with industry partners.

Machine learning and autonomous systems (photos/graphics: own, left: ZF)

About the project(s): We currently have openings in different projects at DSME. The level (PhD or Postdoc) and exact research topic is flexible and will depend on the applicant's background and interest. All projects involve research at the intersection of artificial intelligence (AI) and engineering, and more specifically machine learning and control. All projects combine the development of fundamental methods and theory with real-world impact in engineering applications. Some of the challenges include:

- **Safe Reinforcement Learning** (RL) algorithms with application to autonomous vehicle control. Specifically, we develop new algorithms such as Safe Bayesian Optimization that are guaranteed safe during learning in engineering applications. We seek to demonstrate these algorithms in applications to trajectory control of cars (collaboration with industry partner ZF).
- **Explainable AI** (XAI) and **verification** for learning-based controllers and RL. When used in engineering applications, trust in the control policy obtained from RL or other learning approaches is critical for acceptance and safety. For example, we aim to develop XAI such as concept-based explanation for learned policies.
- Methods for automatic configuration of control and/or AI systems (e.g., **Bayesian optimization**, **Reinforcement learning**, **AutoML**) and transfer learning shall be developed aiming at lowering the effort and hurdles to utilize AI, e.g., in production and other engineering domains.

Within these projects, the PhD/Postdoc researcher will do cutting-edge research on: novel methods and algorithms for machine learning in an engineering context; theoretical understanding and guarantees for these; implementations on real-world engineering systems; and other topics depending on the candidate's interest and aptitude.

Applicants should have a Master's degree in computer science, engineering, mathematics, or related disciplines, with a strong background in machine learning *or* dynamic systems and control. Successful candidates will typically have ranked at or near the top of their classes, have a good mathematical background, excellent analytical skills, relevant computer programming skills, and are proficient in oral and written English.

RWTH Aachen University is internationally renowned as one of the top universities in Germany. The project will be carried out at the DSME, which was newly founded in 2020 and is headed by Prof. Sebastian Trimpe. DSME is a young, highly dynamic, and internationally oriented institute with excellent research opportunities and close ties to several national and international partners (e.g., MPI for Intelligent Systems Tübingen/Stuttgart, ETH Zürich, KTH Stockholm, Mines ParisTech). The working language is English.

Applications should be sent as a PDF file by e-mail to application@dsme.rwth-aachen.de, **preferably until 31.08.22**, and include a research statement (indicating your motivation for a PhD with us, max. 2 pages), a CV, grade transcripts, sample research documents (e.g., publication, thesis), and contact details of at least two references (letters of reference are not requested until possibly a later stage). For **questions**, please do not hesitate to contact Prof. Trimpe at trimpe@dsme.rwth-aachen.de. We look forward to your application.