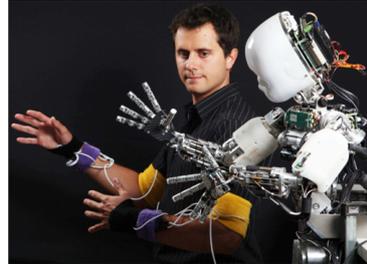
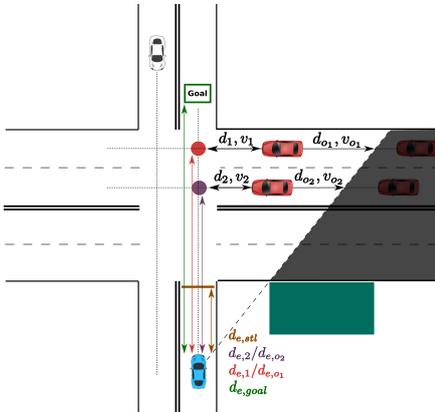


Master Thesis



Combining Demonstrations with Reinforcement Learning for Intelligent Policies in Automated Driving

Reinforcement Learning (RL) is nowadays a famous framework for solving intelligent driving policies for automated vehicles. In our group we have previously used RL to learn high level actions for automated navigation at occluded intersections [1]. We have developed our own simulator in order to train a policy which tries to learn optimal actions for different states at the intersection through multiple interactions with the environment.

One of the main challenges in reinforcement learning is overcoming exploration problem for the agent in order to have more intelligent and close to human policies and prevent sub-optimal solutions. In this thesis we want to tackle this challenge and use demonstrations from realistic datasets or expert policies into the reinforcement learning framework. It can help the agent to explore new experiences which it could not see before and learn to act similar to these experiences that are generated by human. A good reference for this thesis can be found here [2].

The proposed thesis consists of the following parts:

- + Literature research about methods for combining demonstrations with RL like [2]
- + Improve the current RL framework proposed in [1] in order to apply rule-based expert demonstrations into the training process
- + Use realistic human driving datasets like [3] as expert demonstrations in the framework
- + Evaluate the learned policy and compare it with [1]

[1] Danial Kamran *et al.*, "Risk-Aware High-level Decisions for Automated Driving at Occluded Intersections with Reinforcement Learning", IEEE Intelligent Vehicles Symposium, 2020

[2] Ashvin Nair *et al.*, "Overcoming Exploration in Reinforcement Learning with Demonstrations", IEEE International Conference on Robotics and Automation, 2018

[3] <https://interaction-dataset.com/>

I am happy to answer any questions you might have.

Institute of Measurement and Control Systems (MRT)
Prof. Dr.-Ing. Christoph Stiller

Advisor:
Danial Kamran, M.Sc.

Programming language(s)¹:
Python proficient
C++ advanced

Tensorflow Libraries:
Keras/ Pytorch

System, Framework(s):
Linux

Required skills:

- Prior knowledge of machine learning and deep learning algorithms.
- Work on your own

Language(s):
German, English

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Or directly send in your application including your current grades as well as our questionnaire!



¹ **skill levels:**

<i>beginner</i>	< 500 lines of code (LOC)
<i>advanced</i>	500 – 5000 LOC
<i>proficient</i>	> 5000 LOC