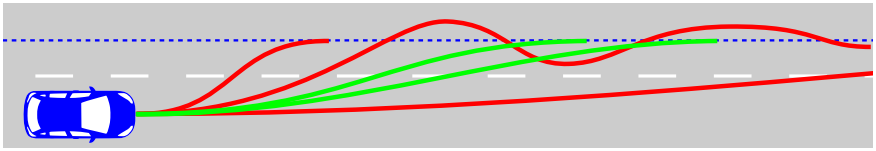
Karlsruhe Institute of Technology

Master Thesis / Bachelor Thesis

Learning Driving Behavior using Inverse Reinforcement Learning from Failures

Inverse reinforcement learning (IRL) tries to learn a cost function from expert demonstrations. Instead of using only near-optimal demonstrations, the expert can also provide failures to make the resulting behavior more specific. In this thesis, prior work [1,2] should be extended to investigate how incorporating failures can be used to learn how to drive optimally.



Examples of two good (green) and three failed (red) trajectories for a lane change

A potential application is to automatically tune the weights in a model-predictive control (MPC) trajectory planner. A difficulty in optimal control is that the cost function often consists of competing objectives. For example, in a lane change there is a trade-off between quickly reaching the target lane but without high lateral jerk and without overshooting and oscillations, as shown in the figure. Labeling undesired behavior as failure allows achieving the desired behavior more easily.

This sounds exciting? Then apply to us! Methods and scope of the thesis can be adapted to your interests and previous knowledge. The proposed thesis consists of the following parts:

+ Literature research about inverse reinforcement learning from failures
+ Designing an MPC control scheme
+ Implementation of IRL methods using failures
+ Generating example trajectories
+ Classification as demonstration or failure
+ Evaluation of the implemented methods

I am happy to answer any questions you might have. Feel free to ask for an appointment or directly ask at my office!

References

[1] Shiarlis, Messias, and Whiteson, “Inverse Reinforcement Learning from Failure”, 2016

[2] Xie et al., “Learning Virtual Grasp with Failed Demonstrations via Bayesian Inverse Reinforcement Learning”, 2019

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

Advisor:
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Programming language(s)[1]:
Python advanced

System, Framework(s):
Linux

Required skills:
- Solid mathematical foundations
- Work on your own

Language(s):
German, English

For more information please contact:

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

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[1] **skill levels:**

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