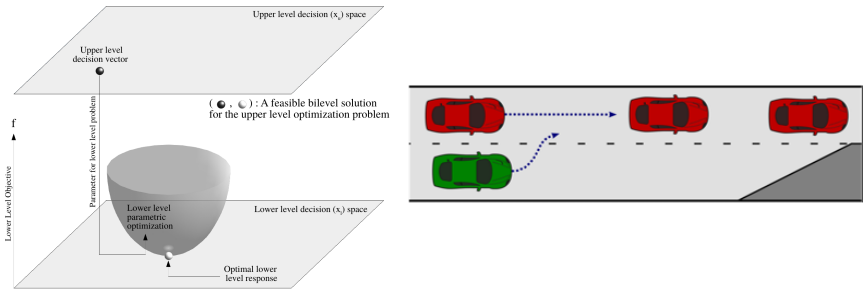
Karlsruhe Institute of Technology

Student Research Assistant (HIWI)

Comparing Different Bi-level Optimization Approaches For Automated Driving

State-of-the-art motion planning techniques for automated vehicles often follow a pipeline approach, meaning that first a prediction of what other traffic participants will do is made, and using these the ego-motion is planned. While this approach is useful in many scenarios it fails in dense traffic.
By separating prediction and planning the interaction between traffic participants is neglected, e.g. how will the other vehicle react to my maneuver? One way to explicitly consider interactions is by modeling the motion planning task in a game-theoretic manner. This formulation leads to a Stackelberg game which can be treated as a bi-level optimization problem.



[1]

The goal of this Hiwi-job is to implement and compare different bi-level approaches to solve cooperative scenarios in automated driving. One scenario of particular interest is a merge in dense traffic, as can be seen in the figure above. Suitable solvers to compare the different methods are already available as a Matlab toolbox [2].

The proposed task consists of the following parts:

+ Literature research about bi-level optimization in the context of automated driving.
+ Implement multiple motion planners for cooperative automated driving using bi-level optimization.
+ Evaluate and compare the implemented methods

[1] A. Sinha, P. Malo, and K. Deb (2020) “A Review on Bilevel Optimization: From Classical to Evolutionary Approaches and Applications,”
[2] BiOpt Toolbox https://biopt.github.io/solvers/

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

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

Advisor:
Christoph Burger, M.Sc.

Programming language(s)[1]:
Matlab or Python — advanced

System, Framework(s):
Linux / Windows

Required skills:
- Prior knowledge of optimization is beneficial
- 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:**
beginner < 500 lines of code (LOC)
advanced 500 – 5000 LOC
proficient > 5000 LOC