Traffic Rule Monitoring for Autonomous Trucks in Highway Traffic

Background

Traffic-rule compliance is crucial for autonomous vehicles to ensure safety for all traffic participants; it is a basic prerequisite for a legal certification. Traffic rules can be formalized using temporal logic to eliminate ambiguity and create a machine-readable format [3]. To evaluate whether a given trajectory of the ego vehicle is compliant with temporal logic specifications, monitoring techniques can be used [1, 4]. As part of this thesis, we want to integrate traffic rule monitoring in an existing autonomous driving framework and assess its usefulness for ensuring traffic rule compliance in motion planning. We specifically consider trucks in highway traffic.

Description

First of all, we want to integrate an existing framework for boolean monitoring of first-order temporal logic specifications into an existing autonomous driving framework. Based on this, we want to achieve the following goals:

- The monitoring should be applied to possibly multiple planned trajectories of the ego vehicle, and, given predictions for the motion of the other traffic participants, compliance with highway traffic rules should be determined for each trajectory.
- The temporal logic specifications of the highway traffic rules should be reviewed and possibly adapted if gaps in the specifications are identified.
- We want to ensure real-time capability of the monitoring. For this, we want to identify performance bottlenecks, and optimize the implementation as well as the underlying concepts if necessary. Possible optimizations include sharing evaluation results of partial formulas and reducing the size of the stored past trajectories to a minimum.
- Instead of only doing boolean monitoring, we want to compute the robustness of the temporal logic specifications to increase the usefulness of the monitoring result. This requires a sensible robustness definition of predicates and their normalization to a common scale [2].
- The monitoring approach should be tested both in simulation and reality.

References

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Traffic Rule Compliance in Autonomous Driving

Programming language:
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Required skills:
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Language:
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