Automatic Labeling of Traffic Scenarios

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Background

For the development and safety validation of autonomous vehicles (AVs), a huge amount of traffic data is necessary. One strategy is scenario-based testing, where the behavior of the AVs is analyzed in short traffic scenarios that require significant control actions. Acquiring and standardizing these scenarios is tedious and time-consuming. For this task, there are solutions to automatically generate traffic scenarios, with one of them being provided by the CommonRoad framework [1].

Description

The scope of this research entails the implementation of a tool capable of automatically labeling traffic scenarios provided by the CommonRoad scenario database[1]. Previously, datasets on the platform had to be labeled manually. The goal is to automate this task, with the aim being to expand the database in a quicker manner. The assignable labels can be dived into infrastructure- and traffic-based labels. While the labeling for the infrastructure-based labels (e.g., road type, presence of certain traffic signs and rules) is already implemented, we will now focus on the traffic-based labels such as traffic jams, traffic rule compliance [2], and criticality [3]. To this end, formalized decision rules and data science approaches may be used to identify the correct labels.

Tasks

The research consists of the following tasks:

- Familiarize yourself with the topic (incl. literature review).
- Describe traffic-based labels and define them formally.
- Propose a solution to solve the research question.
- Implement the proposed solution and summarize its performance on the CommonRoad scenario database.
- Compare to existing solutions, e.g., scenarios labeled in the Scenario Center[2].

References

[1] Matthias Althoff, Markus Koschi, and Stefanie Manzinger. Commonroad: Composable benchmarks for motion planning on roads. In *2017 IEEE Intelligent Vehicles Symposium (IV)*, pages 719–726, 2017.

[2] Luis Gressenbuch and Matthias Althoff. Predictive monitoring of traffic rules. In *2021 IEEE International Intelligent Transportation Systems Conference (ITSC)*, pages 915–922, 2021.

[3] Yuanfei Lin and Matthias Althoff. Commonroad-crime: A toolbox for criticality measures of autonomous vehicles. In *2023 IEEE Intelligent Vehicles Symposium (IV)*, pages 1–8, 2023.

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Research project
Automatic testing of autonomous vehicles

Type
Bachelor's thesis
Guided research
Semester thesis

Research area
Autonomous driving

Programming language
Python

Required skills
High comprehension
Work independently

Language
English

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[1] commonroad.in.tum.de/scenarios
[2] scenario.center