Institute of Automotive Technology
TUM School of Engineering and Design
Technical University of Munich

TUM

Bachelor thesis/Master thesis/Term paper

Identification of challenging Scenarios for the environmental perception of autonomous vehicles

Motivation

Autonomous vehicles (AVs) are confronted with a multitude of challenges in the form of unusual and unforeseeable scenarios, known as edge cases, which can include changing weather conditions, unconventional road layouts, and unanticipated obstacles. Due to the vast number of potential edge cases and their inherent complexity, it is unlikely that all of them can be accounted for during the development of AVs. As a result, it is inevitable that AVs will encounter edge cases during their operation on public roads.

To address edge cases during the operation of AVs, teleoperation can provide a fallback solution by enabling a human operator to remotely control or assist the AV. One viable approach for remote-assistance of AVs is to interact with its perception and interpretation of the surrounding environment. The operator can provide support to the AV by classifying objects, disregarding false-positive detections, or adjusting the predicted behavior of other road users. Given the additional information from the operator, the AV is enabled to continue its mission autonomously. Such teleoperation concepts are summarized under the umbrella term *Perception Modification.*
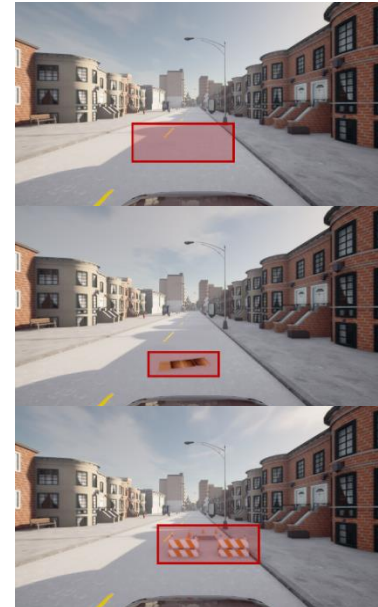
Examples for relevant scenarios: false-positive detection, unclassified object, unrecognized construction site

Project description

In order to understand how Perception Modification concepts should be designed and implemented, edge cases must be identified. Therefore, this project aims to obtain scenarios that challenge the environmental perception of AVs and might lead to edge cases in which Perception Modification concepts could provide remote-assistance for the AV. In a first step, potentially challenging scenarios are derived based on a comprehensive literature review. A selection of these scenarios will be simulated with the open-source simulator CARLA. For this purpose, a framework will be developed for simulating scenarios described by the OpenSCENARIO standard in CARLA. Using this framework, the software stack for autonomous driving, Autoware, should be benchmarked on these implemented scenarios. The simulation results will be used to derive possible use cases for the concept of perception modification.

The following **work packages** comprise the student research project:

- Literature research on challenging scenarios for environmental perception
- Creation of a library with relevant scenarios
- Familiarization with CARLA and Autoware
- Implementation of a framework to simulate the scenarios in CARLA using the OpenSCENARIO standard
- Evaluation of Autoware on selected scenarios
- Derivation of use cases of the Perception Modification concept based on the simulation results
- Documentation and Discussion of the obtained results

Prerequisites

- Intrinsically motivated and interested in the topic of autonomous driving
- Creativity as well as independent and accurate working style
- Programming experience, ideally with Python
- Prior experience with CARLA and, ideally with Autoware

Contact

If you are interested in this or another project, you can also send me an unsolicited application. Just send an email with a short motivation, your CV, and current transcript of records to:

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