

A Realtime Web-based Digital Twin of a Testbed for Networked and Autonomous Vehicles

(Master thesis)



ROBERT MEYER

Motivation

When testing algorithms for autonomous cars, a developer has only two choices until now. First, a full-scale test which supplies the needed quality of the results but is extremely costly. Second, testing in simulated environments. Even though this allows for rapid functional prototyping, most of the times there is a big discrepancy between simulation results and real-world behavior. This is due to the fact that in simulations not every aspect of the real world is modeled. To provide a third option which is positioned between the two extremes, the Cyber-Physical Mobility Lab (CPM Lab) was conceived.

In the CPM Lab algorithms for autonomous vehicles can be tested on model-scale vehicles. The user can interact with the CPM Lab via the Lab Control Center (LCC). This tool is the graphical user interface to the CPM Lab. Here one can view the results as well as manage the simulation

parameters. To enable an intuitive and easy access to the CPM Lab, a web-based application is currently in development.

State of the Art

Right now, the LCC enables simulating vehicles on a fixed map and allows to choose the number of cars that should take part in the test. The cars can either be simulated, or run as a real model car in the CPM Lab. During the simulation the user can see a red line indicating the recent positions of the car, the current position, the commanded trajectory as reference, and the predicted trajectory by the vehicle hardware. On top of that, a vehicle can be controlled by drawing a reference trajectory. In addition, the battery level, the speed, the yaw, the acceleration, and the total distance are displayed.

Goals

The main goal is to create a digital twin of the CPM lab, which is accessible from the web. In order to achieve this, a completely modular and configurable visualization of the map and the simulation objects is necessary. In the end the frontend should be able to represent scenarios from CommonRoad. Another goal is to enable multi-user features such as testing how algorithms from different users work together.

Planned approach

My first goal is to implement the same set of features that are already available in the LCC. During this task I plan to define the information that is necessary as input for the visualization as well as define what aspects of the data should be visualized. Afterwards, I want to continuously increase the modularity and configurability in multiple iterations. Lastly, I want to enable multi-user features.