KI WISSEN
Automotive AI Powered by Knowledge

3.16 Generating Training Data from Formalized Traffic Dynamics

Artem Oppermann, Tino Teige | BTC Embedded Systems AG

Use Case in KI Wissen

When training predictive models in the context of autonomous driving, the quality and quantity of the training data are important to ensure the accuracy and reliability of the vehicle's decision-making algorithms. It is particularly important to have a vast and diverse dataset that not only covers typical driving scenarios but also contains a substantial number of corner cases - unusual or extreme conditions that the vehicle might encounter. Ensuring the model is exposed to and learns from these rare but critical scenarios is necessary to develop a robust and reliable autonomous driving system.

Obtaining enough training data can be challenging. This is especially true for corner cases as they occur infrequently in natural driving environments. This makes their collection and incorporation into training datasets a complex and often resource-intensive task. A possible solution for this is the generation of artificial training data.

Formal Traffic Scenario

We are using our own formal language “Formal Traffic Scenarios” (FTS) to formalize physical and mathematical knowledge of traffic dynamics. We characterize the vehicle dynamics in terms of the longitudinal and lateral position, velocity and acceleration of the vehicles. With FTS, a (possibly infinitely) large set of concrete traffic dynamics can be modeled in a declarative and very abstract way. Specifically, we can model an arbitrary number of corner cases and rare events.

Generation of Trajectories with Scenario Concretization Solver

Based on scenarios formalized with FTS, we generate concrete traffic trajectories that meet the abstract scenario description. For his purpose, we are using constraint solving technologies.

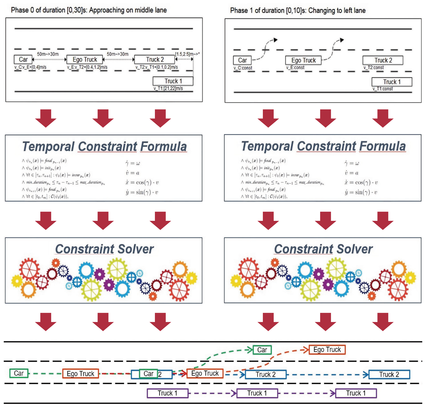

Figure 2: Trajectory generation from FTS (©BTC Embedded Systems AG)

Roughly spoken, the scenario concretization solver takes an abstract scenario formalized with FTS, with its included parameter constraints and uses constraint-solving techniques to provide a trajectory for the traffic scenario that fulfills all formalized constraints. A trajectory contains the positions, velocities and accelerations for each time step in the scenario for all traffic participants. These trajectories can be used as artificial training data.

Generating artificial training data from formalized scenarios not only reduces the effort and costs involved in obtaining and annotating the data, but also makes it possible to include in the training dataset corner cases that are difficult to capture in real-world conditions. In total, this approach aims at significantly increasing the size of the dataset and thus further improving the quality of the predictive models.

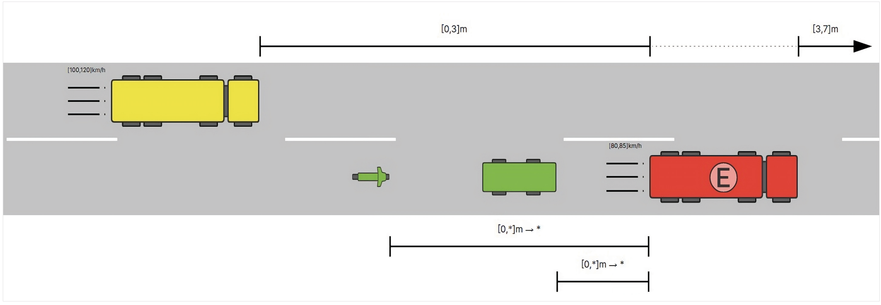

Figure 1: Examples for physical constraints - here: distance between vehicles, longitudinal velocity (© BTC-Embedded Systems AG)

Partners

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For more information contact:
artem.oppermann@btc-embedded.com

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