KI WISSEN
Automotive AI Powered by Knowledge

3.17 TSC-Based Generation of Concrete Scenarios for Synthetic Data

Philipp Borchers, Thies de Graaff | DLR e.V.

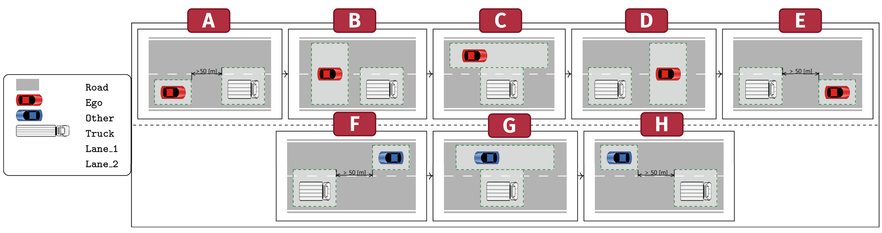


Figure 1: TSC Depicting an Overtaking Scenario with Oncoming Traffic (© DLR e.V.)

Scenario Generation via SMT Problem

The original intention behind TSCs is to specify *what* scenarios are to be realized. To get concrete scenarios, TSCs can be transferred into a satisfiability problem with a respected SMT formula [1]. Each SMT solution is a concrete scenario. Solving the SMT formula multiple time is the basis to get various scenarios. The respected simulation data can serve as training base.

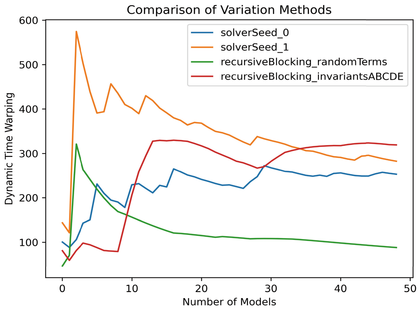
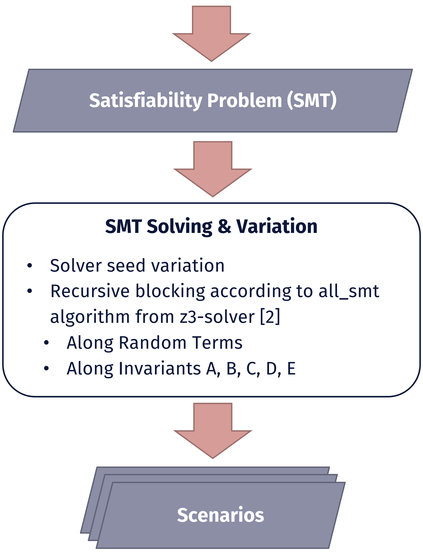


Figure 2: Evolution of dynamic time warping between traffic participants' trajectories (© DLR e.V.)

Evaluation of Variation Methods

For evaluation, we compute the dynamic time warping distance between traffic participants' trajectories. Figure 2 shows the evaluation of the distance between all models found. We implemented and compared four variation methods. For this example the recursive blocking guided on invariant nodes finds scenarios with the highest average distance.



Synthetic Data Generation

For synthetic data, we generate 300 scenarios with the recursive blocking method and transferred them into the standardized OpenSCENARIO and OpenDRIVE format for simulation. Then we use CARLA to simulate the scenarios and used the sensor setup from Figure 3 to record the data. Our dataset contains 300 GB with images from six cameras (360° view) incl. related semantic & instance segmentation, 2D & 3D bounding boxes as well as depth maps and vehicle's trajectories.

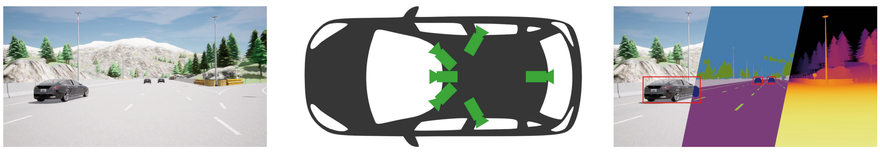


Figure 3: Sensor setup used for synthetic data generation with the CARLA simulation framework. We recorded data with six cameras for a 360° view with images with semantic & instance segmentation, bounding boxes and depth maps. (© DLR e.V.)

References:

[1] Becker et al. (2022) Simulation of Abstract Scenarios: Towards Automated Tooling in Criticality Analysis. In: Autonomes Fahren. Ein Treiber zukünftiger Mobilität Zenodo. Pages 42-51. doi: 10.5281/zenodo.5907154.
[2] Bjørner et al. https://z3prover.github.io/papers/programmingz3.html (last access: 26.01.2024)

Formal Methods and Knowledge Representation

Partners

External partners

For more information contact:
philipp.borchers@dlr.de
thies.degraaff@dlr.de

KI Wissen is a project of the KI Familie. It was initiated and developed by the VDA Leitinitiative autonomous and connected driving and is funded by the Federal Ministry for Economic Affairs and Climate Action.

Supported by: Federal Ministry for Economic Affairs and Climate Action on the basis of a decision by the German Bundestag

Funded by the European Union NextGenerationEU