Master Thesis Work: Safety assessment of automated vehicle functionality in cut-out scenarios

Thesis title Safety assessment of automated vehicle functionality in cut-out scenarios	
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Keywords Virtual counterfactual simulations, vehicle automation, cut-out, expectation mismatch, driver models	
Who are you? Two Masters students at Chalmers about to do a Master Thesis.	
Affiliations This is a master thesis work at Chalmers University of Technology, and the Safety Evaluation group within the research area Crash analysis and prevention, at the division of Vehicle Safety. The thesis will be conducted as an activity parallel to an industry/academia project.	
Thesis aim • To develop methods for assessing the impact of driver expectation mismatch in rear-end cut-out conflicts and to perform a safety assessment sensitivity analysis for this scenario *Thesis objectives* a) Set up/import cut-out scenarios in VTD b) Set up sensor and vehicle model in VTD c) Implement a simple rear-end driver model in VTD (based on already available work; Python/C++ work likely needed) d) Implement the batching (multiple simulations) of sensitivity analysis including the expectation mismatch probabilistic model (Python + VTD scripting needed) e) Perform the simulations and analyse the outcome f) Writing up the work in Master's Thesis report	

Background

One crash scenario that has been identified as problematic for lower levels (SAE level 2-3) of vehicle automation is the cut-out scenario. Here, typically, a car (the automated vehicle; AV) is driving behind (following) a lead-vehicle (LV) while the LV is suddenly changing lane revealing a slow driving or stand-still vehicle in the path of the AV. A study by Tivesten et al. (2019) showed that even if drivers are told that an automated system has limitations, the expectation that the automated vehicle will act in such critical situations affects how the driver responds – approximately 30% of the drivers crashed into the revealed car without braking although having seen the threat. Given the results from the Tivesten et al. (2019) study, it is highly relevant to estimate the overall safety impact of expectation mismatch in the cut-out scenario, including a sensitivity analysis of the role of the expectation mismatch and consequent changes in driver behavior.

Virtual simulations for safety assessment are a methodological approach that is used to estimate the safety impact of traffic safety prospectively. That is, computer simulations where combinations of vehicle models, sensors, models, driver models, and scenarios are conducted to assess what impact specific technologies (e.g., automated vehicle functionality) and driver behaviors (e.g., glance behavior or expectations) has on safety.

Thesis work

You are to implement virtual simulations for cut-out scenarios in the Virtual Test Drive (VTD) virtual environment, including importing and setting up the cut-out scenarios, implementing a simple driver response model and a probabilistic expectation mismatch model, and setting up simulations for sensitivity analysis of driver behavior and the expectation mismatch model. The work will require you to program in Python, and, at least, understand C++ code, and you will need to learn the VTD internal scripting language and the tools/methods to work with that environment.

The output is expected to be a thesis report on the method development and the results from the sensitivity analysis. As this work is done in parallel to other research projects, it may be that you get the chance to implement a new driver response model for cut-out scenarios, but that depends on the simultaneously performed work in PhD student projects. Note that VTD is a tool we at the Safety Evaluation group are just getting, to be able to do these types of simulations. Your work will be one of the first working with VTD. Experience in virtual simulations is a sought-after competence in the automotive industry.