Master Thesis Work: Assessing the performance of performance of virtual simulations across driver model engines

Thesis title
Assessing the performance of performance of virtual simulations across driver model engines

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Virtual counterfactual simulations, vehicle automation, driver models, simulation platform, performance

Who are you?
One or two Masters students at Chalmers about to do a Master Thesis.

Affiliations
This is a master thesis work at Chalmers University of Technology, in the research area of Safety Evaluation within the group 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 assess the performance (in terms of simulation duration) between (at least) two implementations in different "model engines" of a vehicle (or driver model) in the Virtual Test Drive virtual simulation tool

Thesis objectives

a) Set up parameterised rear-end scenarios in Virtual Test Drive (VTD)
b) Implement a simple driver response of vehicle model in the external model engines a) Python, b) Matab/Simulink, (and, possibly c) C++).
c) Make the interface between the model engines and the VTD virtual environment
d) Setup the simulation batches needed to run the assessment
e) Perform the simulations and analyse the outcome
f) Writing up the work in a Master's Thesis report

Background

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. There are a few commercial tools available to conduct virtual simulations for safety assessment. One core issue with several of these is the speed at which simulations can be performed.

At Chalmers (at the Safety Evaluation group in the Crash Analysis and Prevention unit) we are just purchasing the Virtual Test Drive (VTD) virtual simulation environment. We do not, however, know what the performance is of VTD, depending on which modeling interface is used. VTD is based on C++ and runs on Linux. There are APIs that can be used to call external modelling engines, such as Python or Matlab/Simulink. We here want to understand the performance difference when using Python or Matlab/Simulink as the modeling engine. If time permits (and student competence allows), we would also like to see what the improvement would be if we implement the same model in C++. The model can be relatively simple.

Thesis work

You are to implement virtual simulations for a specific scenario (e.g., rear-end) in the Virtual Test Drive (VTD) virtual environment, including generating a set of parameterized rear-end scenarios, and implementing a simple driver response model or vehicle model in each of the external model engines (Python and Matlab/Simulink, and possibly C++). You are then to perform a performance assessment across the different model engines. 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. You will also need to implement a simple model in Matlab/Simulink and implement the API to the VTD virtual environment. 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.