Exploring virtual assurance of a Partially Automated Driving System during car following conditions.

Chris Dijksterhuis, Jeroen Lammersma, Erik Roos, Rix Groenboom

Hanze University of Applied Sciences, Groningen, The Netherlands

Email: h.m.groenboom@pl.hanze.nl

Abstract

Traditionally, driving simulators are used to investigate driver responses to manipulations in the driver-vehicle-environment triangle, such as adding distractors or introducing low visibility driving conditions. This usually implies that the driver has full control of the vehicle all the time. In reality however, the situation is more complicated. Nowadays, cars are often equipped with Advanced Drivers Assistance Systems such as adaptive cruise control and lane keeping assistance systems and it seems only a matter of time before highly automated vehicles will be really accepted on public roads. In these human-vehicle systems the task of safely controlling a vehicle can be switched or even shared between the human driver and the vehicle software. It may be argued that this complicates the task of the human driver who may now be responsible for monitoring an automated system and managing task allocations between de vehicle software and the human driver.

As vehicles become more automated and connected, licensing agencies such as The Netherlands Vehicle Authority (RDW) are faced with the challenge how to evaluate the safety of these vehicles. In 2019 the so-called 'experiment law' went into effect in the Netherlands, allowing experiments with highly automated vehicles on public roads. As part of the exemption procedure an analysis 1) of the entire technical system is made, including the way the car is remotely operated and 2) an analysis of the expected traffic safety effects as related to interaction with human drivers, such as other traffic.

One way to facilitate the safety analysis of given human-vehicle system, is by testing both the human driver and the software module exerting vehicle control in simulated conditions. To investigate the feasibility of this approach we transferred the open-source software module called *openpilot* as used by Comma 3 into the CARLA simulation environment. Comma 3 utilizes two camera's and a connection with the CAN bus to effectively turn a car equipped with lateral and longitudinal ADAS into a partially automated system (i.e. changing from SAE level 1 to level 2).

As a first step, 1) we probed how *Time Headway* (THW) is processed and used by openpilot software during car following conditions, as it represents a safety-critical measure in driving. In addition, 2) we explored an alternative way to process THW by creating a 'tailgating detection' service within openpilot which may be used to warn or coach drivers. The potential of this virtual assurance approach for the safety analysis of various levels of vehicle automation are envisioned.

References

Comma.ai: https://comma.ai/

openpilot: https://github.com/commaai/openpilot

Carla: https://carla.org/

RDW: https://www.rdw.nl/over-rdw/information-in-english