Verification Processes for Automated Road Vehicles

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Description

Automated road vehicles will provide great societal benefits, e.g. reduction of environmental impact, time savings when drivers can use their time for other things instead of driving and, most importantly, reduction of traffic fatalities. However the reduction of traffic fatalities will only be achieved if the vehicles does not cause otherwise avoidable accidents. To ensure this, effective verification methods are necessary. This project aims to estimate the potential safety benefit of automated road vehicles as well as develop verification methods for automated road vehicles.

Background & Motivation

Road traffic accidents are one of the ten largest global health problems, responsible for approximately 1.2 million lives per year.[3] During the last decades countermeasures to reduce the number of fatalities were developed. Lately automated vehicles has been heralded to greatly increase the safety by both vehicle manufacturers, governmental agencies and research institutes. However, only a few attemps have been made to confirm this postulation. Recent studies often suggest methods to estimate the effectiveness, but the number of studies quantifying the potential is limited. Further on the potential benefit will only be realised if the developers can show that the vehicle will not cause avoidable accidents. In order to meet this, an effective verification process is one of the key challenges in the development of automated vehicles, to ensure system safety and reliability. The objective of the verification process is to quantitatively assess the system and show customers and authorities, that the system will solve all situations equally well, or better, than the human driver.

Research Goal & Question

The expected results are a complete estimation of the safety benefit from automated road vehicles. Also methodological devlopment of set-based estimation and verification techniques, to contribute to proper verification processes for automated road vehicles to assess and test complete vehicle functional safety and performance. The result and project might contribute to extend the ISO standard 26262 to whole vehicle safety.

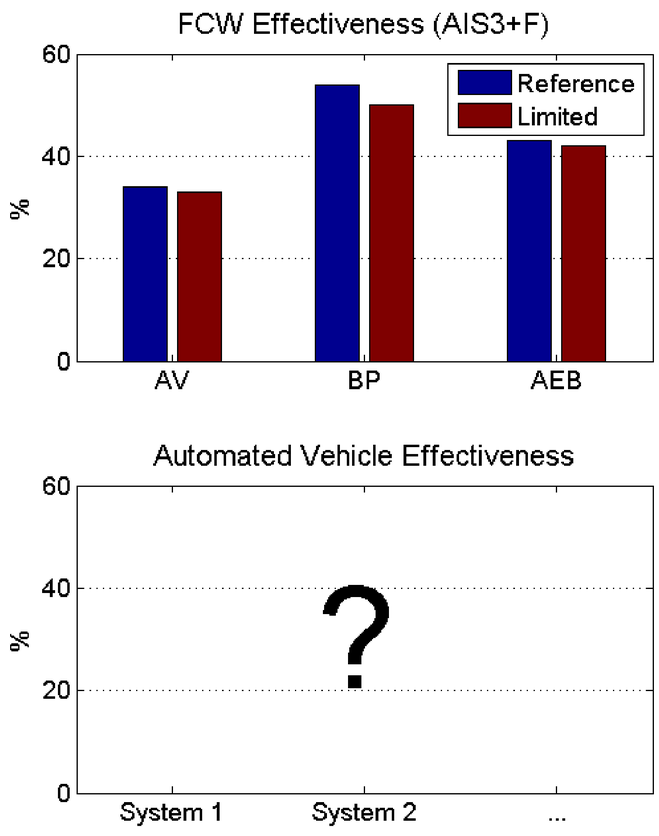

Figure 1: Estimated effectiveness of a Forward Collision Warning system for pedestrians.

Methods & Preliminary Results

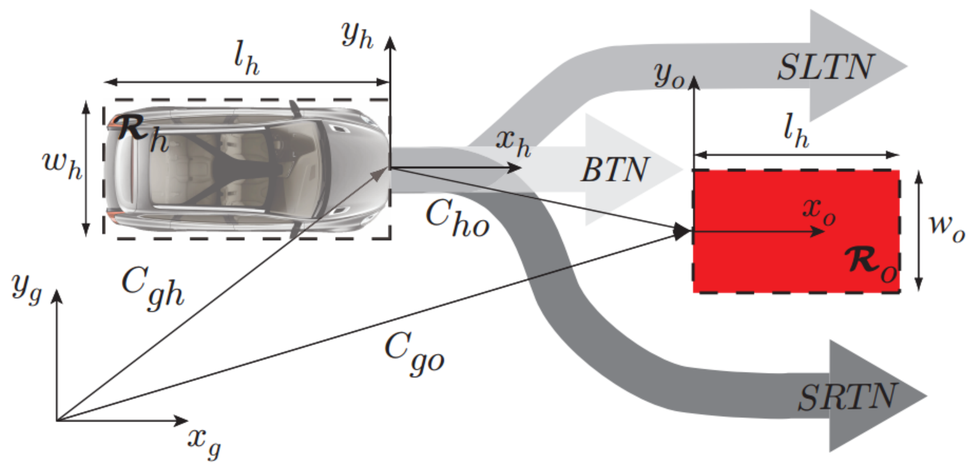

Figure 2: Possible avoidance maneuvers of an automated road vehicle. Figure taken from [2]

In this project we will explore the possibilities of combining statistical methods with computational (formal) methods for safety verification of automated driving in mixed traffic situations. A statistical approach will be used to estimate the potential safety benefit of automated road vehicles. Computational verification methods are treated as methods that predict a system's performance by using mathematical models and/or recorded experimental data as input, see e.g. [2] and [1]. Set-based methods, like reachability theory, have been shown to be viable methods for safety verification and in this work we aim to extend the methods to also include the sensor system. In particular the idea is to develop formally correct sensor systems or sensor data fusion.

Roadmap & Milestones

Three papers are currently in the scope, but more are planned to be published in the future. The first one introduces the type of statistical methods generally used to estimate the safety benefit of an active safety system. The second paper will utilise the same methods in a simplified way in order to estimate the safety benefit of automated road vehicles. The third paper will serve as an introduction to the verification topic.

- Car-to-Pedestrian Forward Collision Warning: A Safety Benefit Estimation
- Safety Benefit Estimation of Automated Road Vehicles in Germany
- *Verification paper*
- ...

Bibliography

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[3] World Health Organization. Violence, Injury Prevention, and World Health Organization. *Global status report on road safety 2013: supporting a decade of action*. World Health Organization, 2013.