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Advanced Materials Science Research

Should We Trust a Self-Driving Vehicles?

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Biography

Luc Rolland primary research area of interest is the design of high performance robotics systems. Since 1996, he have been designing advanced robots and their components for various applications such as material handling, high speed milling, solar tracking, palletizing, reconfigurable robots, stair climbing platforms, etc. His second area of interest is related to robot designs whereby he is investigating modeling, solving, simulation of the complex robotics systems allowing to examine and eventually certify tasks as path planning and path pursuit. This constitutes a global and complete approach in robot controls with the various levels including CAD/CAM which can drive their programming.

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Statement of the Problem: The fantastic achievements in the soft- and hardware sector in the last few years are a key enabler in conservative industries to apply new technologies. In the automotive industry, for example, the race for a self-driving vehicle has already started to come up with a driverless system. Artificial intelligence (AI) and new sensor technologies increase the development speed and open new ways to handle very complex traffic scenarios on the level of a human. In controlled environments like freeways, a few systems have already reached an excellent safety and accuracy level. Adaptive Cruise Control (ACC) and Lane Keeping Assistant (LKA) systems, for instance, are already trusted and accepted by drivers. However, there is also a big problem coming with this trust because the assistance systems allow the driver to perform different activities like writing emails during a drive. Today's system features are not capable of handling all edge problems. These limitations can lead to fatal traffic accidents because drivers are not aware of the feature maturity and the consequences.

Methodology & Theoretical Orientation: The international Society of Automotive Engineers (SAE) has defined a framework with six levels (0-5) of driving automation to show the driver support - and automated driving features. Based on the SAE J3016TM standard, a method was developed to measure the drivers takeover time when performing various activities while driving. The collected data is used to calculate the vehicle stopping distance (reaction distance + breaking distance) for different speed levels to show the consequences in worst- case scenarios. The result illustrates that with increasing automation, the possibility of an intervention by the driver is limited. As a consequence, the developers of high-level system features of self-driving vehicles must focus on very high accuracy to make the right decisions at the right moment because an issue could be fatal. In a worst-case scenario, a traffic accident can kill the passengers of the vehicle or other traffic participants.

Conclusion & Significance: The consequence analysis shows the correlation between higher trust and potential risk based on the six levels of the SAE framework. It highlights the need for safe, accurate and robust systems that is capable of handling very complex traffic scenarios. A major challenge in the development of such a system is to cope with infinite traffic situations on at least the fault tolerance level of a human to be accepted in practice.

Objective: The aim of the study was to analyze the impact on the takeover time of a vehicle driver while he is performing different driving activities if he needs to solve a critical edge problem.

Background: Due to the progressive development of autonomous vehicles, various activities can be legally performed by a vehicle driver during a trip. However, with increasing automation support, the risk of regaining control in a critical situation, and solving the problem increases. The study aims to show how activities with higher automation influence human reaction behavior and resulting consequences.

Method: To measure the reaction, a simulator with a steering wheel and pedals was used as part of the experiment. Thirteen drivers had to perform various activities such as writing an e-mail on a notebook. After a random time, a warning signal was activated, and the driver had to perform a randomly determined action on the steering wheel and/ or pedals to solve the situation.

Results: As automation increases, the driver's attention to the traffic situation decreases. This has a negative influence on the reaction time. If a problem occurs on a higher automation level at a higher speed level, the driver will probably not be able to solve the situation in time, and an accident could occur.

Conclusion: As confidence in self-propelled vehicles increases, the risk of an accident also increases, as drivers are very unlikely to be able to resolve a critical situation in time due to distraction. For this reason, the testing of automated systems is more important than ever, because every wrong decision can have fatal consequences.

Application: Vehicle manufacturers must create a clear awareness among their customers and communicate thelimitations of current systems simply and understandably. In addition, when using autonomous functions, drivers must be informed of the consequences in the event of a problem.

Keywords: Self-Driving vehicles, Safety, Corner Cases, Trust in automated vehicles, Edge problems, Takeover Time

Audience: vehicle driver, safety regulators, car manufacturer, test engineers, software developer.

Publications

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International Conference on Robotics and Artificial Intelligence | Prague, Czech Republic | July 20,21-2020

Citation: Luc Rolland, Should We Trust a Self-Driving Vehicles?, Robotics & AI 2020, International Conference on Robotics and Artificial Intelligence,Prague, Czech Republic, 20-21 July,2020, 9-10