Cutting through the hype: Measuring driver attention and *actual* driver take-over times in automated driving

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Abstract

The transition between manual and automated modes is one of the primary safety concerns in semi-automated driving. This project directly addresses this concern by taking in-depth measurements from drivers operating a Tesla vehicle and responding to take-over requests in on-road driving conditions. The data collected via our driver monitoring system and other sensing technologies is being used to measure driver engagement during semi-automated driving and support a transition based on the engagement measure. These data will feed directly into the development of our next generation driver monitoring systems to improve the driver experience and safety in automated vehicles.

Background

Partially automated vehicles are already currently available in the marketplace with the most widely known being the Tesla and its Autopilot feature. One of the primary concerns in the human factors and safety community relates to the driver's ability to safely resume manual control of the vehicle after the automated driving feature is disengaged (e.g., Erickson & Stanton, 2017; Louw & Merat, 2017; Merat et al., 2014). An underlying hypothesis here is that these features will allow the driver to become less attentive to driving which could decrease their ability to safety monitor and react to changing driving demands. There is currently a chronic lack of relevant data collected from on-road driving conditions.

The CAN Drive project is designed to address this gap in knowledge and is one of the first projects in the world to measure how drivers actually behave in on-road driving conditions with partially automated vehicles. A key here is capturing in-depth measurements that afford determination of the impact on the driver's attentiveness to driving and their safety performance. A core program output is a dataset we can use to drive improvements in our automotive Driver Monitoring System (DMS) technology and that government can use to inform road safety strategy.

Method

In Phase 1 of the study, 30 drivers are being recruited and are participating in a driving study being conducted on a test track. While Phase 2 will be conducted on public roads, use of a test track in Phase 1 allows for more extreme forms of driver distraction and disengagement to be created safety.

The test vehicle is a Tesla Model S equipped with the Autopilot system. It is equipped with a range of sensing technologies that include our automotive DMS (that measures driver attention through analysis of gaze and other ocular metrics; Figure 1 (right) above steering column), forward-looking infrared camera (FLIR), and time-of-flight camera. The study will be conducted at the Sutton Road Training Centre where participants need to drive the Tesla in Autopilot mode while doing secondary task at different states from highly attentive to driving through to being highly distracted and disengaged from driving.

While Autopilot is engaged, drivers are asked to perform tasks that require them to take one or both hands off the steering wheel and eyes off the forward roadway for extended periods of time. For example, selecting music using Spotify presented on the centre console is one task (Figure 1, left). Data from pilot testing confirms that task completion times across three drivers range from 15-25 sec with up to 80% of this time being with the driver's eyes off road. Driving performance is assessed during an unexpected take-over request to the driver – and the driver's reaction time to respond and the quality of this response is measured and represents the primary safety outcome.

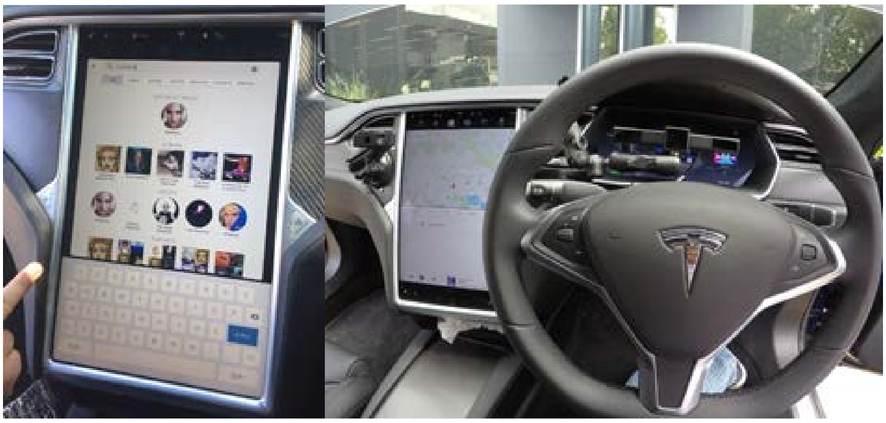

Figure 1. Searching for music on Spotify through the centre console of the Tesla (left) and position of the DMS (right)

Results/Conclusion

A key metric of interest is in using DMS to assess the level of driver engagement while driving in Autopilot mode. Moreover, we will assess the quality of mode transition based on the transition time and then investigate the relationship between driver engagement level and transition quality.

At the time of submission, data from 8 of the 30 participants have been collected. Data collection and analysis will be completed by the end of April, well in time to provide updated statistics in this abstract if accepted.

The CAN Drive project will support Seeing Machines' development of real-time driver monitoring systems to ensure sufficient driver engagement for safe transition.

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