Driver-Specific Exposure to Drowsiness: Real-Time Driver Monitoring in an Operational Heavy Vehicle Fleet

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Problem

The safety and well-being of heavy vehicle drivers is critical in supporting an efficient freight sector, which in turn sustains economic productivity. Truck crashes killed 2462 Australians in the period 2005-2014, representing 17.5% of all road deaths (BITRE). The heavy vehicle industry urgently needs new innovative ways to better measure and manage driver behaviours that impact on safety and productivity.

Method

Ethics approval for this phase of the project was obtained through the Monash University Human Research Ethics Committee. N = 10 Ron Finemore Transport (RFT) trucks were instrumented with the Advanced Safe Truck Concept (ASTC) Sensing Platform.

Specifically, these sensors included a driver monitoring camera (that captures video of the driver's face), a time-of-flight camera (which records a digital image of body position and posture), and a forward facing camera (to capture video of the road ahead).

Independently, drivers were approached via company email or face to face discussion to obtain their informed consent. No specific tasks or stimuli were used in this study. Participants drove trucks from their employer in line with their daily job and were asked to drive as they normally would in the course of their employment. Participants were filmed continuously throughout the duration of their 6-month drives so that their behaviour in relation to fatigue, distraction and workload could be examined.

Results

This analysis centers on an initial 20% subset of the data, comprising 7,400 hours and 604,000km driven, with an analysis of the full dataset to be completed by the time of the conference. Percentage eye closure (PERCLOS) was examined to identify shifts involving drowsy driving. Using a PERCLOS threshold of 0.08, indicating probable drowsiness, 395 shifts were identified across 96 drivers for further analysis. Cumulative exposure to drowsy driving within these shifts is presented in Figure 1 below.

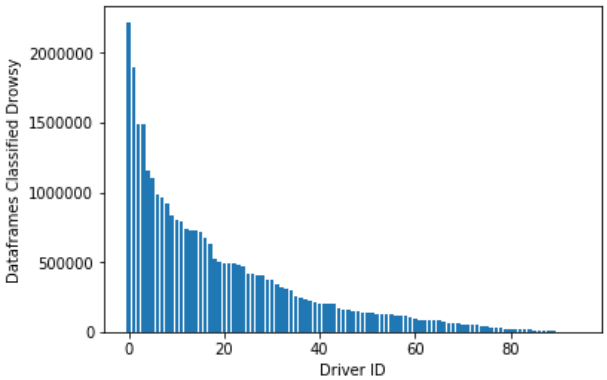

Fig.1 Per-participant exposure to drowsy driving

Discussion

Driver drowsiness is a critical road safety issue, the complexity and impacts of which are exacerbated in the heavy vehicle context. Current efforts to fatigue management notwithstanding, there is an ongoing need to better understand the true prevalence of fatigue events so that they can be better managed and, ultimately, prevented. The naturalistic phase of the ASTC project represents the largest and most data-rich study of its kind. Through collaborative engagement with a fleet operator, an automotive-grade sensing platform was successfully instrumented in an operational fleet, a world-first, providing continuous recording of driver, vehicle, and road environment data at an unprecedented level of resolution.

An initial analysis of the data processed to date has yielded insights into driver drowsiness not attainable through previous means. Specifically, the continuous monitoring of driver drowsiness levels through PERCLOS showed that while most drivers were classified drowsy at some point during the data collection period, a large proportion of drowsy driving (and therefore exposure to risk) could be attributable to a small group of drivers.Analysis of the full dataset is expected to be completed by the time of the conference. A wider range of drowsiness metrics will additionally be explored - while PERCLOS is commonly utilised in existing research as a continuous measure of drowsiness level, a key output of the ASTC project is the exploration of algorithm concepts and metrics that may provide greater accuracy and robustness compared to current state of the art.

Summary

Our findings to date support the efficacy of the real-time monitoring of driver drowsiness. Complementary to currently available aftermarket solutions for event detection, driver state monitoring in the context of heavy vehicles can empower drivers and fleet owners to make more informed decisions around shift scheduling and driver training. As a greater number of heavy vehicle fleets begin to adopt similar technology, it becomes increasingly pertinent to review the safety impact and ongoing relevance of prescriptive schedule-based approaches to fatigue management.