SIEMENS DLR Deutsches Zentrum für Luft- und Raumfahrt bbi Bahnbetrieb & Infrastruktur

# 6th German Conference on Rail Human Factors

**18th/19th February 2025**

## Preliminary assessment of an in-cab driver fatigue monitoring system

Nora Balfe, Filip Florek, Mikel Aguirre Claramunt – Irish Rail

Rail safety relies on the actions and vigilance of the driver to safely operate trains. Train drivers are also human, which means that their alertness and attentiveness can rise and fall over time (RSSB, 2021). Heavy rail has used driver vigilance devices (i.e. deadman) to guard against driver loss of consciousness (including fatigue) for at least a century, but there is some indication that drivers can operate these devices even while asleep (e.g., RAIB, 2011).

Major accidents in recent years have stimulated interest in alternative methods of assuring driver wakefulness and attention within the cab. Following the fatal accident at Sandilands Junction in 2016, technologies have been trialled within the UK tram sector to monitor driver alertness and attention, including fatigue (RSSB, 2021). Such systems are widely used in truck driving to monitor driver wakefulness, and also have the capability of detecting distraction through identifying direction of gaze and use of mobile phones. Irish Rail are currently investigating the feasibility of using such a system on future heavy rail fleet. However, to our knowledge, there are no other applications of this technology in heavy rail, and attentional demands and workload characteristic differ significantly between heavy rail operations and other transport sectors.

This paper presents the results of an initial study designed to validate the performance of a driver fatigue monitoring system in a heavy rail environment against actual conditions experienced by heavy rail drivers on a daily basis. The first objective was to identify which conditions during normal train operations produce false alarms that could be distracting for the driver. The second objective was to assess the detection reliability of fatigue precursors, fatigue events and driver distraction.

A driver fatigue monitoring system was installed on a full-scale but non-functional mock-up of a future train cab. The operational performance of the system was evaluated through the measurement of the event detection rate under 21 different tasks. 19 non-driver participants performed tasks covering common conditions encountered during normal train operations, including simulated standard driver tasks, fatigue, and distraction tasks (i.e., nonpermitted tasks).

The main findings of the study were:

- The system reasonably reliably detected simulated sleep events with a 77% detection rate across all participants over four simulated sleep tasks.
- The system performed poorly at identifying fatigue precursor events (i.e., yawning and slow blinking) with a 40% detection rate across all participants over three simulated tasks. This low rate may have been influenced by the difficult of accurately simulating these behaviours.
- There was very poor detection in the standing position, and it is a limitation of the system that it cannot detect fatigue events in a standing position which is often used by train drivers to remain alert.
- There was good detection for mobile phone distraction tasks when the device was in view of the sensor (89%) but much lower detection when the phone was held below desk level (53%).
- There was a relatively high false alarm rate for some normal driving tasks, particularly those involving looking down (checking timetable and looking at TCMS screen) and while using the GSM-R handset which the system likely recognised as a mobile phone.