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Title of presentation	**Institution**
Train Drivers' Reaction Times to A Visual Detection Task as Benchmark for ATO Systems	German Aerospace Centre

Please highlight workshop topic(s) your paper is relevant for

- ☐ Ergonomics and Usability of advisory and assistance systems
- X Automation, Train control systems
- ☐ Fatigue, monotony, mental workload
- X Risk, Human error and Human reliability
- ☐ Situation awareness
- ☐ Incident investigation
- ☐ Safety culture
- ☐ Human Factors Integration (e.g., in organizational processes)
- ☐ Rules and Standards
- ☐ Others

Abstract

Automated Train Operation (ATO) systems are designed to take over various subtasks of train driving. By this, ATO has the potential to make railway mobility safer, more energy-efficient and increase the overall capacity of the network. In order to ensure that an ATO system has a sufficient quality to take over driving tasks, the safety needs to be determined. According to the European Commission, the safety responsibility shifts from the human to ATO from Grade of Automation 3 upwards. In order to conduct a proper risk evaluation of the new system, an existing reference system is needed. The single point of reference that is currently existing is the human with his or her performance as a train driver. In their role as train drivers, humans rely on visual and auditory sensory input to evaluate the current state and risk of the overall system, consisting of the train and the driving environment. A literature search was conducted and revealed that the visual system is most important for a train driver's task performance. Therefore, in the present experimental study, human performance was investigated with a visual detection task in a high fidelity train driving simulator. Detection performance of train drivers was operationalized by measuring reaction times to cuboids that appeared on the driving track. The size of the cuboids was varied (90 cm vs. 180 cm) as well as the color that either led to a high contrast or a low contrast in relation to the driving background. Furthermore, aspects of railway operations were varied. The type of train protection system was either the German standard (punctiform train protection system "PZB" or European Train Control System (ETCS) level 2. The maximum speed had four levels: driving on sight, 40 km/h, 100 km/h and 160 km/h. In a simulator study with 15 train drivers, differences in the resulting reaction times to the occurring cuboids were recorded. In the presentation, an overview of the simulator study and preliminary results are provided. Insights of their meaning for ATO systems are discussed.