First Things First: Prioritising Safety in Acceptable Overtaking Behaviour

Anna-Maria Sourelli, Loughborough University, United Kingdom, a.sourelli@lboro.ac.uk, **Ruth Welsh,** Loughborough University, United Kingdom, **Pete Thomas,** Loughborough University, United Kingdom

ABSTRACT

The overtaking manoeuvre is considered to be a complex and demanding driving task due to the concurrent regulation of different task and subtasks, along with the agile decision making it requires. Consequently, it is highly susceptible to errors and misjudgements. Modern transport research focuses on Autonomous Vehicle (AV) technologies, which are expected to significantly improve road safety, since most driver related accidents can be prevented. In higher levels of automation, the driving automation system is responsible for the operational and tactical functions, including overtaking decisions. Acceptance will determine if AVs will reach their predicted safety benefits and studies argue that natural, human-like trajectories are more likely to constitute an acceptable behaviour. Consequently, there is a need to thoroughly study manoeuvring behaviour, including overtaking behaviour. However, overtaking behaviour is highly subject to the driving context. The overtaking choices made by the driver depend on the respective conditions and result of numerous and diverse scenarios. All the scenarios need to be considered in the system's design and testing, but their large number raises the need for priorities in overtaking behaviour research.

Existing literature analysing overtaking behaviour has mainly used expert knowledge or specific predefined scenarios. In order to adopt a safety-oriented approach, this paper proposes the use of safety critical scenarios. Since the main objective of emerging vehicle technologies is tackling risky driving situations, critical factor combinations definitely constitute a research priority. A data driven, exploratory approach was followed, in order to highlight priorities for autonomous overtaking research. Data from RAIDS (Road Accident In-depth Studies) (2010-), a UK in-depth study, were used, providing a large number of variables for each case. 204 overtaking accident cases were extracted from the database. Hierarchical Clustering was performed in order to acquire the scenarios, by grouping the cases according to their similarity. Several variable combinations were examined, and the results identified 5 clusters characterised by these variables:

- the presence of a central reserve on the path of the overtaking vehicle
- the lighting conditions
- the total number of vehicles involved in the crash
- the maximum injury severity in all vehicles.

The clusters are a good initial step for overtaking accident data segmentation and highlighting factors related to increased frequency or injury severity. These results can inform the design of overtaking systems that either support human drivers or replace them autonomously by setting guidelines for

safety-oriented priorities in user-acceptance studies, virtual and physical testing and safety benefits evaluation.

Keywords: automated driving, overtaking, safety critical scenarios, clustering.