Driver behavior on highways in congested states: A comparison of German and American drivers

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The integration of current traffic conditions and driver behaviors with connected and automated vehicles is becoming an increasing concern from a traffic safety perspective. A meaningful understanding of driver behavior on highways in congested states is critical for the safety of all roadway users during this phase of mixed, varying levels of automation on highways. Studies investigating driver behavior on highways in congested states have taken place throughout many regions of the world. Car-following and lane-changing models have been developed using data from various regions and conditions; however, a large-scale driver behavior study investigating the differences of lane-changing and car-following behavior in congested states on highways in two countries has not yet been investigated. Without this information, car-following models and lane-changing models developed in Germany cannot be integrated in the United States, and vice versa. Furthermore, this study aims to investigate primary differences in driver behavior between two developed countries and highlight the potential differences that will need to be considered for the future use of connected and automated vehicle on highways in congested conditions.

This study aims to fill this gap in literature through the investigation of lane changing behavior modeling based primarily on vehicle type, distance to following and preceding vehicles at entrance of new lane, gap acceptance, and interacting vehicle types for both German and American drivers. Car-following modeling may also be explored in this investigation as well as lane changing frequency for comparison between to the two driver types.

Two primary datasets will be used in this study. Re-extracted Next Generation Simulation (NGSIM) vehicle trajectory data provides detailed trajectory data on United States highways [1] and the highD dataset provides trajectory data on German highways [2]. Both datasets contain traffic congested states for the purposes of this study. Driver behavior studies, including car-following and lane-changing studies, that have utilized either of these datasets will be evaluated prior to analysis to best ingrate what is already understood and yet to be understood using the datasets, including a recent study by Vishal et al. [3]. To date, no studies have been identified that use the highD dataset to investigate exclusively congested conditions, nor compare congested conditions between two large-scale datasets.

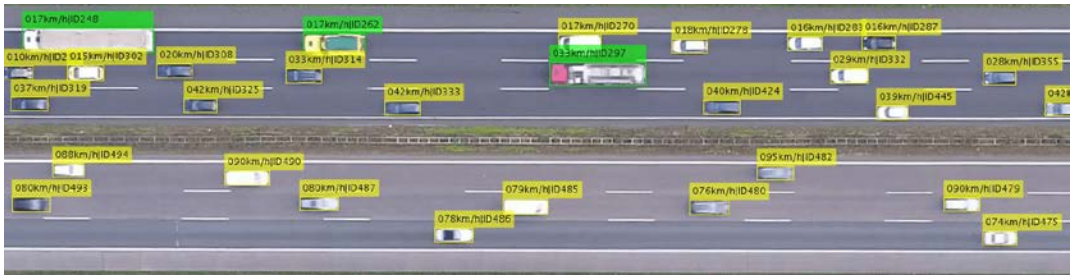

Figure 1: highD dataset snapshot [4]

Research steps will include evaluating current literature on car-following models, lane-changing models, gap acceptance, and differences in driver behavior between different regions; identifying gaps in the literature and primary research questions; developing a comprehensive methodology with appropriate modeling methods to investigation these research questions; discussing the study results and relating them back to current literature where appropriate; identifying limitations and future directions from this work; and identifying applications and drawing meaningful conclusions to add to the current state of literature and practice from the research.

References

[1] B. Coifman and L. Li, "A critical evaluation of the Next Generation Simulation (NGSIM) vehicle trajectory dataset," *Transp. Res. Part B Methodol.*, vol. 105, pp. 362–377, 2017, doi: 10.1016/j.trb.2017.09.018.

[2] R. Krajewski, J. Bock, L. Kloeker, and L. Eckstein, "The highD dataset: A drone dataset of naturalistic vehicle trajectories on German highways for validation of highly automated driving systems," *arXiv*, pp. 2118–2125, 2018.

[3] V. Mahajan, C. Katrakazas, and C. Antoniou, "Prediction of Lane-Changing Maneuvers with Automatic Labeling and Deep Learning," *Transp. Res. Rec.*, vol. 2674, no. 7, pp. 336–347, 2020, doi: 10.1177/0361198120922210.

[4] "The Highway Drone Dataset." https://www.highd-dataset.com/ (accessed Dec. 03, 2020).