Data-driven models for identification of lane-changing characteristics and duration using NGSIM data

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Extended Abstract

Moving towards autonomous driving, it becomes increasingly necessary to fully understand driving behavior, including car following and lane changing behaviors, as well as their interactions. Car-following and lane changing models are fundamental tools of microscopic traffic simulation. Nowadays, technological advances have significantly improved our traffic data collection and facilitated driving behavior analysis. In addition, there has been a significant increase in the use of data driven approaches, as they offer flexibility for incorporation of various parameters avoiding cumbersome reformulations of traditional mathematical models. Rahman et al. (2013) have identified limitations of existing microscopic lane-changing models and have proposed the development of more flexible models.

An innovative methodology based on machine learning techniques for the estimation of car-following models has already been developed by Papathanasopoulou and Antoniou (2015). This methodology is modified in order to include lane-changing behaviors as well. First, this research analyzes driving characteristics before, after and during lane change situation. Traffic features of the vehicle itself, such as speed and acceleration, are taken into account. In addition, the surrounding traffic environment plays a significant role in the lane-changing process. Thus, traffic features regarding the interaction with the preceding or the following vehicle or vehicles in the adjacent lanes, such as distances and speeds differences, are also explored. After analyzing driving characteristics of a lane- changing situation, a methodology based on data-driven methods is developed in order to identify lane change and its duration in vehicle trajectories data. Clustering and classification algorithms are employed to identify inherent patterns in the data. Then, further implications for lane-change prediction for the next time step are discussed. Finally, while in most studies car following and lane changing situation are examined separately, in this research it is

attempted both the car-following and the lane-changing analysis to be incorporated in an integrated methodological framework.

The "Next Generation SIMulation (NGSIM)" program (http://ngsim.fhwa.dot.gov.) includes vehicle trajectories in real traffic conditions and allows both car-following and lane-changing behavior analysis. In order to avoid noise of the data, an enhanced NGSIM dataset was used in this research. The complete set of NGSIM vehicle trajectory data from the I80-1 dataset (from 4.00 p.m. to 4.15 p.m.) was filtered with a multi-step procedure for vehicle trajectory reconstruction by Montanino and Punzo (2014).

Lane change prediction and understanding of lane changing effect on longitudinal movement could contribute into the development of Advanced Driver Assistance Systems and safety research in respect to lane change decision and driving behavior during lane change maneuvers. Moreover, the proposed methodology could be appropriate for incorporation into microscopic traffic simulation models.

References

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