ABSTRACT

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Lane change (LC) is a fundamental driver behavior and has a significant effect on traffic flow, and vehicle distribution across lanes, and may cause oscillations, relaxation, moving bottleneck, and capacity drop in traffic. It is beneficial to develop a good understanding of the types of LC behaviors to improve over the above issues with respect to LCs. Also, LC is one of the most crucial modules in a microscopic traffic simulator, which can help generate more realistic driving behaviors and better simulations. This study aims to classify LCs by using the NGSIM dataset which is a trajectory dataset collected at four different locations in the US with the help of cameras placed over the top of buildings. But this dataset contains high measurement errors, which are smoothed using the symmetrical exponential moving average (SEMA) method. As the start and end points of LC (LC window) significantly influence the analysis, LC window are extracted with a new approach using the absolute value of the derivative of the cumulative lateral speed. Previously, LCs were classified as free, forced and cooperative by Hidas, but these classes fail to stay consistent with field conditions. Therefore, this study initially proposes three new methods of classification based on microscopic traffic variables and vehicle kinematics. These methods are then verified quantitatively, and statistical tests are performed to find a significant difference between the classes. Results of these tests show that the two types are significantly different (free LC and constraint LC) and, a log-normal distribution is fitted to the duration of LC for each type. Further, deep learning is applied to perform time series classification of LCs. Initially, a method is proposed to classify LCs into five types (free, fully constraint, partially constraint-initial, partially constraint-later, and others) based on target follower (TF) speed and its speed difference. Labels were assigned to the different types of LCs to perform classification using supervised learning technique called InceptionTime network. Classification is performed by giving a multivariate time series as input to the model with variables such as TF speed and TF position. The dataset is modified as required and is split into training and testing. Further, the model is tested on the HighD dataset to generalize the model. It was observed that the accuracy of the classification performed by deep learning was significantly better than methods based on aggregate traffic variables.