Master Thesis Defense Kishaan Jeeveswaran

Date: Monday, 31.08.2020
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Room: Online

Title: Efficient and Context-aware Pedestrian Trajectory Prediction

Abstract:
Pedestrian trajectory prediction is very crucial in autonomous driving applications as pedestrians are more vulnerable in urban environment and anticipating their future trajectory would help the autonomous vehicle in planning a safe and efficient maneuver. Most of the research groups focus their work on improving the accuracy of trajectory prediction task and a very few works pay attention to risky situations determined by the interaction between the ego-vehicle and the pedestrian. An efficient inference with less memory consumption is often overlooked as well. This work proposes an approach which includes memory efficient deep neural networks, a compact input representation and two risk-aware loss functions (critical interaction-based and semantic layer-based) to perform pedestrian trajectory prediction. All the proposed architectures are trained on nuScenes dataset and the performance is evaluated based on ADE and FDE metrics.

Architectures based on LSTM, MLP, and CNN are evaluated on increasing levels of complexity, namely, context-unaware prediction, and context-aware prediction by incorporating the proposed loss functions. Qualitative evaluation in addition to quantitative evaluation is done in order to aid visual inspection of the impact of proposed loss functions on critical situations. Based on the experiments conducted, it is seen that all the deep learning-based approaches perform with the best improvement of 36.8% on the ADE metric over the baseline dynamic-based motion models. The semantic layer-based loss function resulted in an average performance increase of 10.86% on trajectories that are coming into the road or going off the road. Average improvement of 5.76% is observed by using the models trained using the critical interaction-based loss function on pedestrian trajectories having higher chances of collision with the ego-vehicle. Combining both the proposed loss functions during the training resulted in an average increase of 1.8% on the overall test data. Convolutional Neural Network-based architecture with static context input performed the best out of all other settings when a combination of proposed loss functions is used to train the network. It is also evident that CNN-based architectures consistently perform well with least inference time and least memory consumption. Predicting the point-wise uncertainty of every position in future trajectory improves the accuracy in most of the cases and these uncertainty values can be utilized to better plan the ego-vehicle’s maneuver.