Predicting Unintentional Vehicle Lane Departure Using Support Vector Machine and Neural Network

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Abstract — Advanced driver assistance systems, such as unintentional lane departure warning systems, have recently drawn much attention and efforts. In this study, we explored utilizing the nonlinear binary support vector machine (SVM) technique as well as the three-layer neural network with the back-propagation learning scheme to predict unintentional lane departure. We developed a two-stage training scheme to improve SVM's prediction performance in terms of minimization of the number of false positive prediction errors. Experiment data generated by VIRTTEX, a hydraulically powered 6-degrees-of-freedom moving base driving simulator at Ford Motor Company were used. All the vehicle variables were sampled at 50 Hz and there were 16 drowsy drivers (about three-hour driving per subject) and six control drivers (approximately 20 minutes driving each). A total of 3,508 unintentional lane departures occurred for the drowsy drivers and 23 for the control drivers. Our study involving these 22 drivers with a total of over 7.5 million prediction decisions demonstrates that: (1) excellent SVM prediction performance, measured by numbers of false positives (i.e., falsely predicted lane departures) and false negatives (i.e., lane departures failed to be predicted), were achieved when the prediction horizon was 0.6 s or less, (2) lateral position and lateral velocity worked the best as SVM input variables among the nine variable sets that we explored, (3) the radial basis function performed the best as the SVM kernel function, and (4) the SVM produced more accurate lane departure prediction than the neural network did.