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A study on short-term future vehicle speed prediction using Gaussian Mixture Regression

Jun Sangtaek [1)] **Kim Soonhyo** [2)] **Sanada Kazushi** [3)] **Umezu Hajime** [4)] **Nishio Yui** [4)]

1) Yokohama National University, Graduate School of Engineering Science
79-5 Tokiwadai, Hodogaya, Yokohama, Kanagawa, Japan (E-mail: jun-sangtaek-pv@ynu.jp)
2) Yokohama National University, School of Engineering Science
3) Yokohama National University, Faculty of Engineering
4) Honda Motor Co., Ltd.

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In this study, machine learning was applied to predict the required vehicle speed several seconds ahead of the driver based on individual vehicle information such as vehicle speed, pedal operation amount, and route information of limited vehicle speed and stop sign. The driving situation of individual vehicles was classified into scenes, and Gaussian mixture regression was applied. It was shown that it is possible to predict the short-term future vehicle speed by selecting the input variables using the stepwise selection method.

For the driving course, the road model of the example course in the commercially available driving simulation software was used. The total distance of the road is 10.6 km. The situation is that one car runs along the driving course while observing the predetermined speed limit and stop sign. The sampling frequency was set to 10 Hz, and the operation data for 1200 s was acquired. The six types of driving data obtained from the driving simulation are the time, vehicle speed, brake pedal input, gas pedal input, speed limit, and distance to the stop line. In this calculation, the situation where one vehicle runs according to the speed limit and the stop line is simulated.

If a single vehicle travels on a given road, the driver is expected to follow the road signs. Therefore, the driving situation was classified into typical scenarios. We assumed a cruise scenario, a sign acceleration scenario, a sign deceleration scenario, a deceleration scenario, and a stop scenario. We proposed a method for learning and forecasting for each scenario, and verified the prediction accuracy by GMR of short-term future vehicle speed.

For example, when building a model of an acceletation when speed limt sing is released we called it a sign acceleration scenario in this papaer, instead of using the entire training data, only the scenario of the sign acceleration scenario was extracted from the original data and used for learning of the GMR. In addition, we made a model and prediction corresponding to the scenario.

Furthermore, the model was divided according to whether prediction window were included before/after the scenario. Let “All” be a model in which all driving data is trained. Let “BeforeAfter” be a model in which a section including 100 steps before and after the sign acceleration scenario is trained. We compared their prediction accuracy.

As shown in Fig. 1, it can be seen that “All” tends to continue accelerating and has not shifted to the cruise scenario. As shown in Fig.2, the result of “BeforeAfter” was excellent. The predicted value is close to the measured value. It can be seen that the vehicle smoothly goes from acceleration to cruising. The reason why “BeforeAfter” was excellent is that the learning data includes scenarios of sign acceleration, deceleration, and stop by using the data of 100 steps before and after.

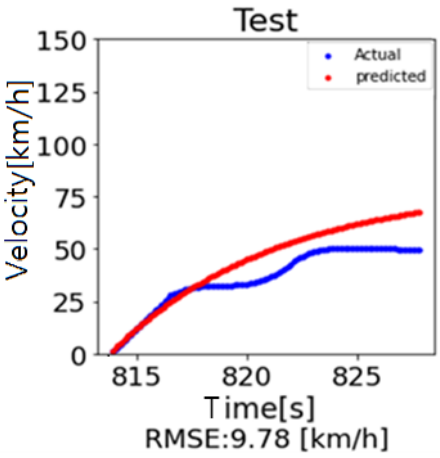

Fig. 1 Prediction of velocity (All)

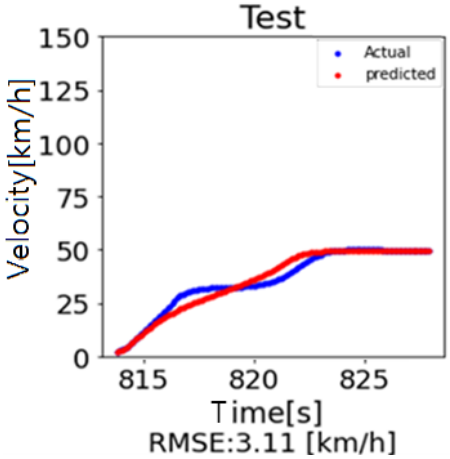

Fig. 2 Prediction of velocity (BeforeAfter)