

Machine-Learning-Based Quantification of Subjective Evaluation for Vehicle Cornering Behavior

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This study proposes a machine-learning-based method for quantifying vehicle line-traceability under combined accelerator and steering operations, which have traditionally been evaluated through subjective assessments.

In vehicle development, shortening development cycles is increasingly important. However, subjective evaluations based on actual vehicle testing require substantial effort, and quantitative performance indicators that can be directly utilized in vehicle design have not been sufficiently established. In particular, studies focusing on vehicle behavior under combined accelerator and steering operations remain limited.

To address this issue, J-turn cornering was selected as a representative combined-operation maneuver. A dataset was constructed by linking subjective ratings with vehicle dynamics data during turn-in and turn-out.

The proposed method consists of two steps: score prediction (STEP1) and feature integration through similarity evaluation of important features (STEP2) (Fig.1). Through this process, factors contributing to subjective evaluations were systematically organized, and performance indicators applicable to vehicle design were derived.

Using five-fold cross-validation, prediction accuracies of 0.91 and 0.92 were obtained for the turn-in and turn-out phases, respectively. Furthermore, important features extracted from the models were integrated based on similarity evaluation, resulting in six performance indicators (Fig.2, Fig.3). The extracted indicators corresponded well with vehicle behavior. Highly rated cornering behavior was characterized by a smooth rise and appropriate peak of yaw rate during the turn-in phase, and smooth convergence of yaw rate during the turn-out phase.

These findings demonstrate that subjective evaluations can be transformed into design-oriented performance indicators based on vehicle behavior, providing a practical foundation for vehicle dynamics design and control development.

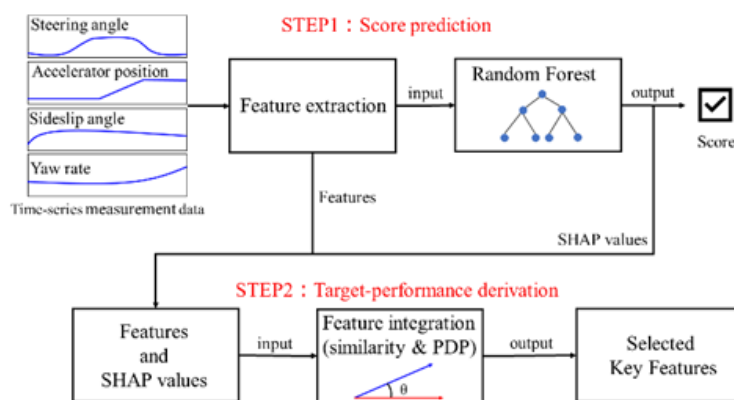


Fig.1 Overall framework of the proposed method

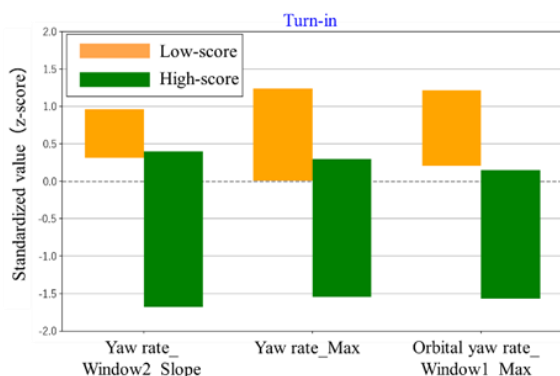


Fig.2 Design indicators for Turn-in behavior

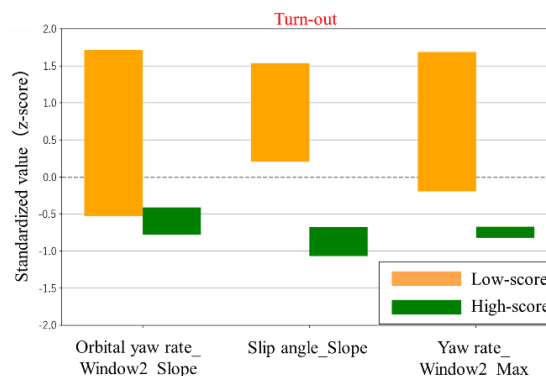


Fig.3 Design indicators for Turn-out behavior