# Evaluation Method for Vehicle Steering Characteristics during the Transition from Straight Driving to Circular Turning

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**KEY WORDS: Vehicle Dynamics, Driver Model, Evaluation Technology, Driver parameter $\tau_L$, G-Vectoring Control [B1]**

In evaluating a vehicle's dynamic performance, it is important to consider not only the vehicle's mechanical characteristics but also the driver's steering behavior as part of the human-vehicle system. The authors have previously proposed a vehicle dynamic performance evaluation method based on a driver model and demonstrated that it is possible to quantitatively evaluate the driver's margin of adaptation to the vehicle's dynamic characteristics based on differences in $\tau_L$, the time constant representing all steering delays during a lane change as a first-order delay. On the other hand, it has become clear that lane-change tests do not always sufficiently reflect differences in performance in the micro-range or high lateral acceleration range in terms of differences in $\tau_L$. Therefore, in this paper, we focus on the evaluation of vehicle dynamic performance in the region of large steering angles and high lateral acceleration. We propose a driver model targeting the steering process during the transition from straight-line driving to circular turning, and describe in detail the process of the driver parameter identification method based on this model. Furthermore, we verify whether it is possible to evaluate vehicle dynamic performance during circular turning through road tests using vehicles with and without control systems.

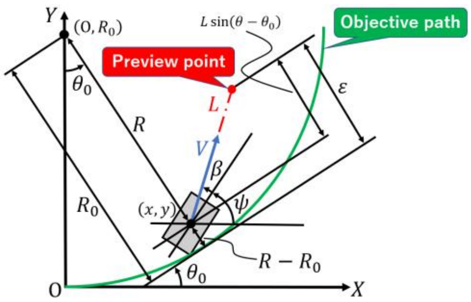


Fig.1 Preview driver model during circular turning

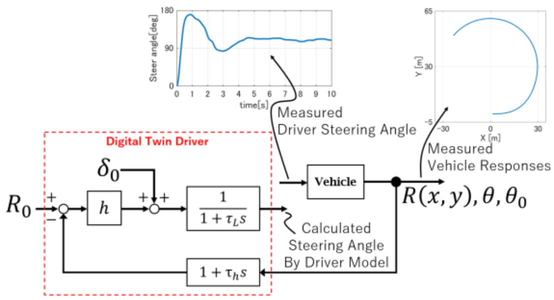


Fig.2 Block diagram of driver-vehicle system for parameter identification

Circular turning tests were conducted using vehicles with and without GVC. The steering angles calculated using the proposed driver model for circular turning showed good agreement with the measured steering angles, confirming that the model accurately reproduces driver steering behavior during circular turning. Furthermore, the results of the tests with and without GVC showed that, for all subjects, the steering lag τL tended to increase in the configuration with GVC, and the results were consistent with the subjective evaluations. Based on the above, we demonstrated that the proposed circular turning driver model and driver parameter identification method enable quantitative evaluation of vehicle motion characteristics during circular turning.

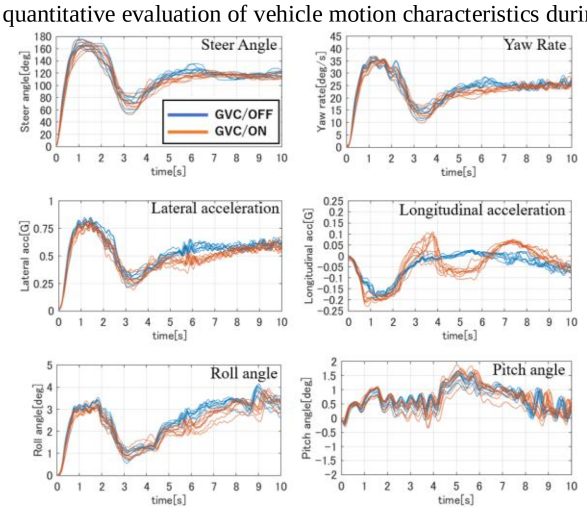


Fig.5 Time histories of the vehicle with Driver A

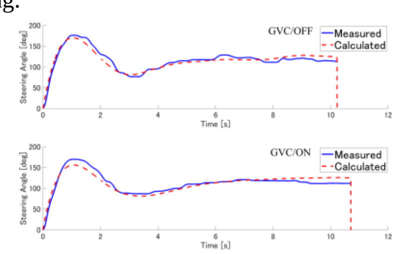


Fig.10 Measured and Calculated steering angle of Driver A

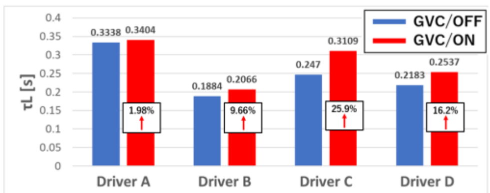


Fig.14 Comparison of identified $\tau_L$ of each driver