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Steering Characteristics of Motorcycles

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Abstract

As the motorcycle market continues to mature and the need for greater safety and running performance increases, more and more makers are installing electronic control devices used in four-wheeled vehicles to control vehicle dynamics. While the installation of electronic control devices makes it possible to fine-tune the performance of motorcycles, the development cost for selecting the optimum control parameters has problematically risen. Therefore, in order to efficiently optimize the control parameters, a development method is needed that can predict the maneuverability for each control parameter and rationally select the optimum parameters from the viewpoint of maneuverability.

Enabling the development of such a method will require a simulation technology that can predict the ride of the vehicle based on its characteristic values and indexes that can be used for determining whether the predicted ride is good or bad. As a matter of fact, many simulation technologies have been studied. However, comparative validation between their results and actual ride data has rarely been published. Kageyama et al. [1] proposed a steering index for motorcycles and showed its theoretical background as well as the differences from the steering index for four-wheeled vehicles. So far, however, activities to validate the index against actual ride data have been insufficient.

One of the reasons why validation using actual ride data has not progressed is the fact that the slight shift in the motorcycle rider's operations and in the way the rider moves his/her body significantly changes the vehicle dynamics characteristics, making it difficult to obtain measurements with a high level of repeatability. However, if we focus our measurements only on the steady-state characteristics, we should be able to restrict the rider's influence to the shifts in his/her center of gravity position according to posture differences, and therefore should be able to obtain measurements with a high level of repeatability.

Therefore, our research restricted the ride pattern to steady-state cornering. At the same time, we expanded our measurement scope to include tire force, tire moment, and tire slip angle, all of which are presumed to greatly contribute to the maneuverability.[2] For the tire slip angle measurement data in particular, we used two methods to validate their accuracy and compared them with the simulation results. Next, we examined a case in which the rider's lean posture, which significantly impacts measurement results, is intentionally changed to a significant degree. Additionally, based on the actual measurement data, we calculated steering indexes for the steering characteristics (stability factors), tire slip characteristics, and hold-steering torque characteristics, and finally, validated them.

Figure 1. Rider's posture difference

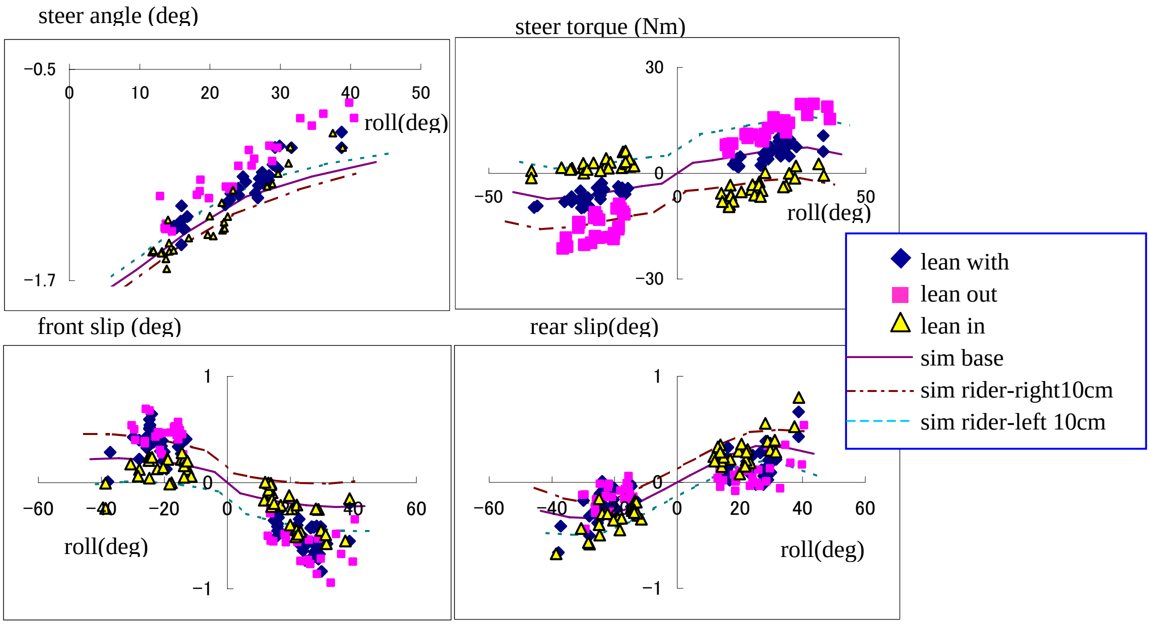

Figure 2. Averaged data for steady-state turning changing rider lean

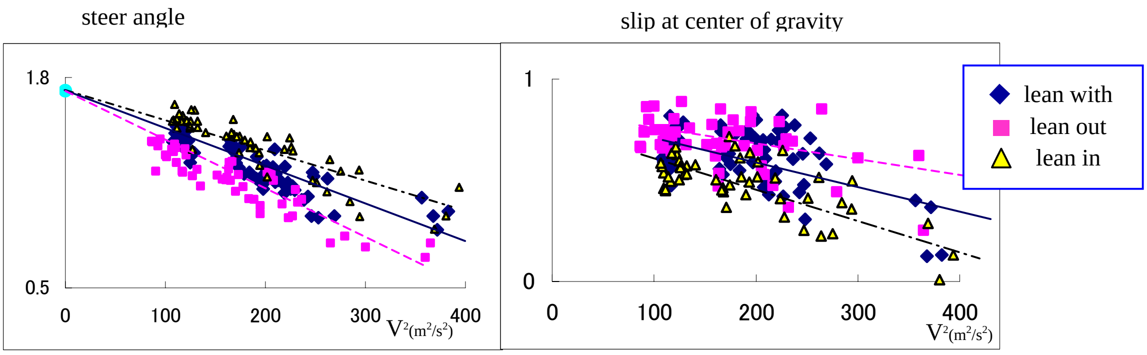

Figure 3. Averaged data for steady-state turning arranged to calculate steering idexes

References

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