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The Effect of the Difference between Front and Rear Wheel Lateral Stiffness on the Dynamic Stability at Directional Change

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The case where the driver evaluates the vehicle controllability, easiness to turn, and feeling of security is mostly the transient condition when changing direction, because it makes possible to compare articulately the amplitude of the transient vibration and the damping performance according to the vehicle characteristics. Accordingly, in order to calculate them from the driver standpoint, it becomes essential to use the Closed loop system that includes a driver model.

On the other hand, the lateral force generated between the tire and the ground surface has the first order delay characteristics due to the dynamic cornering characteristics of the tire. In the past, there had been some discussion that there was a discrepancy between the evaluation and the calculation of the transient condition, which made it impossible to comprehend the situation. Authors believe that the key factor of this problem is to analyze them using the Closed loop system and have advanced the previous researchs.

In the Fig.1 showing the brief summary of the result that was reported in the previous paper for the case of a directional change from a straight line to 300R (30m/s), it is clearly shown that, in the rigid situation that does not consider the cornering dynamic characteristics, the front and rear lateral force delay become zero and the transient characteristics is shown with a single green broken line, but the vehicle characteristics is largely changed; when increasing the front wheel delay only, with the amplitude becomes larger and the ζ becomes smaller, on the contrary when increasing the rear wheel delay only, the amplitude becomes smaller and the ζ becomes larger.

Fig. 2 shows the result of observing the dynamic stability using low frequency root of the characteristic equation, when changing lane to the 3m distance from a straight line at V30m/s. In the summarized result, among the four combinations of the front and rear delay characteristics, the far-left blue line shows the highest dynamic stability. The meaning of the characteristic value: Tf shows the time constant of the front wheel, "1" means the delay equivalent to the amount of one tire. Tr shows that of the rear wheel, "3" means the triple-fold delay. Regarding the vehicle speed, the ranking of the dynamic stability is not affected by the speed from 15m/s to 50m/s. There are more results of the investigation and all of them will be introduced in the main paper.

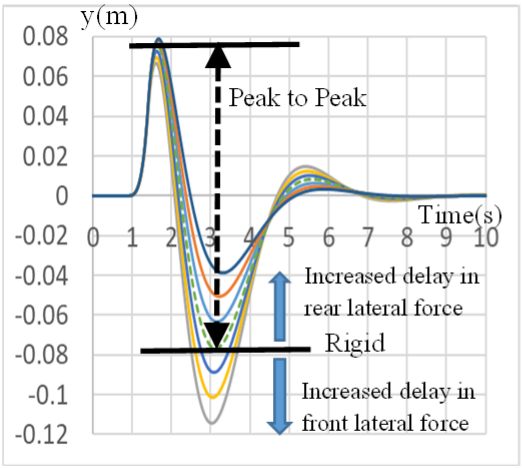

Fig.1 Deviation y from the target line during J-turn

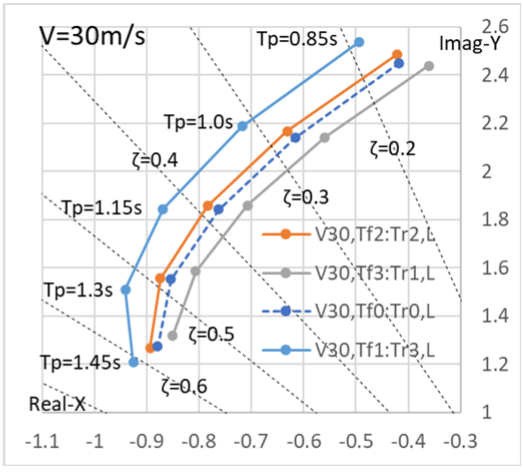

Fig.2 Characteristic root locus at V30m/s