Influence of road friction characteristics on two-wheeled vehicle behaviors

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This research aims to improve motorcycle safety by examining the influence of road friction characteristics on motorcycle behavior. Generally, motorcycle behavior is discussed in the linear characteristics domain, and many studies focus on basic characteristics such as eigenvalues. However, from the perspective of vehicle safety related to traffic accidents, it is extremely important to clarify the changes in vehicle behavior when the road friction coefficient decreases, and this is considered essential for reducing traffic accidents. In this paper, we describe the nonlinear characteristics of camber thrust and cornering force using a brush model that physically expresses tire characteristics in order to represent changes in tire characteristics in response to fluctuations in road surface friction characteristics. This model is then used to analyze the characteristics of two wheeled vehicle as affected by road friction. To describe in detail the effects of these changes in the friction coefficient, a quasi-steady-state analysis of a two-wheeled vehicle is used. In constructing the brush model, the shapes of the contact surfaces of the front and rear tires of the motorcycle were measured, as shown in Fig. 1, and this data was used to construct the model. To represent the effects of road friction, adhesion and sliding regions were defined within the contact surface, and these were represented using static and dynamic friction, respectively. When transitioning from maximum static friction to dynamic friction, characteristics were represented using relaxation length to ensure continuity.

Fig. 2 shows the analytical results for cornering force and camber thrust on motorcycle tires using the brush model. Using the results from these tire models, a quasi-steady-state analysis model for motorcycles was created. Using the results from these tire models, a quasi-steady-state analysis model for motorcycles was created. The reference conditions used for the calculation were steady-state circular turning characteristics with a radius of 50m, and the analysis assumed various road surface friction conditions. The analysis results are shown in Fig. 3. This figure shows that when turning under conditions of low friction coefficient, the specified turning radius cannot be maintained, the centripetal acceleration at that point cannot maintain the maximum friction coefficient of the road surface, and is strongly affected by kinetic friction. The next challenge is to create a model that includes not only lateral forces but also tire moments.

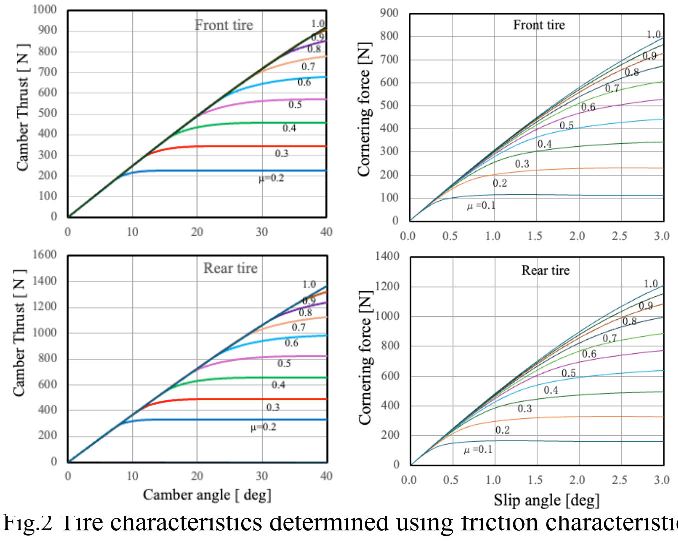

Fig.2 Tire characteristics determined using friction characteristics

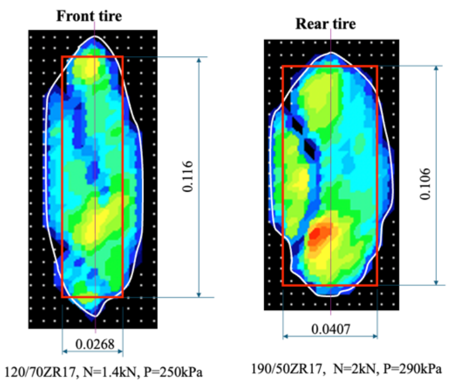

Fig.1 Tire contact patch shape

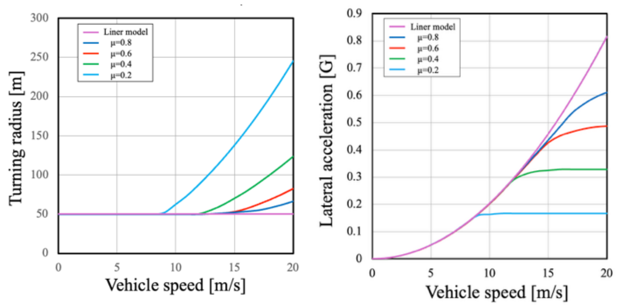

Fig.3 Road friction affecting motorcycle cornering

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