

Study on road friction information for next-generation road traffic safety - Construction of new system to improve measurement procedures and accuracy -

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Efforts to improve road traffic safety have been pursued from various perspectives for many years; recently, however, the widespread adoption of technologies such as ADAS (Advanced Driver Assistance Systems) has significantly enhanced passenger car safety. In particular, Autonomous Emergency Braking Systems (AEBS)—which are effective at reducing accidents—are now installed in nearly 100% of new passenger cars, and further benefits are anticipated in the future. Yet, as the adoption of these highly effective systems progresses, the reduction in traffic accidents is approaching a plateau, leading to rising expectations for innovative technologies such as more advanced ADAS and the introduction of autonomous vehicles. A "forward road surface friction information support system" represents a crucial technology capable of enhancing the performance of such systems. This information is expected to significantly improve the performance of braking and driving systems—including AEBS—thereby contributing substantially to road traffic safety. We have previously proposed and published a method for estimating road surface friction ahead of the vehicle by continuously measuring the road surface friction coefficient—specifically the peak μ -value of the μ -slip (μ -s) characteristic—on actual road surfaces. Building on these achievements, we developed a new measurement device designed to resolve issues associated with our previous measurement system, improve measurement efficiency, and construct a comprehensive database of road surface friction. This presentation outlines the device and introduces examples of results from fundamental experiments conducted using it.

The device developed in this study serves as a crucial source of baseline data for the subsequent stage of constructing a road surface friction estimation system; therefore, it was designed with the aim of enhancing both measurement accuracy and efficiency. The modifications made are as follows:

1) Taking measurement accuracy and expandability into account, a cantilever-type six-component force transducer was adopted for each test tire. This facilitated easy tire replacement.

2) To improve estimation accuracy, the number of tires used for measurement was increased from three to four tires.

3) The setup for applying braking torque to the test tire was modified—shifting from the previous trailer-tire configuration—to one where the torque balance generated between the tires is utilized for measurement. This change reduced the internal resistance of the drive system.

4) To stabilize the rolling of the drive tire, the load was set to three times that of the other measurement wheels.

5) Since tire friction characteristics depend on contact pressure, a method was proposed to correct tire characteristics for different loads.

6) Small-sized all-season tires were adopted to enable a comparison of friction characteristics ranging from dry asphalt to icy road surfaces.

7) Based on the above results, to ensure accurate identification, the μ -s characteristics corresponding to various road surfaces were estimated using the MF model; this information was then used to set the gear ratio such that the slip ratio would be positioned at the optimal point.

Fig. 1 shows the mechanism and a photograph of the newly developed road surface friction measurement system. Fig. 2 presents the analysis results of the slip ratio distribution based on the finally determined gear ratio.

Details regarding the system construction process are provided in the references and the presentation, while the measurement results are presented in this paper.

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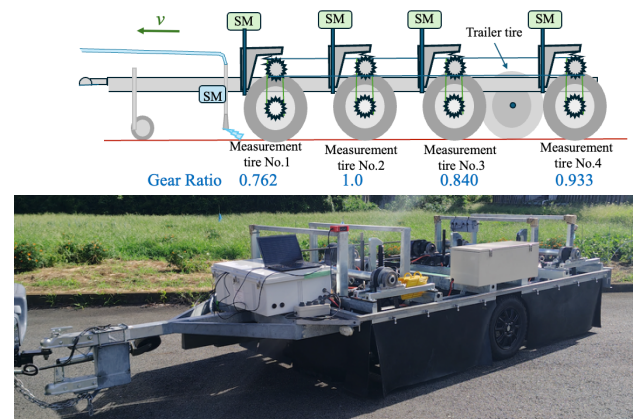


Fig.1 New road friction measurement system

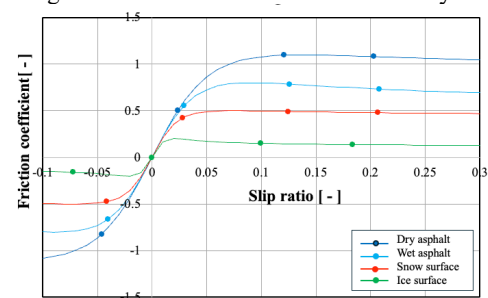


Fig.2 Assumed slip ratios for driving