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Performance Evaluation of Flat-Type Dynamometer for Road Simulation Using Driving Force Control of In-Wheel Motor Electric Vehicle

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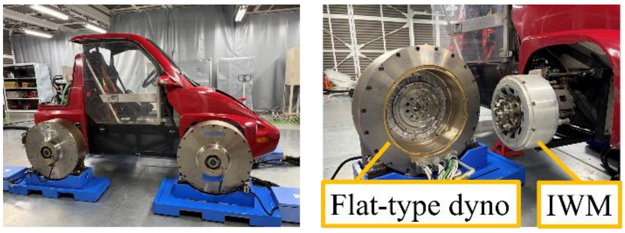
xEVs are gaining attention due to their advantages of not only the reduction of CO2 emission during cruising but also the high responsiveness of the motor torque. Especially, the advanced motion control of in-wheel motor (IWM) vehicles is widely studied to utilize the direct precise torque output without gears and driveshafts. A dynamometer is generally used to measure the fuel or energy consumption and evaluate the vehicle motion. In order to evaluate the xEVs' motion, hub-connected type dynamometer is effective because it has low inertia and no tire slippage comparing the conventional roller type dynamometer. In this paper, the performance of a newly developed flat-type dynamometer in Fig. 1 that can be installed in a wheel-well is evaluated using the driving force control of an IWM electric vehicle.

Three experiments are conducted; Exp. a. Identification of tire model on a low friction road, Exp. b. Experiment of μ-jump on an actual road, and Exp. c. Experiment of μ-jump on the flat-type dynamometer. Fig. 2 shows the measurement results of Exp. a using slip ratio control. This model is utilized in the dynamometer control in Exp. c. Fig. 3 shows the experimental results of Exp. b. The driving force is controlled at the reference on the high- μ area and decreased on the low- μ area. The slip ratio is controlled at less than the slip ratio limiter of 0.1 to prevent the driving force reduction by the high slip ratio. Fig. 4 shows the experimental results of Exp. c. The waveforms are similar with Fig. 3. The slip ratio exceeded the slip ratio limiter, and the oscillation frequency during the low- μ area in Figs. 3 and 4 are about 4 Hz and 5Hz, respectively. The reason of the difference may come from the communication lag in the dynamometer control system. For the IWM vehicle test using the dynamometer, the response needs to be more similar with the on-road test response. The dynamometer control system will be improved in the future.



(a) (b)
Fig. 1. Flat-type dynamometer.
(a) After installation. (b) Before installation.

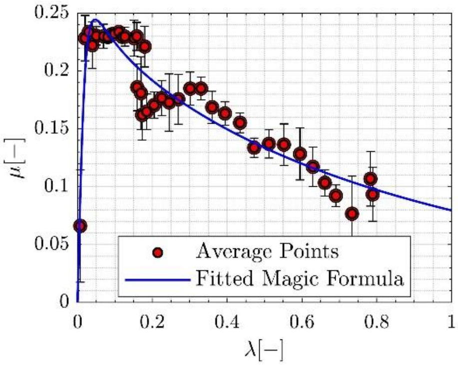
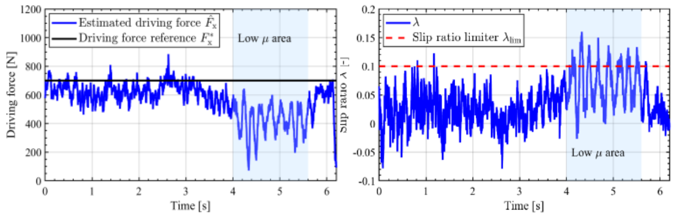
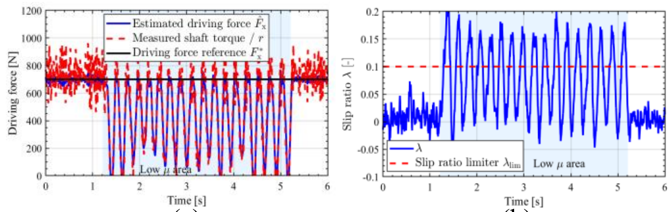


Fig. 2. Measurement results of tire model.



(a) (b)
Fig. 3. On-road test results.
(a) Driving force. (b) Slip ratio.



(a) (b)
Fig. 4. On-road test results.
(a) Driving force. (b) Slip ratio.

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