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Development of Driving Force Characteristic Design Technology to Realize Confident and Natural

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The basic performance of a car is said to be "driving," "turning," and "stopping," and the limits of each performance have been raised through advances in hardware and software. On the other hand, there is also a need for performance improvements in "ease of driving" and "at-will" performance, which are not in the area of maximum performance limitations but are more in line with human sensibilities, such as ease of use and comfort in daily use. In response to this "ease of driving," the development of powertrain control related to the vehicle's longitudinal motion has conventionally relied heavily on the calibration of the sensory evaluator for each vehicle and for each specification. In addition, driving performance is often limited to the range of possible calibrations due to constraints caused by hardware and the need for compatibility with fuel consumption and NV performance. In response to this situation, it is necessary to define the ease of driving in the daily driving range in a manner that is independent of vehicle systems and specifications in order to improve development efficiency and achieve consistent driving pleasure.

In this paper, we first focus on the longitudinal vehicle behavior at slow accelerator pedal operation speeds used in daily use, and then define the following four requirements for longitudinal acceleration for the driver to feel the desired behavior in daily use, assuming a variety of driving scenes.

(1) Ease of fine acceleration adjustment by accelerator pedal operation
(2) Moderate increase in acceleration in response to accelerator pedal pressure
(3) Ease of adjusting and maintaining vehicle speed
(4) Less fatigue when maintaining vehicle speed for long time

The driving force characteristics of the powertrain were then quantified from multiple perspectives and defined as driving force design requirements that consider accelerator pedal position, vehicle speed, and accelerator pedal hard characteristics, as shown in Fig. 1. We also studied design methods for applying to a vehicle, as well as the effects of sound and fuel consumption, and the effects of opposites, such as compatibility between controllability and acceleration feeling, and proposed a method to solve these problems.

Fig. 2 shows an example of the ease of operation in a vehicle incorporating the driving force characteristics designed to meet each requirement. Focusing on the accelerator pedal operation when following a certain speed pattern, it can be seen that the variation in operation is smaller in the vehicle to which this study was applied. As shown above, by realizing the index of ease of driving from multiple perspectives, it can be said that the range in which the vehicle behavior can respond to the driver's demands that change from moment to moment has been expanded. Furthermore, by designing the driving force in consideration of the vehicle specifications, it is possible to achieve the same ease of driving in different vehicle models, thus contributing to the unification of driving performance and the reduction of adaptation time to the different specification vehicles.

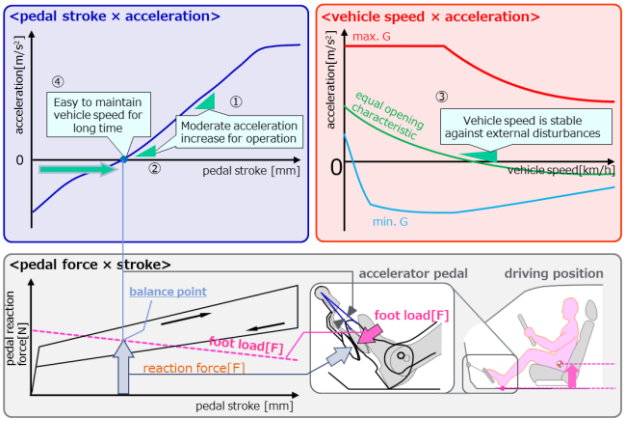

Fig.1 G Design Based on the Indexes

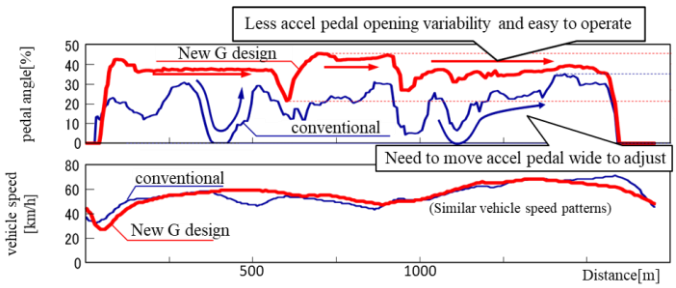

Fig.2 New G Design and Conventional Comparison