140-20145658 Analysis of vehicle motion on chassis dynamometers

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Presented at the JSAE Annual Congress on October, 23 ,2014

KEY WORDS: **vibration, noise, ride comfort, body vibration while driving**, vehicle constraint device (B3)

To analyze the vibration of the vehicle on a chassis dynamometer, the constraints imposed on the vehicle that affect its pitching motion are important. This paper describes the effectiveness of a vehicle pitching motion analysis method and describes how to simulate the vehicle pitching motion using a chassis dynamometer.

In the study of vehicle pitching motion, the analysis was focused on the motion of the vehicle when it started to accelerate, and the deceleration of the vehicle when it was stopped. A simplified simulation model of a vehicle was created to analyze the vehicle pitching motion. The test vehicle has a manual transmission. The test vehicle has been installed an sensor that can measure the vehicle acceleration during normal driving. The positions of sensors were determined on basis of consideration of result of the simulation.

The experiments were conducted on a dry asphalt road and with the fixed transmission position at first gear. On the chassis dynamometer, a high friction material was used on the surface of the roller, and a vehicle constraint device was designed and installed based on consideration of the moment of inertia of the vehicle. Fig.1 shows the placement of the vehicle constraint device. Measurement data from both the road and the chassis dynamometer were collected and analyzed.

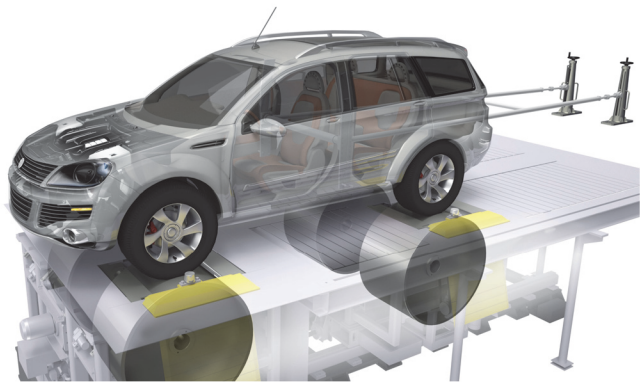

Fig.1 Placement of vehicle constraint

The vehicle pitching motion analysis assumes the vehicle acts as a rigid body. Identification of the pitching motion uses the theory of rigid body mode enhancement with constraint equations and a least squares method is used for operational modal analysis. The time domain data used in the analysis is created from measured data by calculations that use the time domain rigid body mode enhancement method. The time domain rigid body mode enhancement method results were evaluated by operational modal analysis. The results obtained from both the road and chassis dynamometer were similar in terms of the modes of vibration.

This paper shows the effectiveness of a method that can be used to reproduce valid vehicle pitching motion on a chassis dynamometer. The vehicle pitching motion analysis was quantified and illustrated by animation of the low frequency vibration modes. For example, Fig.2 shows a “freeze frame” capture of the animation of the squat mode of acceleration. Fig.3 shows a similar picture for the nose dive mode of deceleration. It was confirmed that using a combination of operational modal analysis and time domain rigid body mode enhancement is an effective method of analyzing and evaluating vehicle pitching motions.

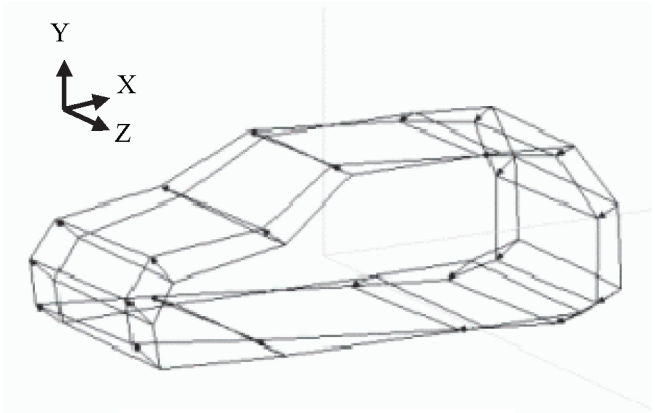

Fig.2 Squat mode of acceleration

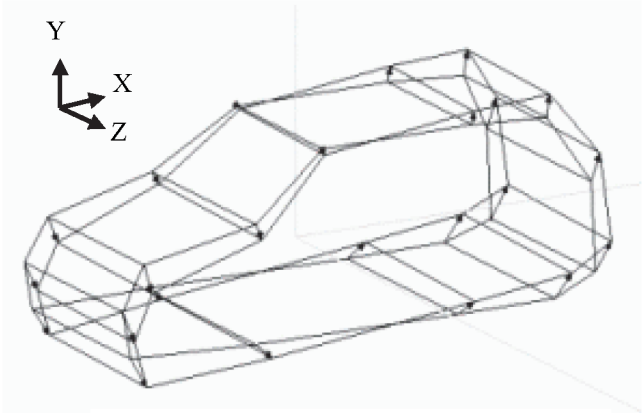

Fig.3 Nose dive mode of deceleration