

Evaluation of the dynamic characteristics of the human body-seat system and ride comfort using actual vehicle vibration

Takuya Yoshimura ¹⁾, Koji Ogasawara ¹⁾, Jiajun Hong ¹⁾, Gen Tamaoki ¹⁾, Shuya Nojima ²⁾, Hirotaka Shiozaki ²⁾

1) Tokyo Metropolitan University

1-1 Minami-Osawa, Hachioji, Tokyo 192-0397, Japan

2) Mitsubishi Motors Corporation

1 Aza-Nakanoshinkiri, Hashime-cho, Okazaki, Aichi 444-8501, Japan

KEY WORDS: Ride Comfort, Human-Seat System, Operational Modal Analysis, Frequency Domain Decomposition, Six-axis Exciter

Ride comfort is determined not only by vehicle-body vibration but also by vibration transmitted through the seat to the human body. This study aims to identify vibration components that may affect ride comfort by reproducing actual-road vibration with a six-axis exciter and comparing two automotive seats under identical input conditions.

Accelerations at four seat mounting points during unpaved-road driving at 40, 60, and 80 km/h were measured. The waveforms were reproduced by a 6DOF exciter. The excitation is applied to Seats A and B with a seated subject (Figure 1). Three-axis acceleration was measured at 17 points, providing 51 response components. Frequency Domain Decomposition (FDD) was applied to the response power spectral density matrix, and the first principal component was used to characterize the dominant operational modes. The vibration characteristics and the ride comfort of seats A and B are compared.

Figure 2 shows representative operating deflection shapes extracted from the FDD peaks. The shapes were interpreted as whole-body Z translation in the 1–5 Hz band, head Z translation combined with backrest roll in the 5–10 Hz band, and large backrest/headrest roll in the 15–20 Hz band. Thus, the figure provides the physical interpretation of the dominant spectral components, while the frequency comparisons below quantify their changes with speed and seat.

FDD was then used to quantify seat-dependent changes. Seat B additionally exhibited FDD peaks corresponding to normal backrest motion, buttock/thigh motion, and large backrest/headrest pitch in the 1–5, 10–15, and 22–28 Hz bands. For the 22–28 Hz peak, the center frequency was about 26 Hz. These characteristics were only found for seat B. The ride comforts for two seats are evaluated, and it is found that the ride comfort of seat B is inferior to seat A. Therefore, it is suggested that these vibration characteristics might affect the ride comfort evaluation for seat B.

As a future work, we would like to focus more on the relationship between the vibration characteristics and the vibration comfortness.



Fig. 1 A subject seated on seat A(left) and B(right)

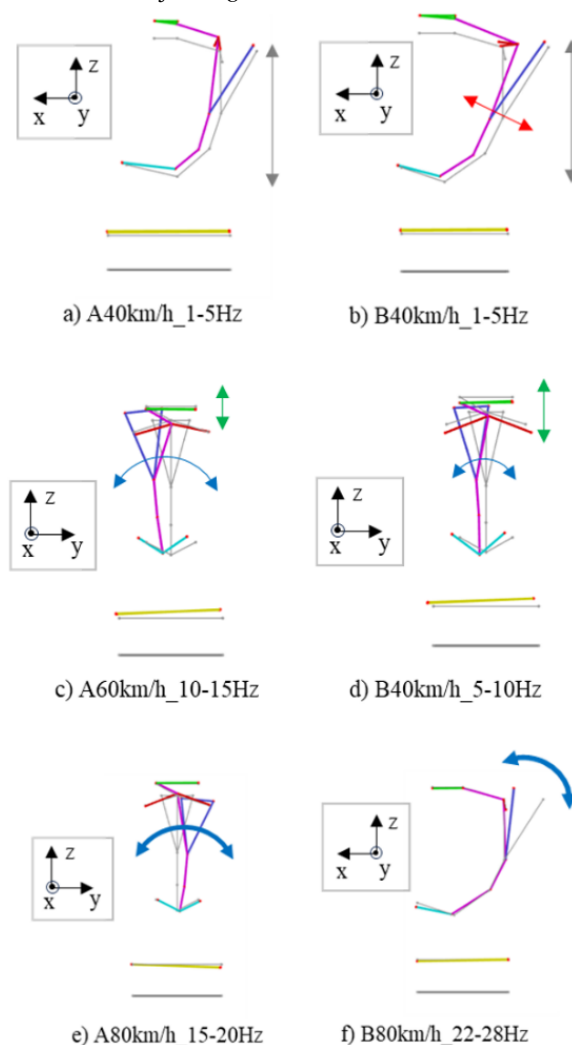


Fig. 2 Six operating deflection shapes.