Evaluation of seat vibration sources in driving condition using spectral analysis

Abstract

Seat vibration is one of the major causes of discomfort in moving vehicle. Tyre, engine, drivetrain and aerodynamic forces excite the cabin and interior through various pathways. In this paper, the contributions of tyre and engine vibration to seat excitations are studied. Virtual Source Analysis (VSA) is implemented to decompose the source signals into incoherent phenomena. Studying these phenomena (virtual sources) shows the amount and frequency bands that physical sources affect the seat vibration as the response channel. Experiment is conducted while riding on smooth and bumpy roads. Road roughness is characterized using International Roughness Index (IRI). VSA technique approve that tyre is the main source of seat vibration for the moving vehicle. Seat vibration has significant values below 400 Hz and tyre is found to be the dominant source of excitations for both smooth and bumpy roads. For smooth road, strong engine harmonics below 200 Hz also has some involvements. But in bumpy road, tyre vibration rise up and become the dominant broadband source of excitations. Tyre damper and engine mount Frequency Response Function (FRF) analysis show that these parts are designed to be highly efficient below 1400 Hz and 200 Hz, respectively. These ranges are identical with those that were found as the critical operational frequency spans in VSA.