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Design and Analysis of Semi-Active Isolation System in Low Frequency Excitation Region for Vehicle Seat to Reduce Discomfort

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Abstract : The vibrations transmitted to the drivers and passengers through vehicle seat seriously effect on the level of their attention, fatigue and physical health and reduce the comfort and efficiency of the occupants. Recently, some researchers have focused on vibrations at low excitation frequency(0.5-5 Hz) which are considered to be the main risk factors for lumbar part of the backbone but they were not applicable to A and B-segment cars regarding to the size and weight. A semi-active system with two symmetric negative stiffness structures (NSS) in parallel to a positive stiffness structure and actuators has been proposed to attenuate low frequency excitation and makes system flexible regarding to different weight of passengers which is applicable for A and B-Segment cars. Here, the 3 degree of freedom system is considered, dynamic equation clearly is presented, then simulated in MATLAB in order to analysis of performance of the system. The design procedure is derived so that the resonance peak of frequency–response curve shift to the left, the isolating range is increased and especially, the peak of the frequency–response curve is minimized. According to ISO standard different class of road profile as an input is applied to the system to evaluate the performance of the system. To evaluate comfort issues, we extract the RMS value of the vertical acceleration acting on the passenger's body. Then apply the band-pass filter, which takes into account the human sensitivity to acceleration. According to ISO, this weighted acceleration is lower than 0.315 m/s^2, so the ride is considered as comfortable.

Keywords : low frequency excitation, negative stiffness, seat vehicle, vibration isolation
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