ABSTRACT:

Vibration isolation is widely achieved by using semi-active magneto-rheological (MR) fluid dampers in many applications. In present work, a mono-tube MR-fluid damper is modeled from physical principles. The model includes Bouc-Wen hysteresis element to represent the behavior of the MR-fluid. The nonlinear hysteresis elements are replaced by equivalent linear elements using method of equivalent linearization. The input-output characteristics are calculated in the form of impedance of the damper. To study the performance of the MR-fluid damper when used in passive mode, a single stage isolator with the MR-fluid damper is first considered. An analytical solution of the system is found by using a modified averaging technique. A new definition of transmissibility is provided to measure the performance of the nonlinear isolators as the linear transmissibility equations cannot be applied. Thereafter the performances of the MR-fluid damper in a two stage isolator are studied for harmonic, transient and stochastic excitation. The MR-fluid damper is used in semi-active mode and is controlled using on-off sky-hook control strategy. The rapid switching of the on-off control strategy results in jerk and chatter of the system. Two anti-jerk solutions are discussed in the present work, one is by providing a dead-band around the switching points and the other is by using a first order filter to the control input which makes the transition from on to off state smooth. Although the MR-fluid dampers are used for the reduction of vibration to the lowest possible level, in practical cases it may not be acceptable because of various other measures. For example, in automotive suspension system, the low vibration of the sprung mass leads to large stroke length and large dynamic tire force. Thus, different performance indices are used for evaluating the performance of an isolator. The performance indices considered are different for harmonic excitation and transient excitation. An optimization problem is constructed to find out the optimum voltage to be applied to the MR-fluid damper for best performance.