

Application of Magnetorheological Dampers for Vehicle Seat Suspensions

by

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This study evaluates and provides solutions to the problem of poor subjective feel of seat suspensions that employ magnetorheological (MR) dampers and skyhook control. An Isringhausen seat suspension that had been modified to replace the stock passive damper with a controllable MR damper was used to evaluate the problems and potential solutions. A seat suspension tester was built using materials from 80/20 Incorporated and a hydraulic actuation system from MTS. An HP Dynamic Signal Analyzer was used as the main piece of data acquisition equipment, along with a Pentium PC and National Instruments Data Acquisition card. All of the hardware is installed in a controlled laboratory facility at Virginia Tech's Advanced Vehicle Dynamics Lab.

The first task was to analyze the source of the unexpected peak in the acceleration spectrum of the suspended seat. This analysis was accomplished using a combination of pure tone inputs and a Fourier analysis of a simple model of the system. This analysis indicated that the peak is actually three times the resonant frequency of the seat suspension. The analysis also indicates that the frequency components continue at odd multiples of the resonant frequency, however, the third peak is the most noticeable. The third multiple is in the resonant frequency range (4-8 Hz) of the human body, so it was initially blamed for the poor subjective feel of the seat. However, solutions to remove this harmonic were tested without success.

The work progressed to a time domain analysis, which eventually led to determining the source of the poor subjective feel. The seat suspension was excited with a variety of inputs. The seat acceleration and damper control current were examined in

the time domain to show that the cause of the poor subjective feel is the control signal discontinuities. The control policy was modified to remove the control signal discontinuities and was found to improve the subjective feel of the seat.

Finally, several two-degree-of-freedom control policies were implemented and tested. Although the results from this testing are inconclusive, they generated several recommendations for future research.

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