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Mitigating Vehicle Shock Loads in Occupant Protection Systems using High Speed Magnetorheological Flows

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ABSTRACT

Controlling dissipation of energy in vehicle systems, especially with the goal of protecting occupants from potentially injurious shock, crash or blast loads, is a critical issue as the cumulative impact of these load spectra on chronic health and acute injury are becoming better understood. Energy is dissipated utilizing a stroking element, such as a hydraulic damper or energy absorber. However, it is difficult to anticipate precisely what range of occupant mass an occupant protection system might be expected to protect, or what shock spectra the system might encounter.

Therefore, adaptation of stroking load is required to enable a system to have sufficient adjustability or control of energy dissipation across a wide range of anticipated disturbances, as well as robustness. The goals of this research are threefold: (1) to develop field magnetorheological (MR) fluids that suitable for these applications, (2) to develop magneto-rheological energy absorbers (MREAs) that enable adaptation of stroking load to minimize lumbar loads in the human spine and to minimize the potential for injury, and (3) to use adaptive seat suspension technology to protect occupants from a wide range of shock spectra, as well as to accommodate variable occupant mass.