Passive Control Of An Electromagnetic Friction Damper For Displacement Reduction Of Multi-Story Base-Isolated Buildings

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This paper studies the application of Simple-Passive (SP) control algorithm to improve the energy dissipation capability of a high-performance electromagnetic friction damper (EMFD) utilized for passive vibration control of multi-story base-isolated buildings subjected to strong earthquakes. The EMFD consists of a ferromagnetic plate and two similar arrays of thick rectangular ferromagnetic-core coils (FCs) connected in series. The FCs are attached to the two sides of the ferromagnetic plate through two non-magnetic friction pads. The damper force is generated by the friction developed between the friction pads and the ferromagnetic plate when the FCs moves relative to ferromagnetic plate during the ground motion. The normal force developed at the contact surfaces between the friction pads and the ferromagnetic plate is generated by the attractive magnetic interactions between the FCs arrays and the ferromagnetic plate. The magnitude of this force can be changed by varying the current flowing through the FCs using the SP controller which is designed to apply a high current to the FCs around the zero-displacement position of damper piston to maximize the dissipation of input seismic energy. This controller can be emulated using a simple mechatronics mechanism without need for any electrical power and sensor (e.g., accelerometer), or computer processor. The capability of EMFD to control the seismic response of base-isolated buildings is demonstrated by implementing it into the dynamic model of a six-story base-isolated building supported on lead-rubber bearings (LRBs). The numerical results show that the EMFD when controlled by the SP controller is capable of fully protecting the base-isolated building from ground motions with intensities at the level of ASCE 7-10 Maximum Considered Earthquake (MCE), presenting a performance that is comparable to the case when the EMFD is controlled by the Saturated Semi-active Friction (SATSAF) controller.