ABSTRACT

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In recent years, the expectations of civil engineering as a discipline have begun to change. More importance is being placed on sophisticated design, with an emphasis on sustainability and resiliency. Natural hazard protection is becoming more of a concern to communities around the globe, given the recent devastation that occurred as a result of earthquakes in Haiti, Chile, Japan, Turkey, and China, and earthquake awareness is rising. Simply put, society is demanding more of its structures.

This research proposal focuses on the development, evaluation, and validation of a new semi-active control strategy for use with large-scale MR dampers in structural control applications through real-time hybrid testing. The proposed control algorithm, which consists of an optimal regulator coupled with a control law that utilizes an over-/back-driving algorithm to select the current applied to the MR Damper, is expected to improve structural performance under seismic loading and ultimately, lead to improved design methodologies which utilize these devices. A series of three large-scale validation experiments (using large-scale 200kN MR Dampers and steel frames) are planned for the proposed control algorithm, including: (1) a three-story linear structure real-time hybrid simulation, with a large-scale steel frame and MR damper as tbe physical substructure; (2) a nine-story linear structure real-time hybrid simulation, with a large-scale steel frame

and MR damper(s) as the physical substructure; and (3) a non-linear nine-story structure numerical simulation analysis.

The results of this research will prove meritorious to the field of structural control and seismic mitigation. Validation of improved structural performance using MR Dampers on large-scale nonlinear structural models will demonstrate the intrinsic worth of using these devices in performance-based design applications. Development and validation of control algorithms will help facilitate the use of MR dampers on a larger scale, both within the academic and professional engineering communities.