DESIGN AND IMPLEMENTATION OF AN AMD SLIDING MODE CONTROLLER BASED ONA REDUCED MODEL

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ABSTRACT

Active structural control has attracted considerable interest in recent years, as structures are getting taller yet more flexible (Soong, 1998). Active mass dampers (ADMs) are one of the efficient solutions presented for mitigating destructive effects of seismic and wind loads. However, design of model-based active structural control systems is such a hardship, as the available models for the control design are contaminated with parametric uncertainties and unmodeled dynamics. Robust control is agoodsolutionfor active control of uncertain structural systems (Zhao et al, 2000). In this research, design and implementation of a new robust sliding mode controller for tackling seismic excitations in the presence of parametric uncertainty is presented. For this purpose, a shear frame model developed based on a reduced model of a high rise building is built in laboratory scale. The structure is then equipped with a laboratory scale AMD system and the proposed controller is implemented in the system. Finally, effectiveness of the proposed controller is evaluated via shake table tests. The test results prove success of the proposed controller in suppressing inter-story drift and base shear responses in the presence of structural uncertainty.

INTRODUCTION

Nowadays preserving building performance against natural phenomenon such as earthquake and wind is one of most controversial subjects between engineers. It would be more necessary if we notice that the rate of construction is going up especially in areas with high level of seismic activity. Therefore, this subject has attracted many researches in recent years(Somali et al,2004,Lu et al,2003).

Dynamic response control of a structure may be performed via passive, semi-active, or active systems. Among them, the passive structural control systems have attracted more interests in recent years because of their simplicity, low cost, andzero energy consumption (Housner et al,1997, Park et al,2002, Somali et al,2003, Choi et al,2005,Guclu R, Yazi et al,2008, Mohan et al, 2008, Tani et al,2008, Li et al, 2010, Bitaraf, et al,2012). Nevertheless, performance of the passive systems is restricted as they are usually tuned for a certain frequency range, most of the time the first structural mode. Therefore, they are not able to adopt themselves with different disturbances. Due to uncertain nature of seismic disturbances, this maybeconsidered as a serious drawback of the passive structural control systems (Yang et al,1996 and