Semi-Active control of base-isolated structures using a nonlinear feedback strategy

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ABSTRACT: Base isolation systems have been proposed for reducing the transmission of seismic forces and energy to buildings when subjected to earthquake loads. Passive devices are often prescribed to reduce displacements at the isolation level but in certain circumstances structural interstorey drifts and absolute accelerations can increase. This work explores the use of semi-active devices whose input is obtained from an output nonlinear control law resulting from the transformation of the nonlinear system into a linear one which is then controlled by a proportional controller. Within this nonlinear feedback control strategy the whole system formulation is considered for deriving the control law. A two degree of freedom experimental model representative of a typical base isolated building, currently under development at LNEC, is used as an example to evaluate the performance of the proposed strategy when subjected to accelerograms for the Portuguese territory. The results of the experimental characterization of the model components and for a magneto-rheological damper are presented. Numerical simulation results show that the proposed strategy to command the damper in real time can reduce the base relative displacement with better performance at the superstructure level (interstorey and accelerations) than the damper working in the passive mode. Although a small increase in the base acceleration for one type of seismic action is observed when compared to the original structure, it is always lower than the one resulting with the passive case.

KEY WORDS: Semi-Active Control; Nonlinear Feedback Control; MR dampers; Hybrid Base Isolation; Seismic Protection.

1. INTRODUCTION