SEMIACTIVE CONTROL OF THE BASE ISOLATED BENCHMARK BUILDING WITH MR DAMPERS IN THE CONTEXT OF DISSIPATIVITY

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Semiactive control of structures with smart dampers for seismic mitigation has received special attention in the structural control community due to its advantages over other control strategies. Smart damper commands are generally designed using linear active control theory assuming that the damper is a fully active device; this is obviously not a realistic assumption since a damper, whether passive or semiactive, can only exert dissipative forces. Although previous research showed that the linear active assumption yields performance sufficient for most civil structures, there are some cases where it is not as efficient as expected. In general, if the active control force yields highly dissipative forces, the damper is successful in exerting these forces. It is, therefore, clear that *a priori* knowledge of the dissipative nature of the active control theory used in semiactive control will be quite useful, not only in the prediction and thorough understanding of the semiactive performance, but also in obtaining better control designs. Interestingly, there is very little work on dissipativity in the structural control community. Two recent attempts have been the introduction of so-called "dissipativity indices" to characterize the dissipative nature of an active controller (see [1] and references therein). While these studies have been very helpful in understanding the concept of dissipativity, they were bound to simple structural models and idealized damper models. It would be useful to investigate dissipativity indices in the context of a real-life semiactive control problem, where realistic structure and damper models are used, such as the recently introduced base isolation benchmark building [2] and magnetorheological fluid (MR) dampers [3].

This paper investigates the effects of dissipativity on semiactive control of the base isolated benchmark building with several MR dampers. Mathematical models of both benchmark structure and the damper are readily available [2, 3]. In this study, linear quadratic regulator (LQR) control theory is selected as the primary control strategy. Two control approaches are investigated: a conventional clipped-optimal semiactive control design and a semiactive clipped-optimal control design based on the dissipativity characteristics of the active controller. It is observed that dissipativity indices can be used to identify active controllers those are more likely to produce efficient semiactive performance in a real-life semiactive control problem, which eliminates active controllers those are not expected be efficient. The indices also provide useful information regarding the individual dampers, such as their efficiency and necessity in the structural system.

References

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