



Effect of Optimum Control Input in Seismically Excited Structure Considering Modal Control Spillover

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Abstract

In this work, the adverse effects of the modal control spillover are investigated for a multi-degree-of-freedom (MDOF) system under seismic excitation. The spillover occurs primarily due to the non-ideal optimal control force applied to the structure. In the study, the optimum control force is designed in accordance to the linear quadratic Gaussian control algorithm in the independent modal space. A closed form expression is developed in the frequency domain in the form of transfer function for assessing the amplification in responses due to the presence of spillover. Based on the formulation, a numerical investigation is carried out for a ten-story frame structure subjected to three ground excitations within the range of modal natural frequencies of the structural system. The optimum modal control force is designed by minimizing the displacement of the system considering a single input location. The performances of the structure under the designed control action are assessed in terms of the floor displacement and the horizontal floor acceleration. A huge amplification of the absolute maximum horizontal floor acceleration is observed for the structure under the control action as compared to the uncontrolled structure. The performance is found to be satisfactory in case of the floor displacement however, a response degradation in terms of the absolute maximum horizontal floor acceleration is observed for all the floor levels due to the spillover phenomena.

Keywords: Control spillover, Transfer function, Linear quadratic control