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# A Strategy for Multi-hazard Response Analysis of Structures Using Real-time Hybrid Simulation

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## Abstract

This paper focuses on the development of a real-time hybrid simulation (RTHS) framework for multi-hazard response analysis of structures. The RTHS controls for the transfer system are designed using a strategy based on impedance matching. The major advantage of this strategy is that it decouples the control design from the physical subsystem, which may exhibit arbitrary complex behaviour. The proposed strategy can be adapted to incorporate different type of hazard scenarios, occurring individually or in sequence. Although applicable more generally, the strategy is demonstrated for the response analysis of two-storey structure subjected to base- and force-excitations. The physical subsystem consists of the bottom storey. The effect of the remaining structure, which forms the virtual sub-system, is realized with the help of a transfer system (electromagnetic shaker) placed at the top of the physical subsystem. The earthquake loading is applied using a shake table, while the effect of wind loading is accounted in the computer model. The responses obtained from RTHS are found to match well with that of the full structure. The proposed strategy can be effectively used for the response analysis of structures subjected to dynamic loads due to various hazards like wind, earthquake, tsunami or fire.

**Keywords:** Multi-hazard, Impedance matching, Controller design