

Testing platform and delay compensation methods for distributed real-time hybrid simulation

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Abstract

Real-time hybrid simulation (RTHS) plays an essential role in understanding the time-dependent behavior of structures when subject to extreme hazard loadings in civil engineering research. During RTHS, physical experiment on critical substructure component(s) and numerical simulation of the remaining structure are seamlessly integrated to obtain the whole structural response at the system level. To leverage test equipment among several laboratories for complex structure systems, distributed real-time hybrid simulation (dRTHS) was proposed and has been successfully applied in seismic experimentation of building structures. In addition to actuator delay experienced in a typical RTHS experiment, internet delay due to data transmission between controllers of loading equipment located at geographically distributed laboratories also exists in dRTHS. To compensate the total large and varying time delay, four delay compensation methods were implemented in a recently developed dRTHS testing platform and their performances were evaluated through a series of virtual and physical dRTHS experiments. The development of the dRTHS testing platform and the four delay compensation methods are introduced first. Then testing results demonstrating the effectiveness of these methods were presented together with the reliability of dRTHS experiment method in earthquake engineering and its potential applicability in other engineering fields. .