Adaptive multi-rate interface: development and experimental verification for real-time hybrid simulation - DTU Orbit (08/11/2017)

Adaptive multi-rate interface: development and experimental verification for real-time hybrid simulation

Real-time hybrid simulation (RTHS) is a powerful cyber-physical technique that is a relatively cost-effective method to perform global/local system evaluation of structural systems. A major factor that determines the ability of an RTHS to represent true system-level behavior is the fidelity of the numerical substructure. While the use of higher-order models increases fidelity of the simulation, it also increases the demand for computational resources. Because RTHS is executed at real-time, in a conventional RTHS configuration, this increase in computational resources may limit the achievable sampling frequencies and/or introduce delays that can degrade its stability and performance. In this study, the Adaptive Multi-rate Interface rate-transitioning and compensation technique is developed to enable the use of more complex numerical models. Such a multi-rate RTHS is strictly executed at real-time, although it employs different time steps in the numerical and the physical substructures while including rate-transitioning to link the components appropriately. Typically, a higher-order numerical substructure model is solved at larger time intervals, and is coupled with a physical substructure that is driven at smaller time intervals for actuator control purposes. Through a series of simulations, the performance of the AMRI and several existing approaches for multi-rate RTHS is compared. It is noted that compared with existing methods, AMRI leads to a smaller error, especially at higher ratios of sampling frequency between the numerical and physical substructures and for input signals with high-frequency content. Further, it does not induce signal chattering at the coupling frequency. The effectiveness of AMRI is also verified experimentally.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Structural Engineering, Purdue University
Authors: Maghareh, A. (Ekstern), Waldbjørn, J. P. (Intern), Dyke, S. J. (Ekstern), Prakash, A. (Ekstern), Ozdagli, A. I. (Ekstern)
Pages: 1411-1425
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Earthquake Engineering and Structural Dynamics
Volume: 45
Issue number: 9
ISSN (Print): 0098-8847
Ratings:

BFI (2017): BFI-level 2

Web of Science (2017): Indexed yes

BFI (2016): BFI-level 2

Scopus rating (2016): CiteScore 2.91 SJR 2.293 SNIP 2.265

Web of Science (2016): Indexed yes

BFI (2015): BFI-level 2

Scopus rating (2015): SJR 2.771 SNIP 2.824 CiteScore 3.08

Web of Science (2015): Indexed yes

BFI (2014): BFI-level 2

Scopus rating (2014): SJR 3.046 SNIP 2.99 CiteScore 3.25

Web of Science (2014): Indexed yes

BFI (2013): BFI-level 2

Scopus rating (2013): SJR 2.5 SNIP 2.824 CiteScore 2.93

ISI indexed (2013): ISI indexed yes

BFI (2012): BFI-level 2

Scopus rating (2012): SJR 2.829 SNIP 2.717 CiteScore 2.19

ISI indexed (2012): ISI indexed yes

Web of Science (2012): Indexed yes

BFI (2011): BFI-level 2

Scopus rating (2011): SJR 2.669 SNIP 2.45 CiteScore 2.46

ISI indexed (2011): ISI indexed yes

Web of Science (2011): Indexed yes

BFI (2010): BFI-level 2

Scopus rating (2010): SJR 2.261 SNIP 2.13

BFI (2009): BFI-level 2