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International Doctoral Program in Civil and Environmental Engineering

SEMINAR

Developing rate-rate digital twins for structures under shock loading

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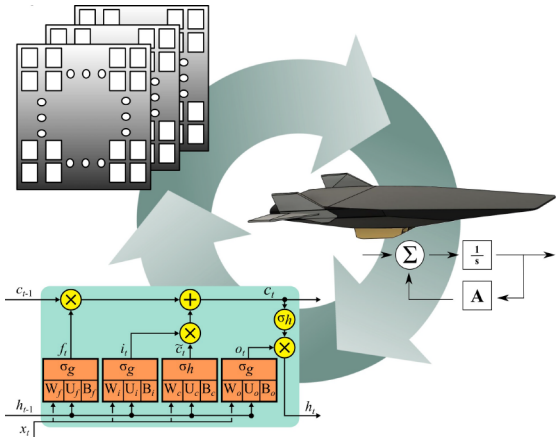

Location:
UNIPG Campus of Engineering
Via G. Duranti, 93, Perugia, Italy
Aula 3

Timetable:
October 26th 2022 - 11:30 a.m. (CET)

Abstract
A structural system operating in a high-rate dynamic environment can experience sudden and unmodeled plastic deformation of the structure that may further lead to damaged electronics, sensors, and/or delicate payloads. Examples of structures that may experience high-rate dynamics include hypersonic vehicles, space crafts, and active blast mitigation barriers. To enhance the survivability of these structural systems, real-time decision-making modules capable of taking corrective actions need to be developed. A current challenge exists in the development of structural modeling techniques that can provide accurate representations of the system at a time interval of less than 1 millisecond. This presentation will discuss recent efforts undertaken on developing co-design hardware/software solutions to enable high-rate model updating. Hardware targets include field programmable gate arrays (FPGA) and real-time operating systems (RTOS); both running on small-footprint hardware. Software approaches for developing physics-informed and data-driven approaches for updating structural models at the microsecond timescale will be presented. Moreover, methodologies for forecasting dynamic structural responses subjected to nonstationary inputs will be discussed. Results demonstrate that continuously changing boundary conditions can be successfully tracked at time intervals of 1 millisecond or less. Computational speed and estimation accuracy as a function of model size as well as the role of measurement noise are examined in this work.

Prof. Austin Downey is an Assistant Professor at the University of South Carolina in the Department of Mechanical Engineering with a dual appointment in the Department of Civil and Environmental Engineering. His research focuses on increasing the resiliency of structures to both manmade and natural events through low-latency machine learning, real-time model-updating, adaptive structures, and structural health monitoring. He has authored over 80 publications related to his research and is the lead inventor on two U.S. patents. In 2021 he received a YIP award from the AFOSR. He obtained his Ph.D. from Iowa State University in 2018 in Engineering Mechanics and Wind Energy Science, Engineering, and Policy (Dual Majors) where he was an NSF-IGERT fellow.

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