OPPORTUNITIES FOR CYBER-PHYSICAL TESTING IN WIND ENGINEERING

Brian M. Phillips[*1], Michael L. Whiteman[1], Pedro L. Fernández-Cabán[1], and Forrest J. Masters[2]

[1]University of Maryland, College Park, MD 20742, USA; [2]University of Florida, Gainesville, FL 32611, USA

[*]bphilli@umd.edu

Experimental testing remains an essential tool for wind engineers to evaluate the performance of buildings under stead wind loads, gusts, and wind-structure interaction. As laboratories develop new capabilities toward experimentally modeling tornadic events, additional hazards and loading conditions can be experimentally studied. Cyber-physical testing has its origins in earthquake engineering where a structural system is partitioned into numerical and experimental components. The experimental partition is used to represent components that are difficult to model numerically. Numerical and experimental components are linked together through a loop of action and reaction using actuators and sensors to simulate the seismic response of the total structural system. This partitioning, known as hybrid simulation, enables laboratories to make more efficient use of limited experimental resources. Hybrid simulation falls under the broader category of cyber-physical testing. Recently, researchers have begun to explore the potential for cyber-physical testing in wind engineering. With an increasing ability to experimentally model tornadic events, the cyber-physical testing of structures under tornadic loading is an exciting possibility. This presentation explores the potential for cyber-physical testing in wind engineering, including test automation, hybrid simulation (model-in-the-loop testing), and optimal design (loop-in-the-model testing). Focus is placed on a new approach to the optimal design of structures in wind engineering that integrates traditional experimental testing with heuristic optimization algorithms and mechatronic building models.