

Hybrid Simulation Capacity Building and Standardization: Before, during and after NEES

Božidar Stojadinović
Professor, Chair of Structural Dynamics and Earthquake Engineering
Institute of Structural Engineering
ETH Zürich

Two questions every chief lab technician faces when a happy researcher announces that he or she just received a grant for a fantastic new project that involves hybrid simulation are: how are we going to do this? and who (not me!) is going to run the tests?

The George E. Brown Jr. Network for Earthquake Engineering Simulation (NEES) is a remarkable milestone in the history of capacity building and standardization of hybrid simulation. Before NEES, the field of hybrid simulation may best be characterized as “the Wild West”. This is not only because a lot of work happened to take place at UC Berkeley, but more so because every new hybrid simulation project was a high-wire balancing endeavor in its own right. It included developing custom hardware and software and conduct of unique, never-repeated, tests. The “Wild West” phase lasted through 1980’s and 1990’s and produced remarkable advances in hybrid simulation.

NEES brought about an era of consolidation and systematization in hybrid simulation that lasted through the 2000’s. The first hybrid simulation platforms, OpenFresco, Sim-Core but also Mercury, PISA/VISA and the JRC platform to mention a few, were formulated and the ideas on a general hybrid simulation architecture and the component interactions were firmed up. Attempts to regularize the conduct of tests, to curate the data, to quantify errors, and to define what is an acceptably good hybrid simulation also took place during NEES. The NEES era is also remarkable for the efforts in capacity building marked by numerous instructional (not research) workshops at NEES (and other) labs with hybrid simulation capabilities. The result of these workshops was a significant increase in the number of people who conducted some form of hybrid simulation. Another outcome of the NEES era is support and industry implementation of hybrid simulation options in structural testing software and hardware (e.g. MTS system). Importantly, the NEES era is one where collaboration among people doing hybrid simulation became the norm.

The era after NEES, this decade, is marked by a slowdown in capacity building activities. For a variety of reasons, there are fewer research meetings and significantly fewer instructional workshops. There are, also, not as many research projects that use hybrid simulation as the means to get results: instead, projects on the development of the hybrid simulation methods and techniques (e.g. real-time simulations) dominate. These, again, tend to be insular, arching back to the “Wild West” era.

Today, we have a chance to define the next decade in hybrid simulation work. Capacity building, education, of the next generation of engineers capable of doing hybrid simulation and using it in their primary research area, must be restored and invigorated. Standardization, starting from formal verification and validation techniques and definition of methods and

acceptance criteria for good hybrid simulations, and moving toward dynamic virtualization, needs to come back into focus. I single out these two activities, knowing full-well that they cannot exist in a vacuum, without fundamental work on further developing the hybrid simulation method and expanding the scope where it can be applied. Only in synergy between frontier-moving research, standardization and capacity building can the entire field of hybrid simulation advance further and remain vibrant in the decades to come.