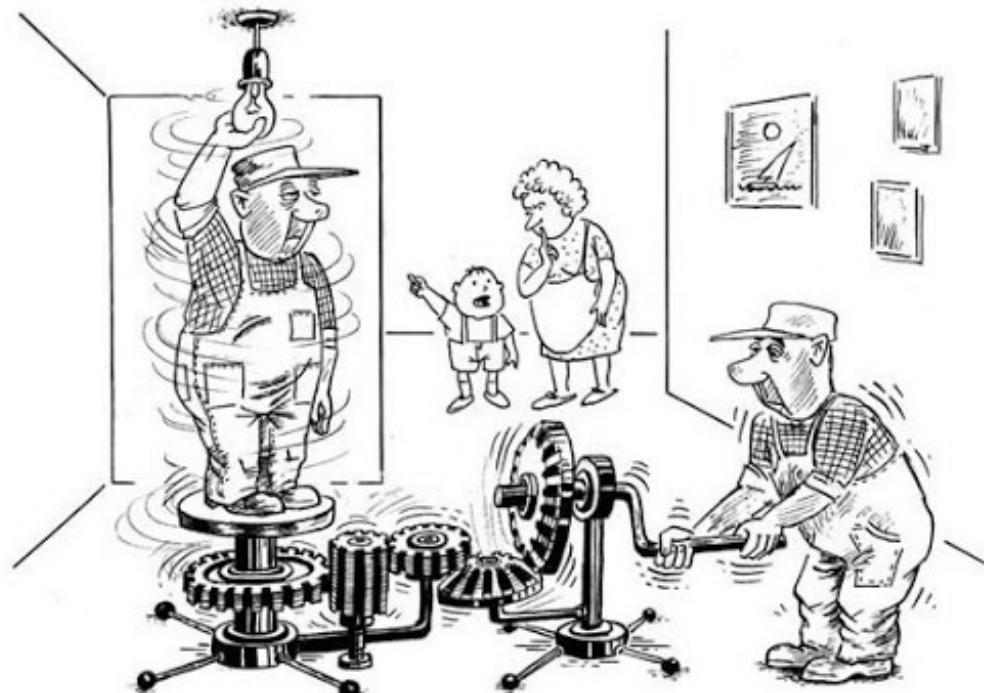


HySim19: Hybrid Simulation Capacity Building and Standardization: Before, during and after NEES

Prof. Dr. Bozidar Stojadinovic
ETH, Zurich

Question:

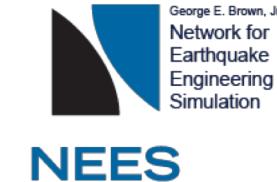
- How many PhDs does it take to run a hybrid simulation?



HS Timeline



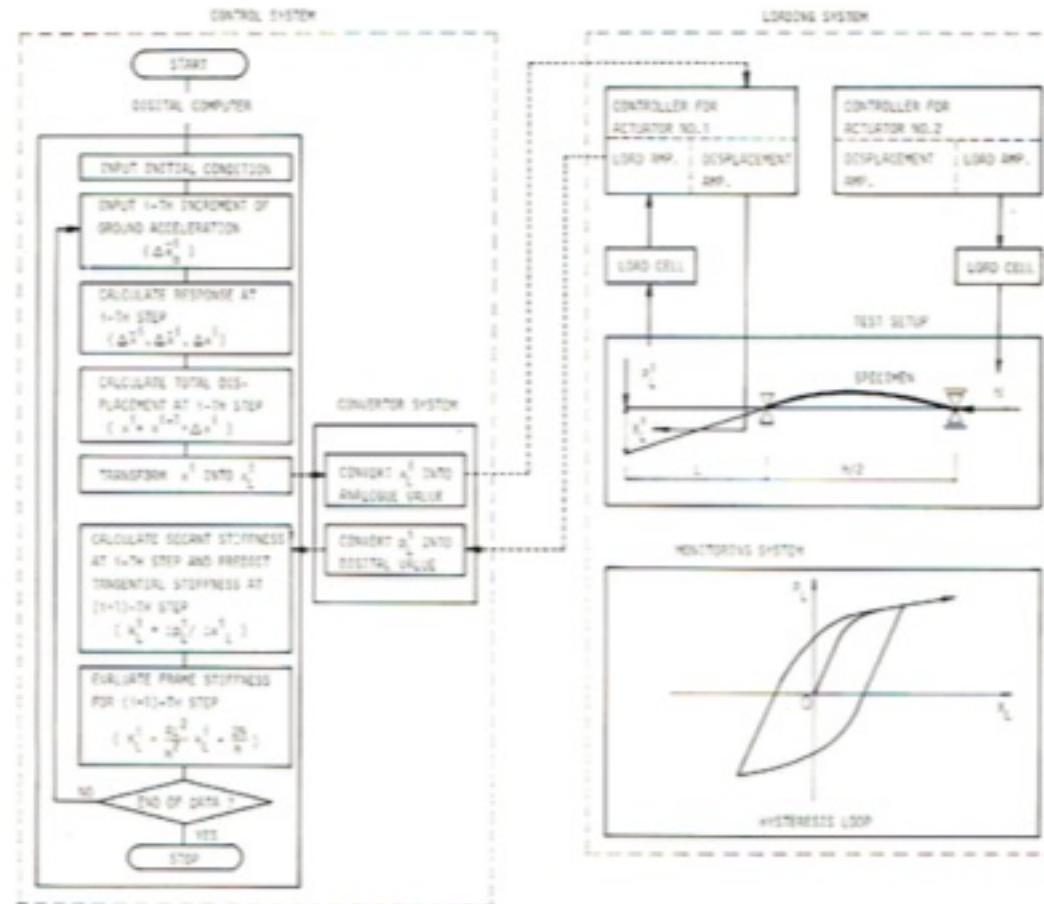
Wild West



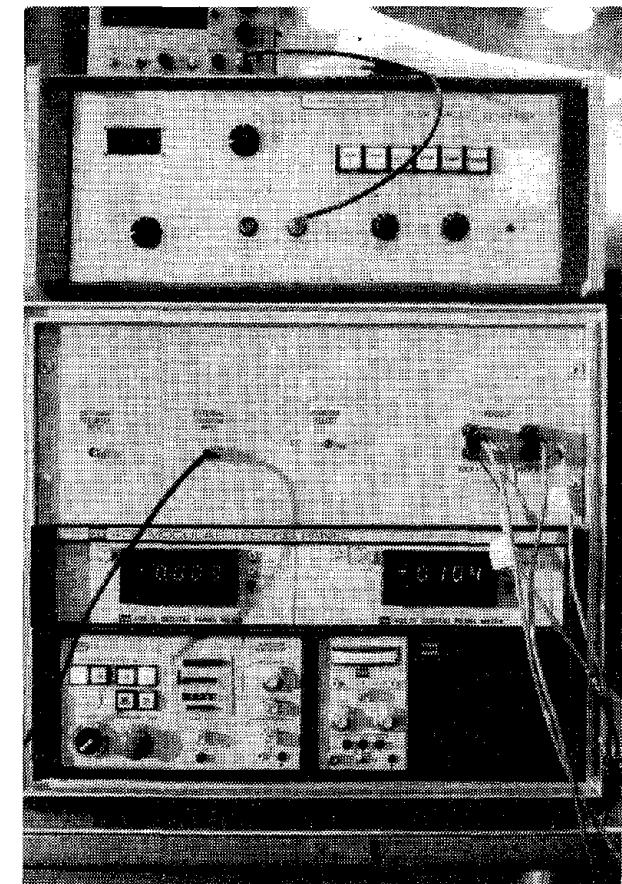
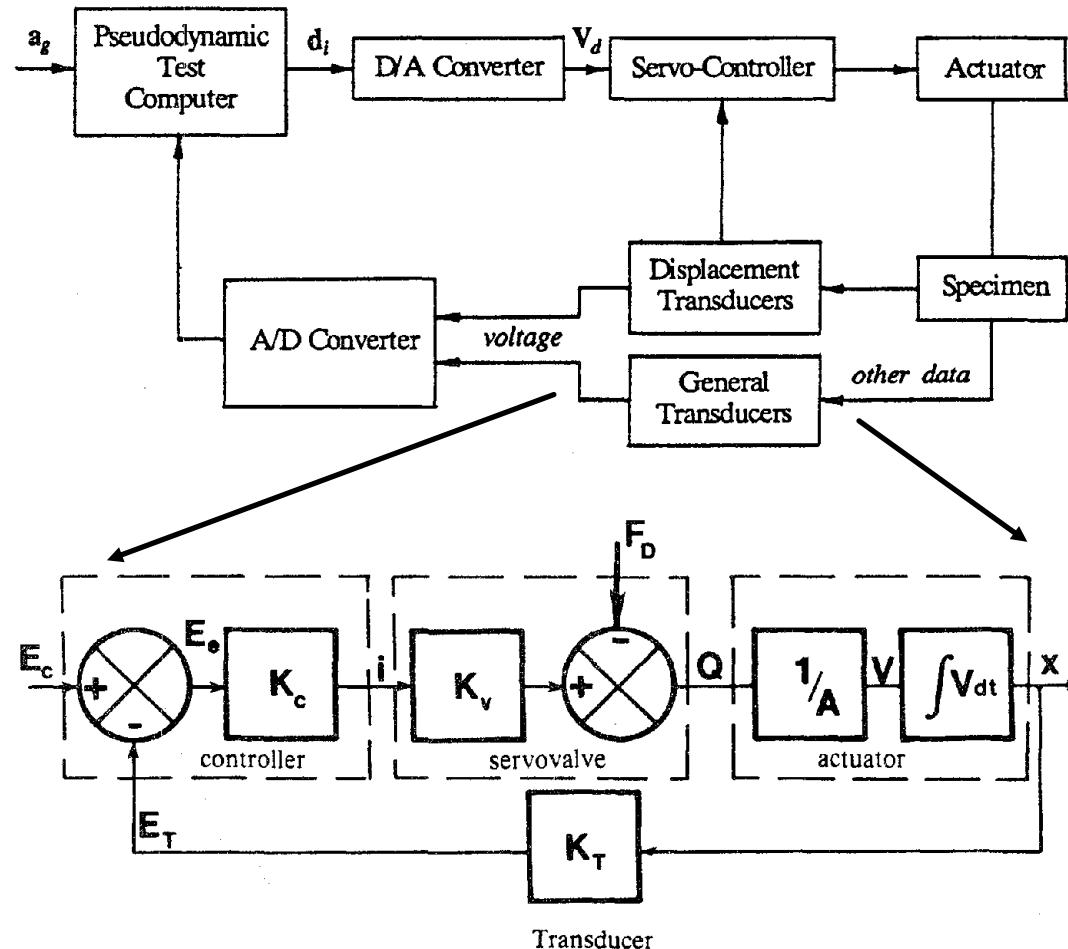
post-NEES



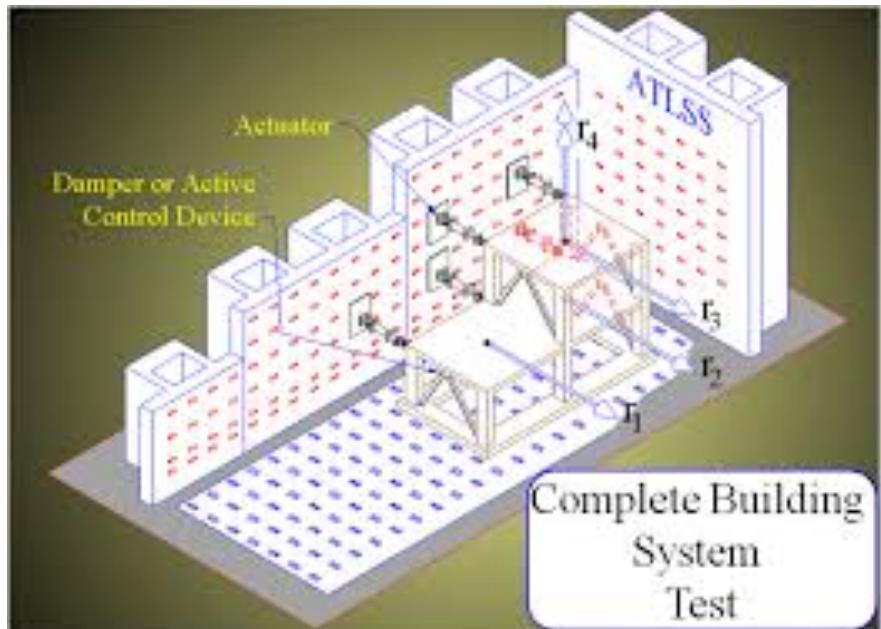
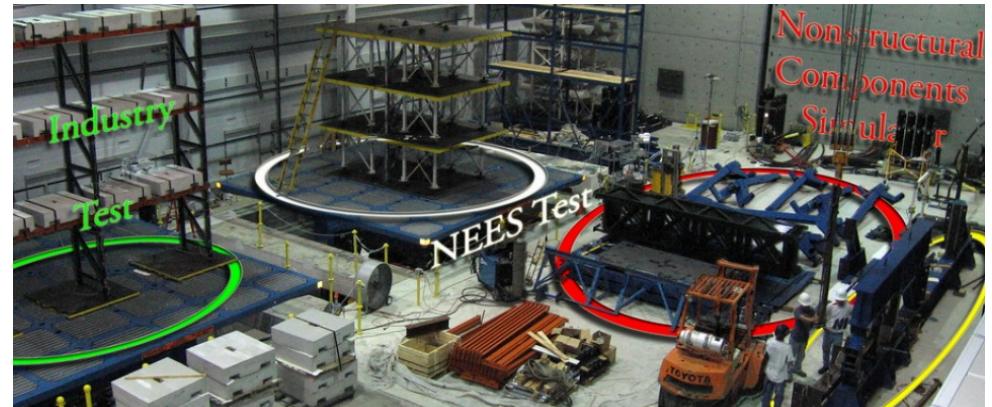
Wild West: *Ad hoc* Hybrid Simulation



Wild West: Ad hoc Hybrid Simulation



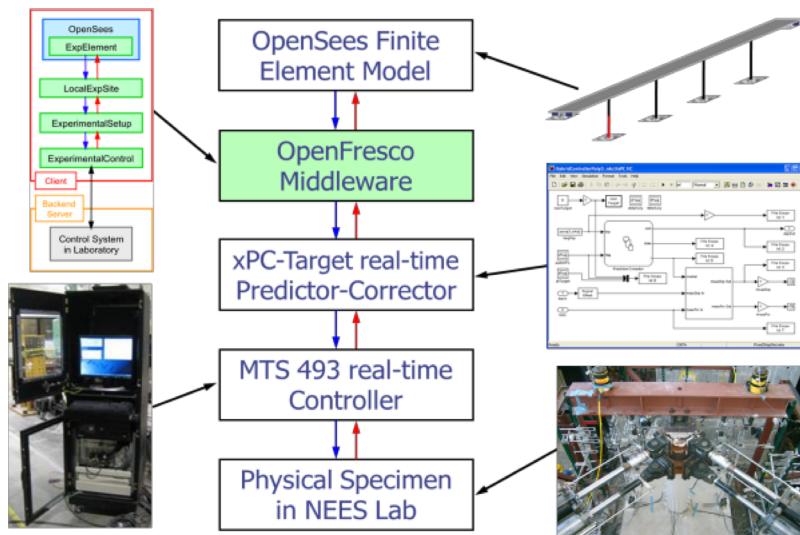
NEES (and SERIES): The Labs



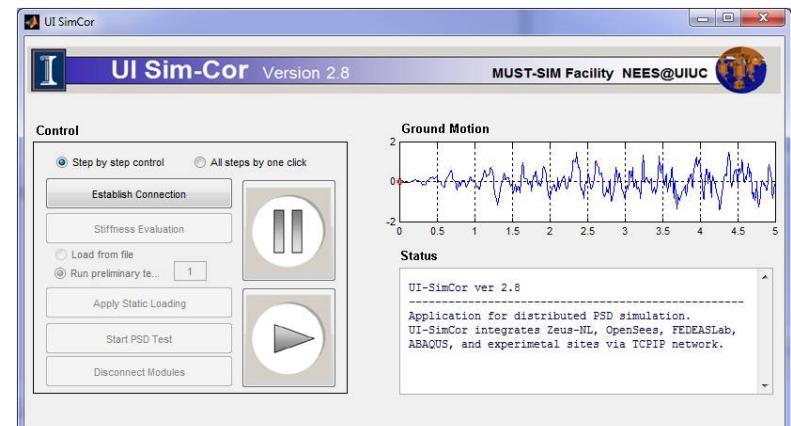
Last one left standing!

NEES (and SERIES): The Frameworks

- OpenFRESCO



- UI-SIMCOR



NEES (and SERIES): The Workshops

nees@berkeley The George E. Brown, Jr. Network for Earthquake Engineering Simulation

Second Hybrid Simulation WORKSHOP
24–25 April 2006
nees@berkeley Equipment Site

Come to join us for the second hybrid simulation workshop, focused on hybrid simulation and experimentation at nees@berkeley. Professor Bozidar Stojadinovic will lead this workshop. This training session includes lectures and a real, hands-on hybrid simulation experiments.

Attendees will:

- Learn the basics of the hybrid simulation method.
- Conduct a hybrid simulation at the nees@berkeley Equipment Site.
- Use OpenSees and hybrid simulation basics to develop new hybrid simulation algorithms for nees@berkeley and other NEES Equipment Sites.
- Use this hands-on experience to develop viable NEES-R proposals involving hybrid simulation.

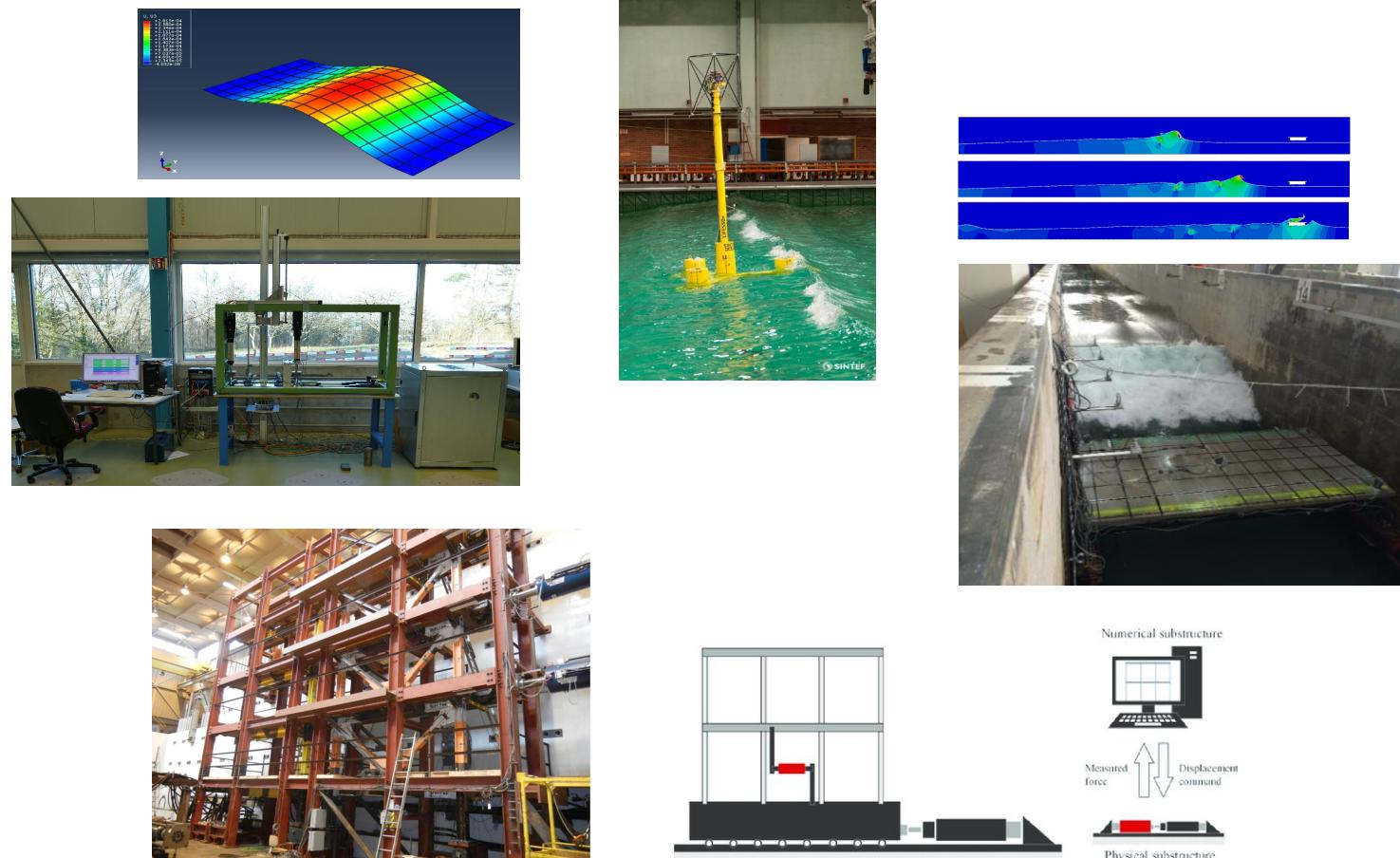
More information is available at the workshop pages:
 nees@berkeley URL: <http://nees.berkeley.edu>
 Workshop URL: <http://nees.berkeley.edu/workshop/>

Technical Bozidar Stojadinovic boza@ce.berkeley.edu 510-643-7035	Administration Nancy Nelson nancyn@berkeley.edu 510-665-3617
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nees@berkeley Control Room



post-NEES: Explosion of Research on Hybrid Simulation

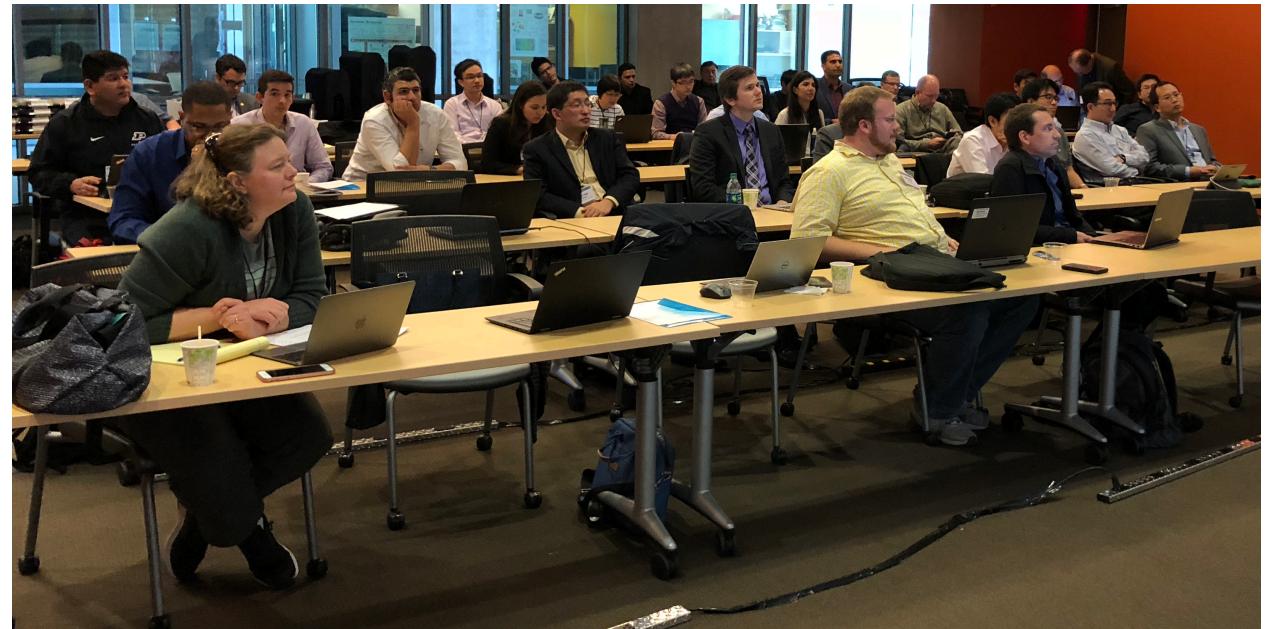


post-NEES: Some Research using Hybrid Simulation



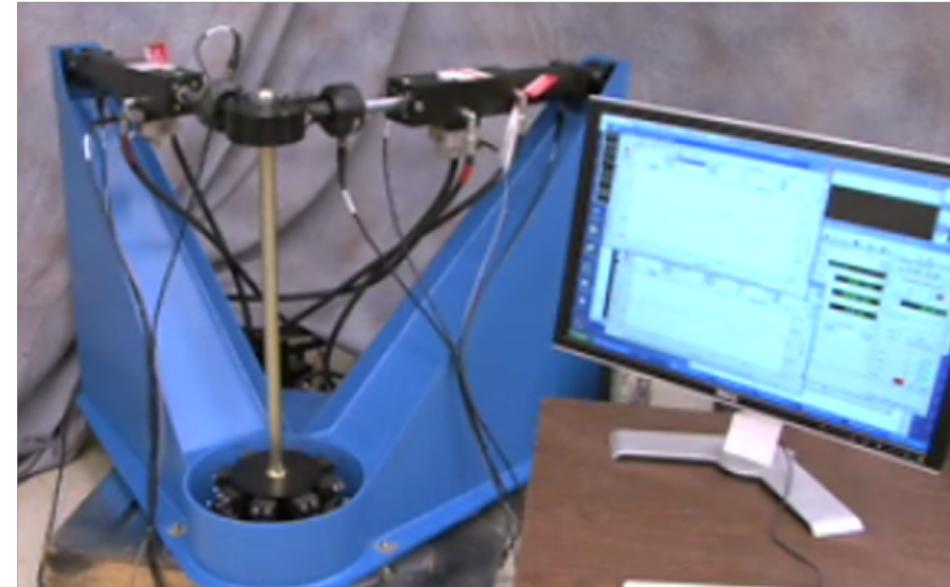
post-NEES: Not That Many Workshops

- MECHS
- SIMCenter
- ...



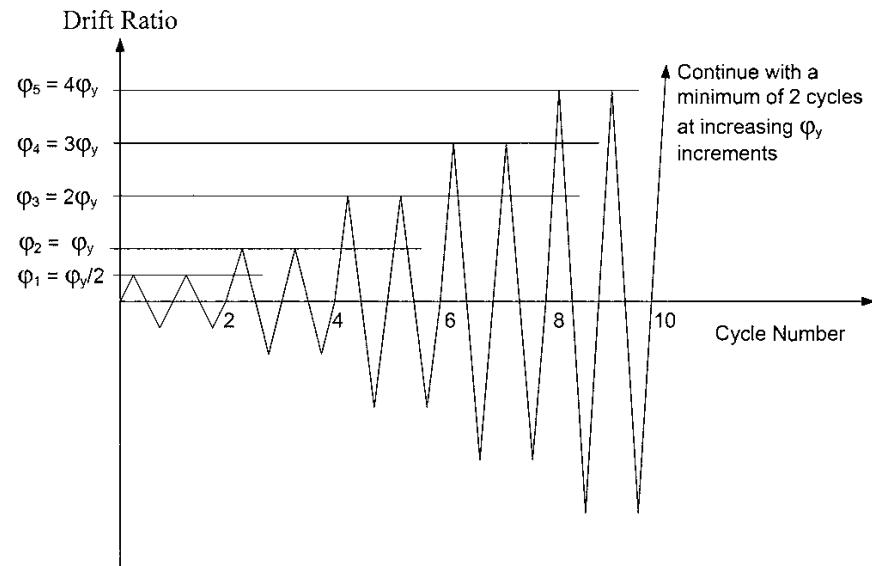
post-NEES: Some Industry-Supported Products

- MST FlexTest
- Others... ?



Questions:

- Why does a remarkable majority of earthquake engineering experimental research resort to:
 - Quasi-static cyclic testing?
 - Only numerical simulation?
- When are we going to have a FEMA-461-HS?



ACI 374.R2-13

Questions:

- Why does a remarkable majority of earthquake engineering experimental research resort to:
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Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components

FEMA 461 / June 2007



FEMA



Missing Links: Standards

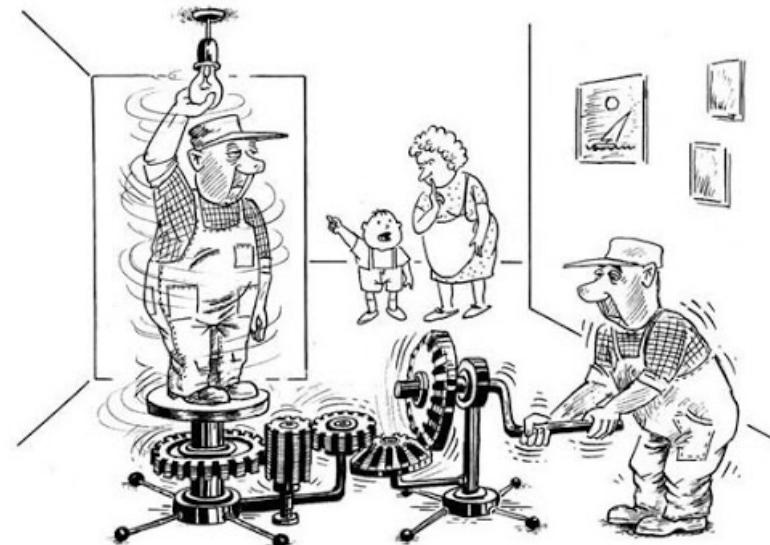
- Performance:
 - Define how to perform a hybrid simulation (protocols)
 - Define what is an acceptably performed hybrid simulation (acceptance criteria)
- Implementation:
 - Define standard setups
 - Define standard software (tools and interfaces)
 - Define standard frameworks (middleware)

Missing Links: Capabilities

- People:
 - Education on experimental methods in general and hybrid simulation in particular
 - Workshops
 - Education on benefits of hybrid simulation
 - Enabling by reducing the slope of the learning curve
 - Benchmark problems
- Labs (enabling technologies):
 - Hybrid Simulation in a Box:
 - Industry-supported products
 - Equipment specifications and recipes

Our Performance Objective

- How many PhDs does it take to run a hybrid simulation?



$$n \implies 0$$



