Hybrid Simulation: Examples

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Clevises and Coupons

a. non-linear connection

b. dimensions of clevis (in.)

c. dimensions of coupon (in.)
Response

- Stable and repeatable hysteretic response
- Different coupon designs result in very different response
Other Hardware

- Micro-NEES actuators controlled by the MTS controller
- Data acquired by the Pacific data acquisition system
- Computers connected through the fiber-optic shared ram (SCRAMnet) network
Exercise Goal

- Develop an HS application
- Think of the clevis as a physical model of an element that has a hysteresis:
  - Use boundary condition transformation to represent what you want
  - Use scaling
  - Even if this hysteresis is not exactly what you need, use this exercise to see how it comes together.
Our Examples:
1-DOF Bridge

UC Berkeley

Boulder, Urbana and Lehigh had computer models

Buffalo
Response

![Graphs showing response data for Berkeley and Buffalo with plots of restoring force vs. displacement, and time-step duration vs. number of steps.]

**Berkeley**

- Restoring force (kN) vs. Displacement (mm)

**Buffalo**

- Restoring force (kN) vs. Displacement (mm)

**Time-step duration**

- Total step time (s)

**Duration histogram**

- Number of steps vs. Total step time (s)
Our Examples:
2-DOF Frame

- Idealized two DOF building model
- Deforms in shear
- Point of inflection assumed at center of columns
- Response of half-column model is obtained experimentally
Experimental Setup

- Two independent SDOF specimens
- Specimens were designed for repeatability of non-linear tests
Simulation Results:
Linear Response
Simulation Results:
Non-linear Response
Thank you!

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http://nees.berkeley.edu

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