
Challenges Related to Extending Hybrid Simulation to Exploring the Next Generation of Structural Control Devices

Nicholas E. Wierschem, Ph.D

Assistant Professor

Department of Civil and Environmental Engineering
University of Tennessee, Knoxville

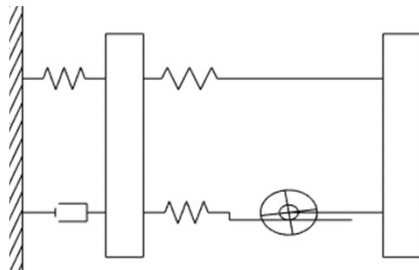


THE UNIVERSITY OF
TENNESSEE
KNOXVILLE

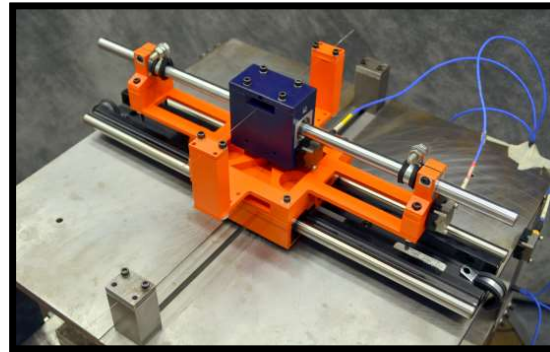
Structural Control Devices



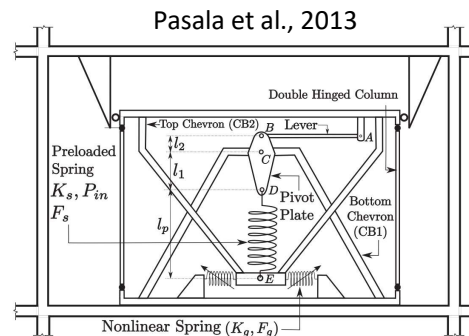
Particle Dampers



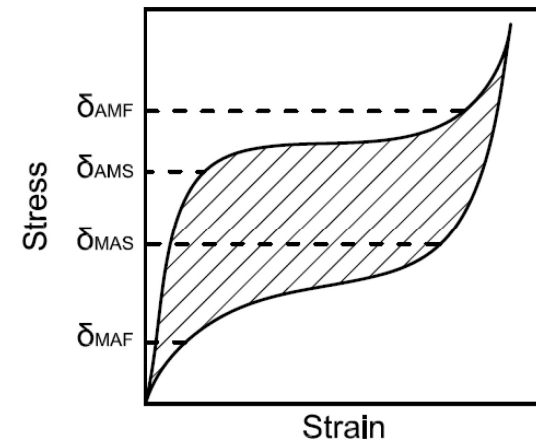
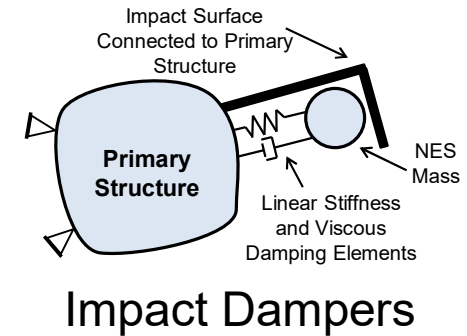
Inerter-based Devices



Nonlinear Energy Sinks

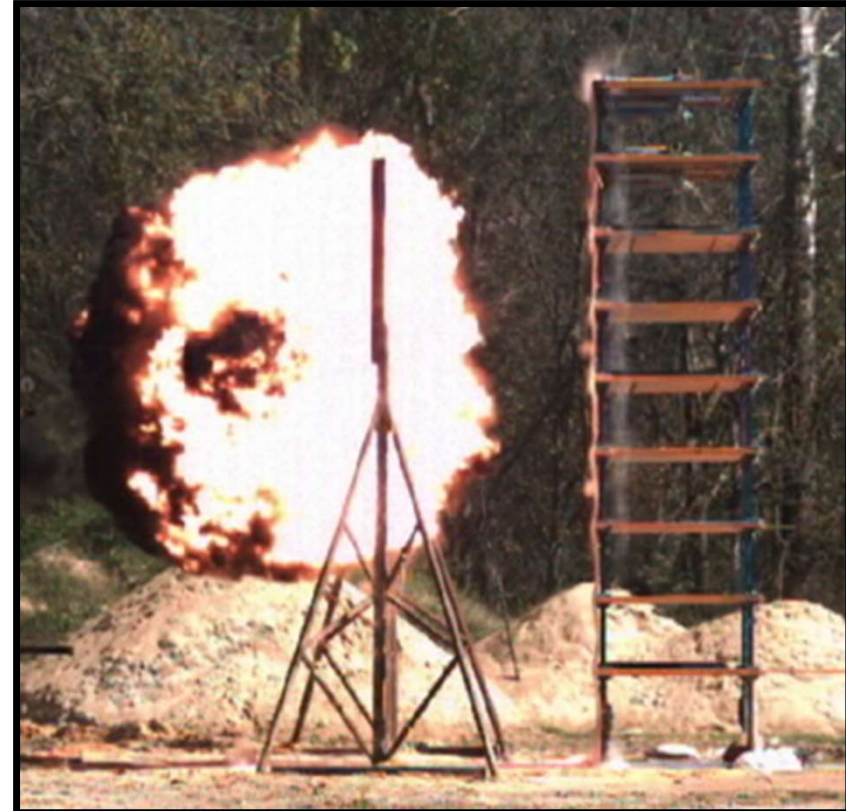


Negative Stiffness Devices



Devices with Shape Memory Alloys

Large-scale Testing

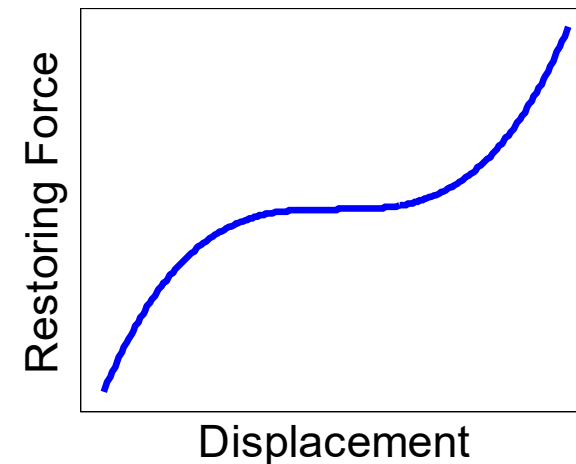
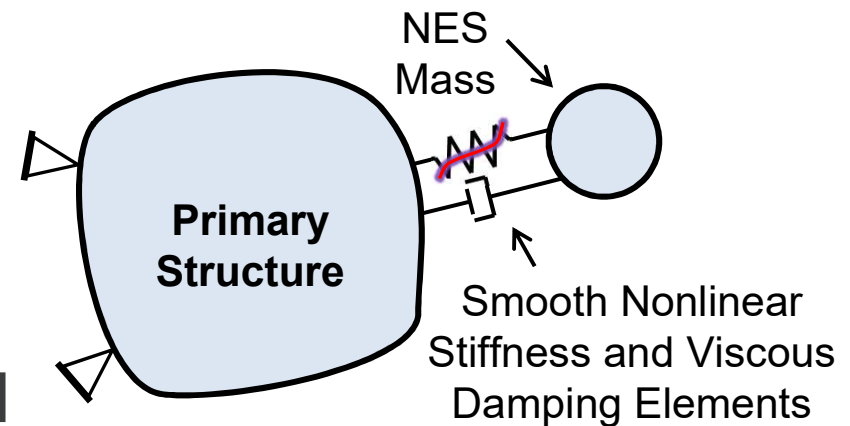


Directions in Research

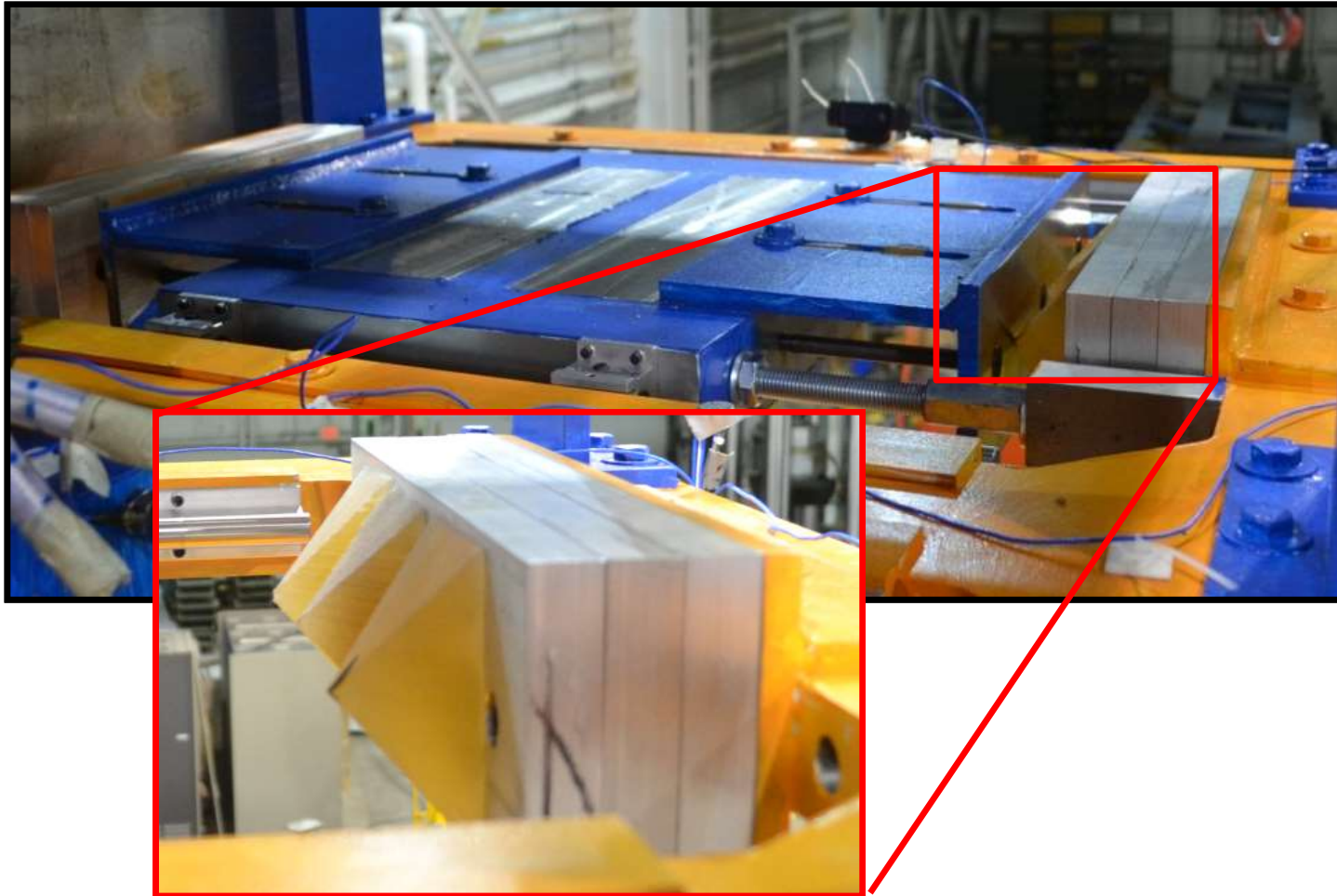
- WP 27 / JRA 5: Innovative testing methodologies for component/system resilience
 - Task 27.2 Advanced testing of components / substructures with hybrid simulations and shaking tables
 - Task 27.3 Advanced multi-hazard testing of prototype urban infrastructure using coupled conventional and city-laboratory facilities

Nonlinear Restoring Force

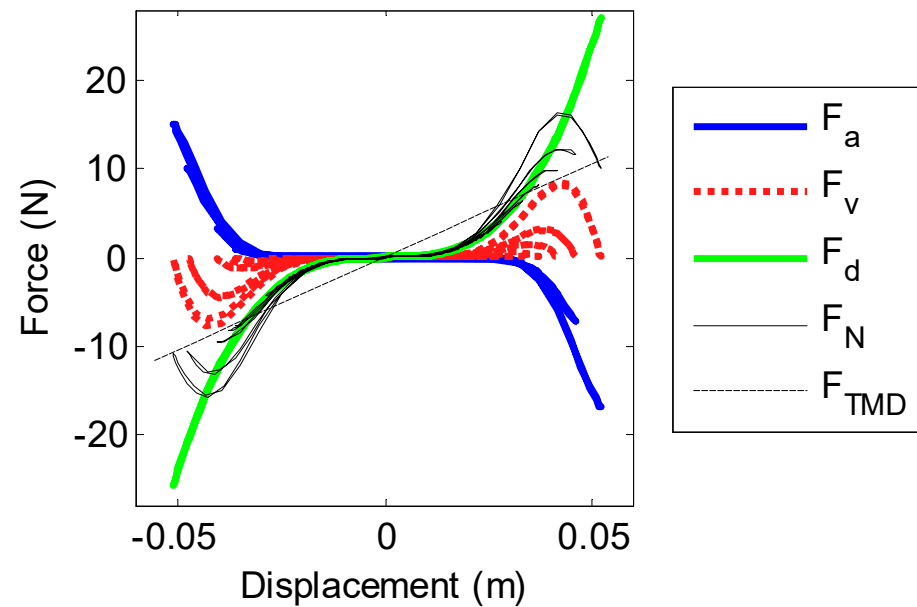
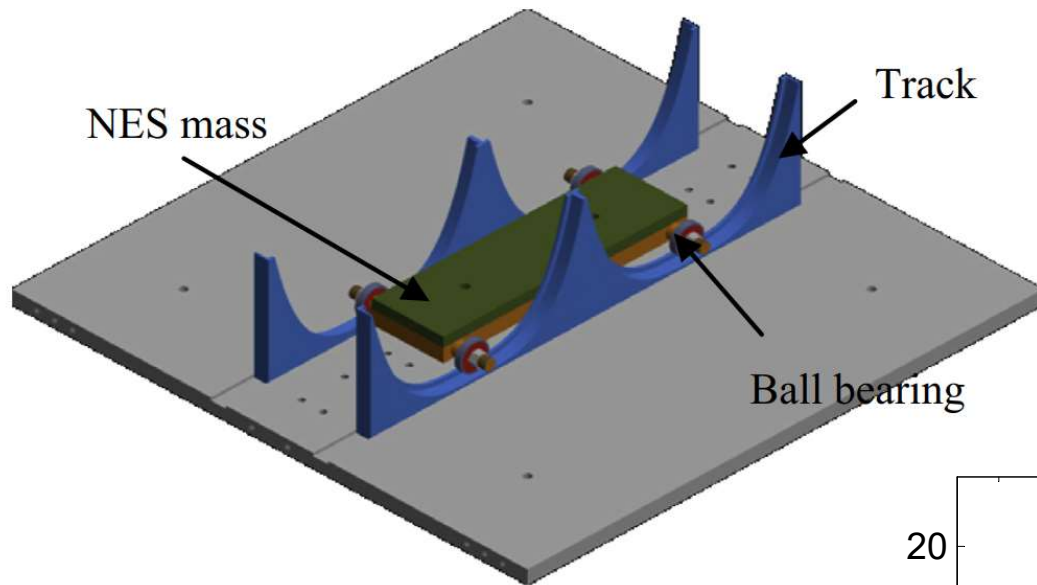
- Nonlinear energy sinks exploit essential nonlinearities
 - Nonlinearizable, with zero initial stiffness
- Realized with geometric and repeatable material nonlinearities
- Researchers are currently working to adapt and develop RTHS method for strongly nonlinear applications (including Maghareh et al.)



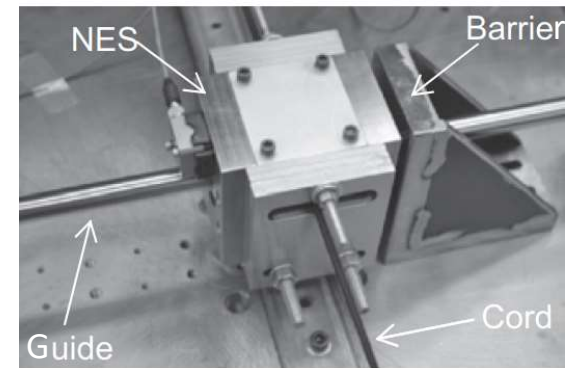
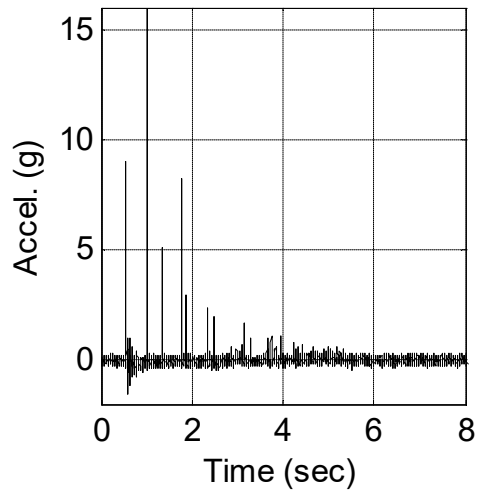
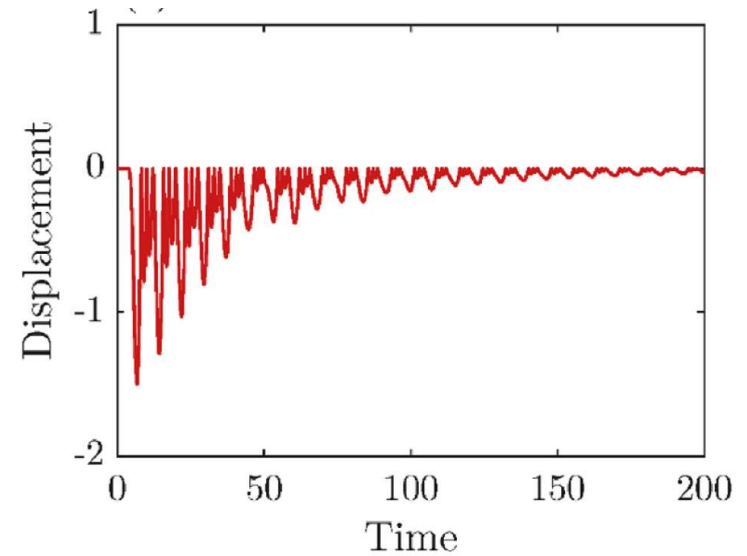
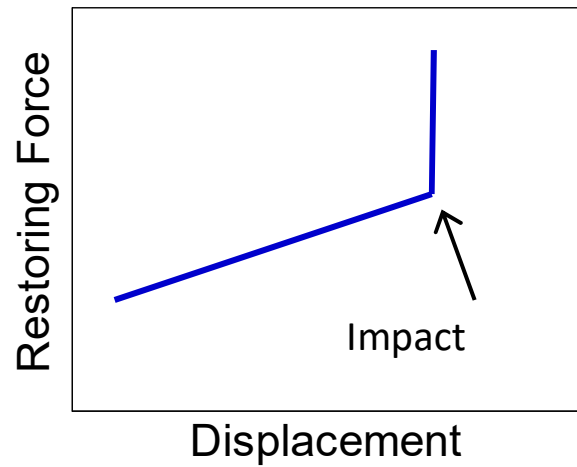
Nonlinear Restoring Force



Nonlinear Restoring Force

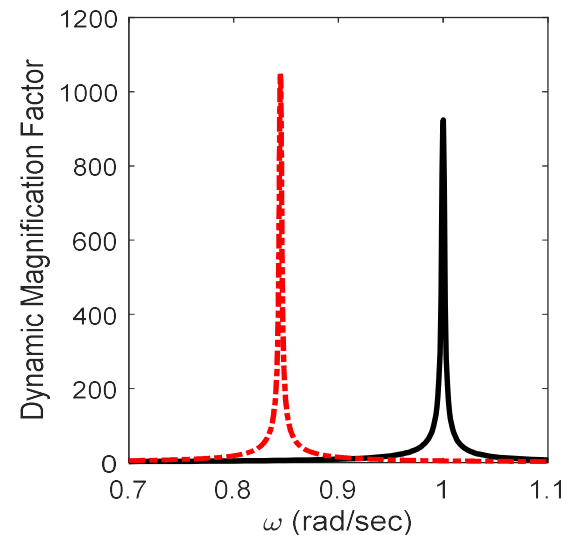
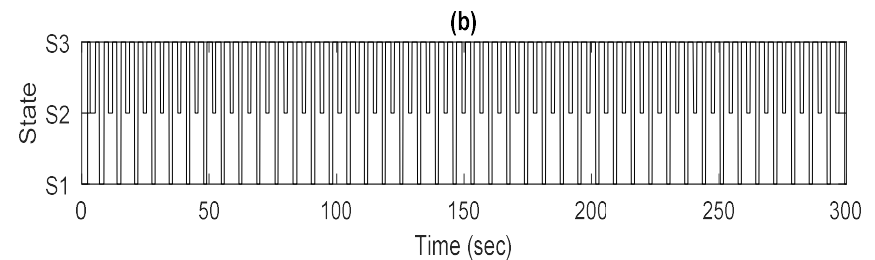
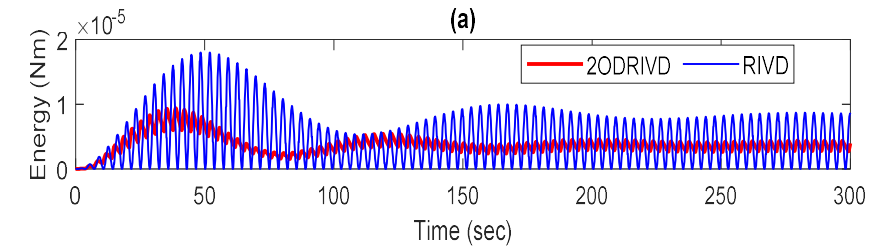
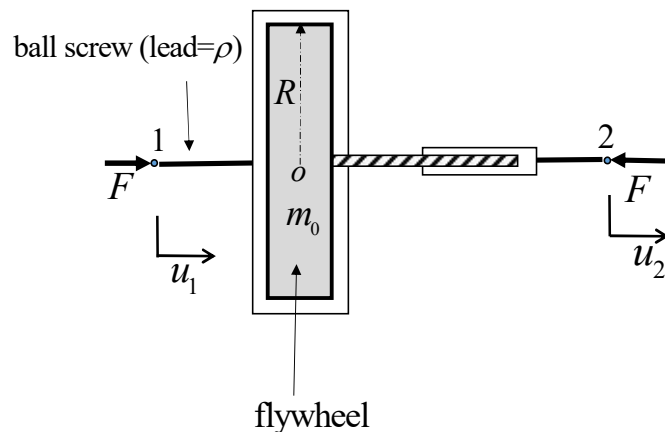


Impact



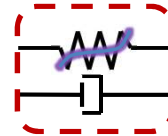
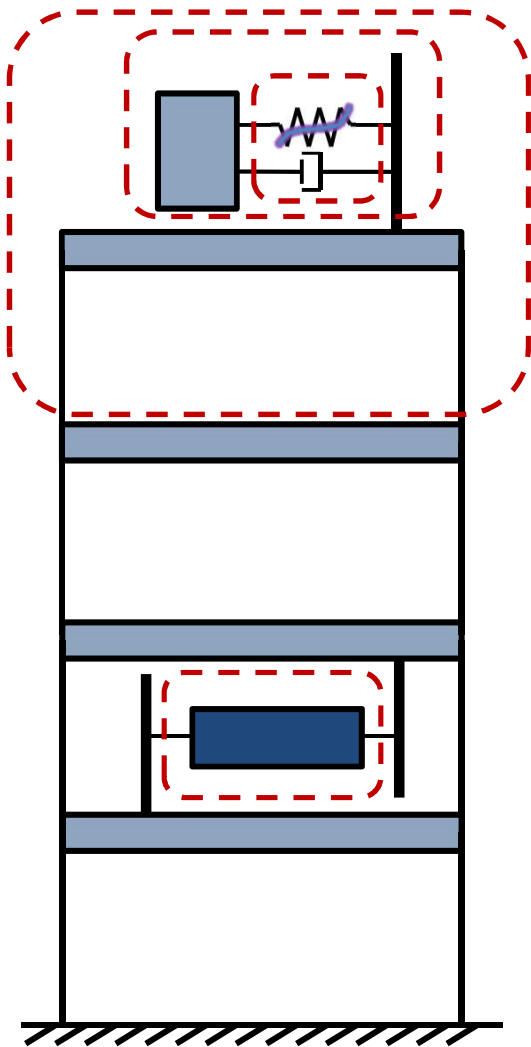
State Switching

- Some passive and semi-active devices feature state changes
- These changes in states can be sudden
- Can results in large changes in the natural frequencies of the system

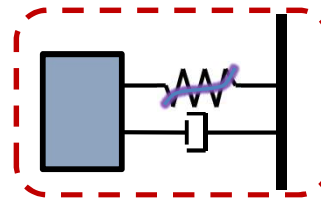




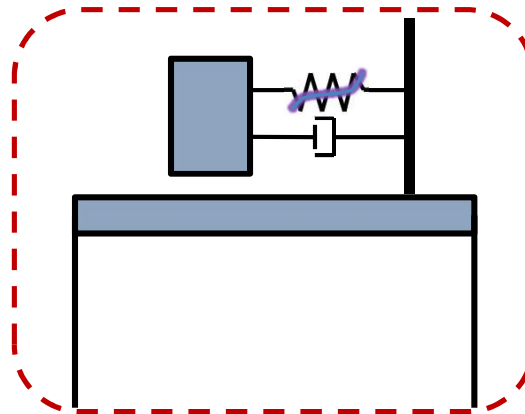
Substructuring Choices



RTHS with actuators



RTHS with shake
table?



Closing Remarks

- The structural dynamics and mitigation community is excited for RTHS
- There are plenty of studies that are good candidates to benefit from RTHS
- There are also plenty of challenges to consider that will push forward the state of the art of RTHS