

SEISM Project OpenSees Interface and Other Future Plans

Sanaz Rezaeian (USGS) speaking in place of

Farzin Zareian, UC Irvine

In possible collaboration with:

**Carmin Galasso
Junio Iervolino**

Statement from SEISM proposal:

Three-step validation framework:

1. GMSV using SDoF oscillators
2. GMSV for geotechnical systems
3. GMSV for MDoF nonlinear building systems

“To facilitate the application of these validation procedures to suites of SEISM simulations, we will develop an API that will **automate use of the OpenSees framework** to calculate **elastic and inelastic SDoF** response spectra; Zareian will lead this development. This SEISM-OpenSees interface will set the stage for GMSV procedures that utilize more realistic **MDoF** nonlinear systems.”

Research Goal

- Develop analytical tools that can assist ground motion simulation developers and users assess how well:
 - Broadband synthetic **waveforms** fit recorded ground motions? (SANAZ & UCI)
 - Broadband synthetic waveforms' **intensity measures** fit recorded data? (CARMINE & UCI)
 - Structural **response** to broadband synthetic waveforms match the response to recorded ground motions? (CARMINE & UCI)

Research Focus

- Comparison between simulations and recordings from historic events. At three levels:
 - ✓ Waveforms (waveform metrics)
 - ✓ Engineering Intensity Measures (S_a , PGV, etc.)
 - ✓ Structure Response (maxIDR, PFA)
 - ✓ Estimated Loss
- Comparison between simulations and recordings conditioned on the same S_a spectrum. Again at the three levels explained above.
- Move from 1D GM application to 2D application.

Previous work presented at SCEC 2012:

Validation of broadband platform ground motion simulations for historical events.

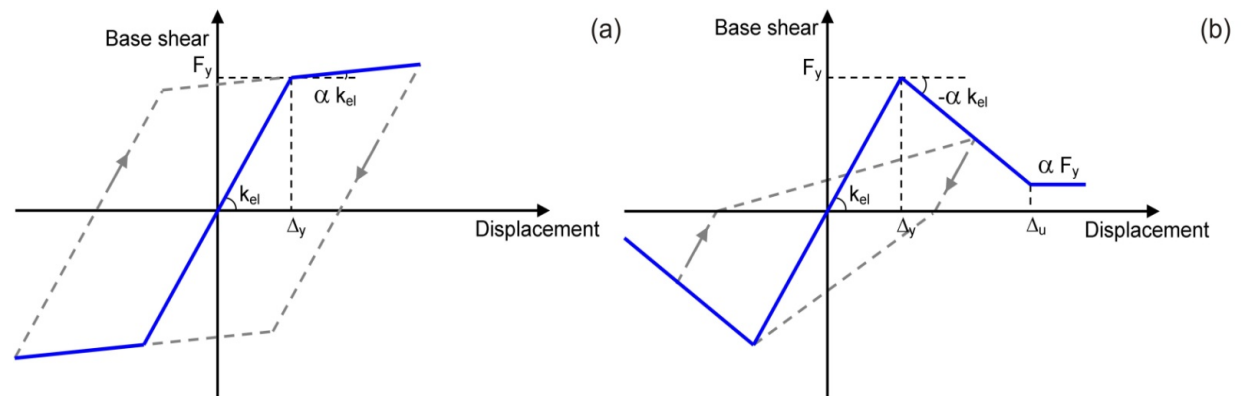
- Systems:
 - SDoF
 - MDoF
 - Buildings
 - Bridges
 - Waveforms

Previous work presented at SCEC 2012:

Validation of broadband platform ground motion simulations for historical events.

- Systems:

- SDoF



Bulletin of the Seismological Society of America, Vol. 102, No. 6, pp. 2727–2740, December 2012, doi: 10.1785/0120120018

Validation of Ground-Motion Simulations for Historical Events Using SDoF Systems

by C. Galasso, F. Zareian, I. Iervolino, and R. W. Graves

Abstract The study presented in this paper is among the first in a series of

Previous work presented at SCEC 2012:

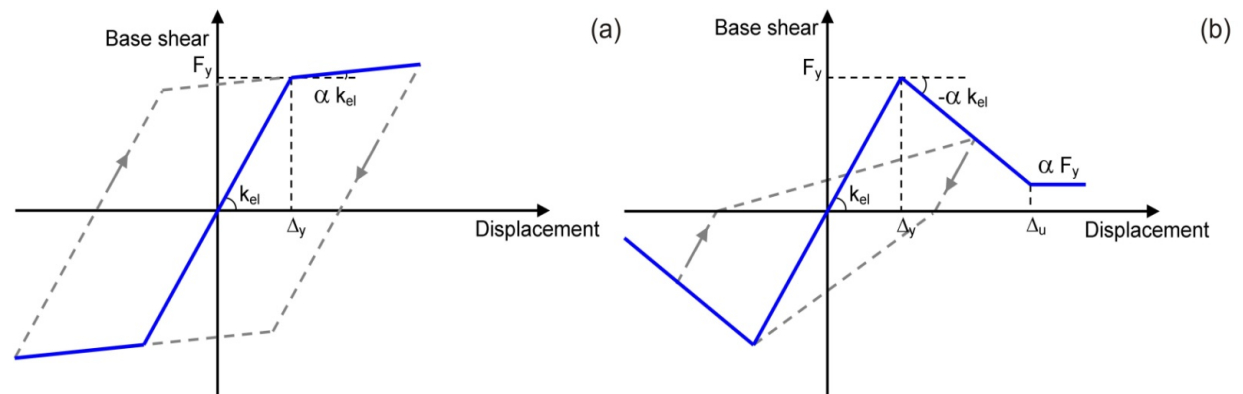
Validation of broadband platform ground motion simulations for historical events.

- Systems:
 - SDoF

Future work:

More variations of SDoF to be implemented in OpenSees framework for GMSV

Possibly looking into 2 horizontal directions



Bulletin of the Seismological Society of America, Vol. 102, No. 6, pp. 2727–2740, December 2012, doi: 10.1785/0120120018

Validation of Ground-Motion Simulations for Historical Events Using SDoF Systems

by C. Galasso, F. Zareian, I. Iervolino, and R. W. Graves

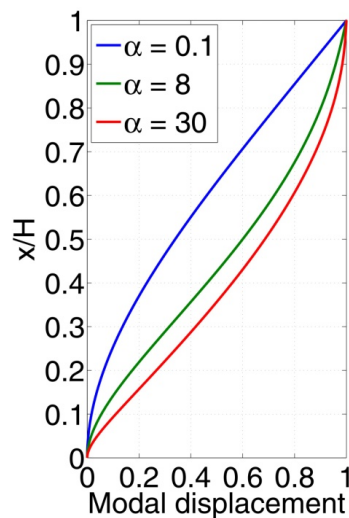
Abstract The study presented in this paper is among the first in a series of

Previous work presented at SCEC 2012:

Validation of broadband platform ground motion simulations for historical events.

- Systems:

- MDoF

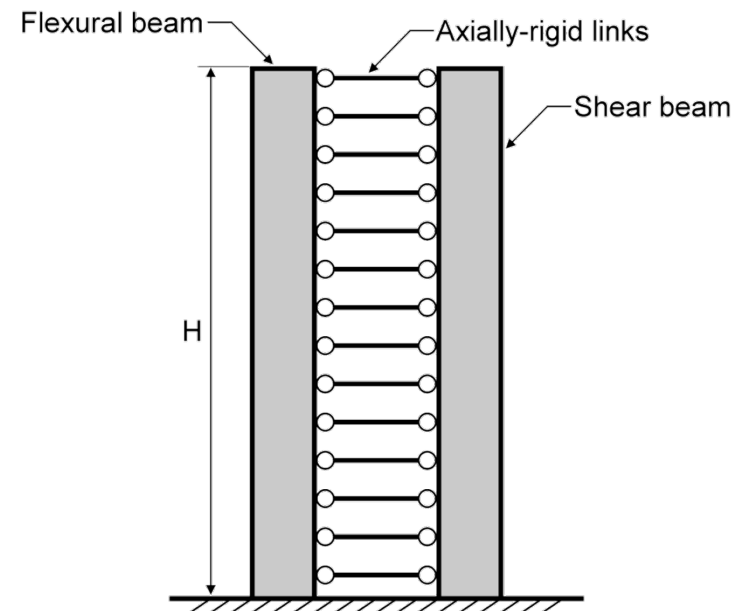


- EDPs:

- *Story Drift*
 - *Floor Acc.*

- Parameters:

- T_1, α



Generic buildings were considered previously, will not focus on this for SEISM

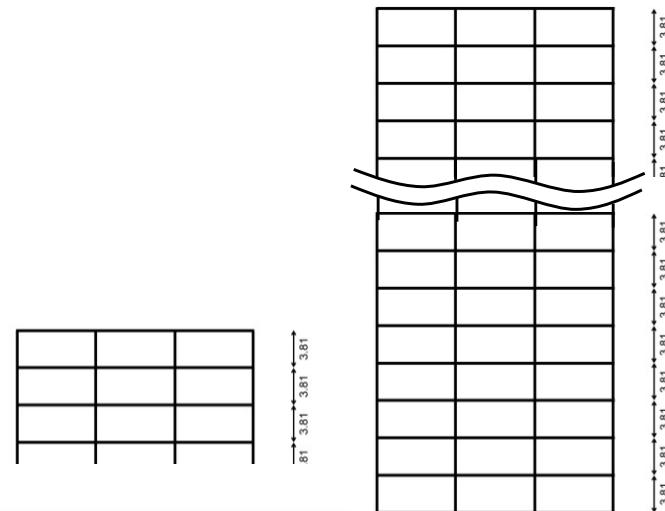
Previous work presented at SCEC 2012:

Validation of broadband platform ground motion simulations for historical events.

- Systems:
 - Buildings

More realistic steel frame buildings.

Emphasis will be on 2D SMRF systems to use the OpenSees link for validation



EARTHQUAKE ENGINEERING & STRUCTURAL DYNAMICS

Earthquake Engng Struct. Dyn. (2013)

Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/eqe.2278

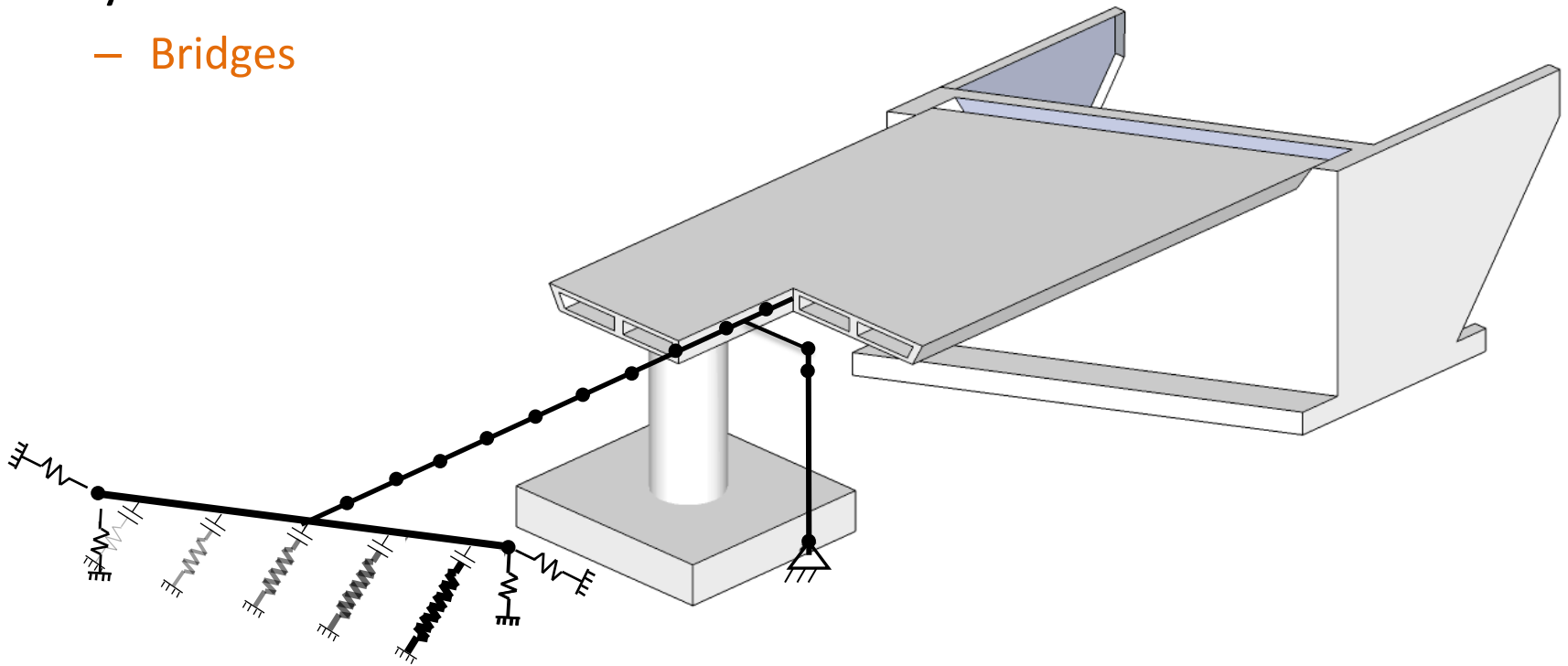
Validation of ground-motion simulations for historical events using
MDoF systems

Carmine Galasso^{1,2}, Peng Zhong¹, Farzin Zareian^{1,*†}, Iunio Iervolino² and
Robert W. Graves³

Previous work presented at SCEC 2012:

Validation of broadband platform ground motion simulations for historical events.

- Systems:
 - Bridges

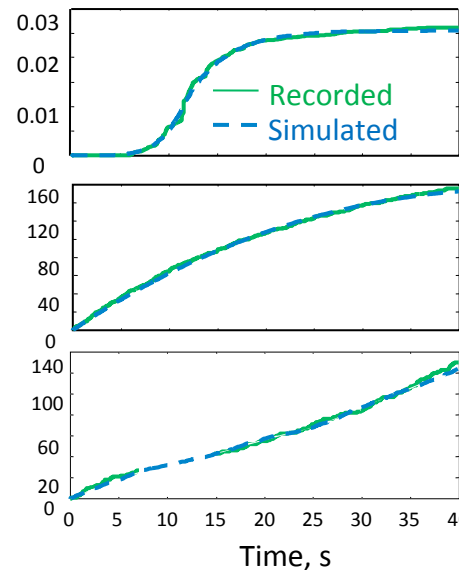
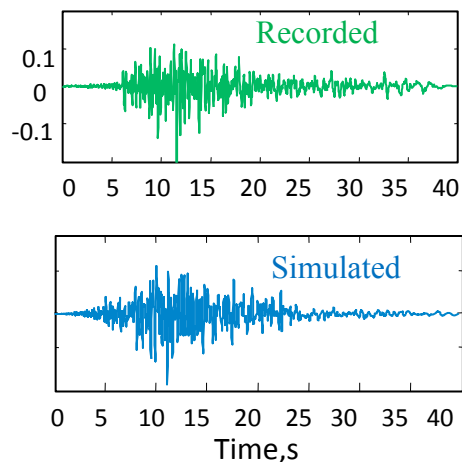


Previous work presented at SCEC 2012:

Validation of broadband platform ground motion simulations for historical events.

- Systems:
 - Waveforms (work in progress)

Using statistical characteristics of ground motion time-series, compare the **intensity** and the **frequency content** over time.



1. Evolutionary intensity, Includes Arias intensity and duration
2. Predominant frequency
3. Bandwidth

Next Steps:

- OpenSees links for GMSV using SDoF and MDoF systems
- Using the OpenSees links for validation of SEISM ground motions

Questions/Comments?