Ground Motion Simulation Validation: Motivation and Needs

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Motivation

- Two SSHAC Level 3 Ground Motion Characterization Projects
  - NGA-East: Ground motion models east of the Rockies
  - SWUS: Ground motion models for Southwestern U.S.
- SSHAC Objective
  - Describe the center, body, and range of ground motions from technically defensible interpretations
- Ground motion parameters of interest
  - Elastic response spectral values at 5% damping over the frequency band of 0.1-100 Hz

Needs

- Evaluation of the finite-fault simulation (FFS) methods using 1-D crustal models
  - Are they ready for engineering applications or is more research needed?
- Consider a suite of representative FFS methods for evaluation
  - Add additional modules to capture the range of candidate methods
- SCEC evaluation of the FFS methods on the Broadband platform
  - Identify the frequency and distance ranges for which the FFS methods are applicable

Additional Methods to Add

- Add to Broadband Platform
  - Zeng/Anderson Composite source model
  - Irikura recipe
  - Atkinson Stochastic FF
    - Also the Boore modification
- Methods tested outside the Broadband platform
  - Point source stochastic
  - NGA GMPEs

Two Parts to Validation

- Part A: Comparison with past Earthquakes
  - 20 active crustal region earthquakes
  - 3 EUS earthquakes
  - Corrected to rock site conditions
- Part B: Comparison with Empirical GMPEs
  - 2 scenarios (e.g M6.5, R15 km; M6.5, R40 km)
  - Compare median ground motions
  - Rock site conditions

Proposed Active Crustal Eqk for Validation

From GMSV workshop	Additional Eqk from NGA-west2
2010 El Mayor-Cucapah, M=7.2 (EQID 280)	1999 Kocaeli, Turkey, M=7.5 (EQID 136)
1994 Northridge-01, M=6.7 (EQID 127)	1999 Chi-Chi, Taiwan, M=7.6 (EQID 137)
1999 Hector Mine, M=7.1 (EQID 158)	2000 Tottori, Japan, M=6.6 (EQID 176)
1992 Landers, M=7.3 (EQID 125)	2007 Chuetsu-Oki, Japan, M6.7 (EQID 278)
1987 Whittier, M=6.0 (EQID 113)	2004 Niigata, Japan, M=6.6 (EQID 180)
1992 Big Bear-01, M=6.5 (EQID 126)	2008 Iwate, Japan, M=6.9 (EQID 279)
2004 Parkfield, M=6.0 (EQID 179)	2009 L'Aquila, Italy, M6.3 (EQID 274)
1989 Loma Prieta, M=6.9 (EQID 118)	2010 Darfield, NZ, M=7.0 (EQID 281)
1984 Morgan Hill, M=6.2 (EQID 90)	2003 San Simeon,M6.5 (EQID 177)
1986 N. Palm Springs, M=6.1 (EQID 101)	
1983 Coalinga, M=6.5 (EQID 76)	

EUS Earthquakes for Validation

- NGA-east data set
  - 1988 Saguenay, M=5.9 (EQID=5)
  - 2005 Riviere-du-Loup, M=4.6 (EQID=32)
  - 2011 Mineral, M=5.8 (EQID=88)

Schedule

- May – Sep 2012
  - Set up validation exercises
- Jun - Nov 2012
  - Additional modules added to broadband platform
- Sep 2012 – Mar 2013
  - Validations (parts A and B)
- Apr 2013
  - SCEC evaluation of simulation methods (combination of modules) that pass the validation
- May – Oct 2013
  - Initial results from forward simulations from methods that passed validation
  - Explanation of the causes of differences
- Nov 2013 - Feb 2014
  - Final results from second set of forward simulations

Use of Results

- NGA-east
  - Constrain low freq (0.1 – 1 hz) scaling to guide double-corner point source model
  - Develop alternative broadband (0.1 – 100 Hz) GMPE based on FF simulations
- SWUS
  - Provide estimates of spectral acceleration for cases (eqk, station location) not well constrained in empirical GMPEs
  - Provide constraints on epistemic uncertainty