CyberShake Simulations for Path Effects near SONGS

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SCEC’s CyberShake utilizes 3D simulations and finite-fault rupture descriptions to compute deterministic and probabilistic seismic hazard in Southern California. (Graves et al., 2010)
CyberShake: Simulation-based seismic hazard model

~7000 fault ruptures (UCERF 2)
~60 realizations per rupture
multiple hypocenter locations, and
pseudo-dynamic rupture descriptions
~440,000 rupture variations

Rise time for slip velocity function

Slip directions (rake distribution)
CyberShake: Simulation-based seismic hazard model

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3D velocity structure, e.g.
CVM-S4,
CVM-Harvard

Community Velocity Model 4.0, SCEC (CVM-S4)
CyberShake: Simulation-based seismic hazard model

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3D velocity structure, e.g. CVM-S4, CVM-Harvard

Seismogram synthesis for 235 sites using **reciprocity**, and stochastic methods (EXSIM)

- ~10^8 broadband synthetic seismograms: LF (<0.5 Hz) + HF (up to 10 Hz)

PGV, PGA, SA Hazard curves and maps
NGA (2008) Attenuation Relations used in National Seismic Hazard Maps

CyberShake shows higher hazard in sedimentary basins relative to NGA GMPEs

PoE = 2%/50 yr

Source: http://scec.usc.edu/scecpedia/CyberShake
Path effects can be explicitly calculated for each CyberShake source.
Site-specific effects, corrected using Vs30 effects of Boore and Atkinson (2008), are larger in CyberShake model than in other three NGA GMPEs (2008).
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Three-dimensional velocity models (CVM-S and CVM-H) have different basin structures around SONGS

(Magistrale et al. 2000; Suess and Shaw 2003)
The major source of epistemic uncertainty is the 3D basin structure.
CyberShake Hazard Curves for s758

0.5 s SA (g)

Probability Rate (1/yr)

CVM-S4
CyberShake Hazard Curves for s758

Probability Rate (1/yr) vs. 1.0 s SA (g)
CyberShake Hazard Curves for s758

Probability Rate (1/yr)

3.0 s SA (g)

CVM-S4
CyberShake Hazard Curves for s758

Probability Rate (L/yr)

5.0 s SA (g)

CVM-S4
CyberShake Hazard Curves for s758

10.0 s SA (g)

Probability Rate (1/yr)
CyberShake layered seismic-hazard models

1. Hazard map

2. Hazard curves

3. Hazard disaggregation
   (Bazzurro and Cornell, 1999)

5. Seismograms

4. Rupture model
San Onofre Nuclear Generating Site

Disaggregation Diagram

Figure generated using OpenSHA (Field et al. 2003)
San Onofre Nuclear Generating Site

Disaggregation Diagram

Hazard curves

3.0 s SA (g)

4 x 10^{-5} per year
References


Campbell, K. W. and Y. Bozorgnia, 2008. NGA ground motion model for the geometric mean horizontal component of PGA, PGV, PGD and 5% damped linear elastic response spectra for periods ranging from 0.01 to 10s, *Earthquake Spectra*, 24 (1), 139-171.


SCEC wiki: [http://scec.usc.edu/scecpedia/CyberShake](http://scec.usc.edu/scecpedia/CyberShake), last accessed on March 17th, 2013.