SEISM plans: GMSV using SDOF oscillators

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Spectral correlations

*Hypothetical* response spectra having the same means and standard deviations.
Spectral correlations are important and easily measurable

Hypothetical response spectra from ground motion simulations with a fixed M & R. All sets of spectra have the same means and standard deviations.

Correct correlation

Over-correlated

Under-correlated

Empirical models for correlation are available, and are surprisingly stable across magnitude, distance, site condition, tectonic regime, etc.
Nonlinear response spectral ratios

- Complimentary to elastic response spectra
- Also tied to engineering intuition
- Can still be tied to statistics of recorded ground motions
  - Predictive model available (e.g., Tothong and Cornell, 2006)
  - Relatively insensitive to most parameters besides magnitude and site nonlinearity

Simulated ground motions

Observed ground motions

T = 4s

Record criteria:
M > 6.5
V_{S30} > 300 km/s
Nonlinear response spectra

Simulated ground motions
Comparative observed ground motions

T = 1s
Record criteria:
M > 6.5
V_s30 > 300 km/s
Nonlinear response spectra

Simulated ground motions

Comparable observed ground motions

Simulated ground motions

Observed ground motions

$T = 0.3\text{s}$

Record criteria:
$M > 6.5$
$V_{s30} > 300 \text{ km/s}$
Illustrative results are presented for several sets of Puente Hills broadband simulations at 648 sites in the Los Angeles region (Graves and Somerville 2006)

One-second elastic spectral accelerations (from Graves and Somerville 2006)
Elastic response spectra

- Often serve as the link between seismic hazard analysis and structural response calculation.
- Basis of significant engineering intuition
- Looking at these in a statistical sense is important (means, standard deviations, and correlations)

**Simulated ground motions**

**Comparable observed ground motions**

- $M \approx 7$
- $R \approx 15$ km
- $V_{s30} > 300$ km/s
- No directivity