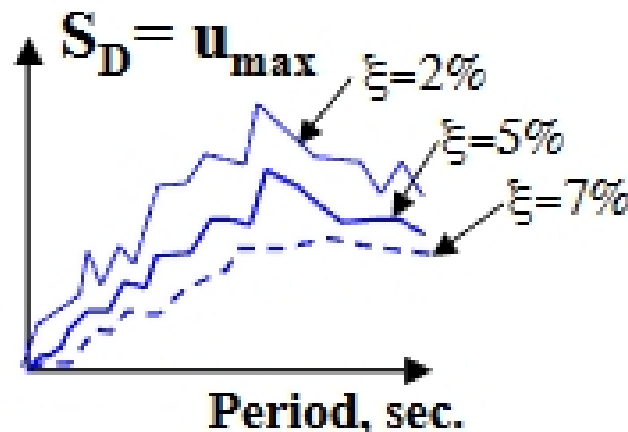


Elastic Design Response Spectra

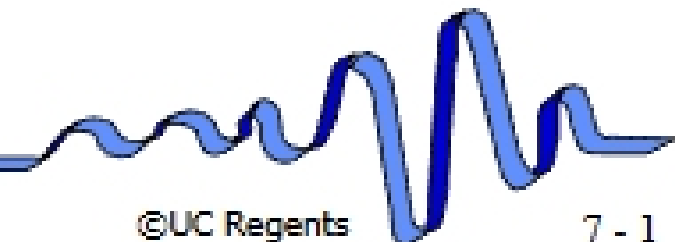
Envelop of a computed peak dynamic response parameter for single degree of freedom elastic systems having a range of periods, for a given ground motion and viscous damping ratio

$$m\ddot{a}(t) + 2\xi\omega v(t) + Kd(t) = -ma_g(t)$$



Uses

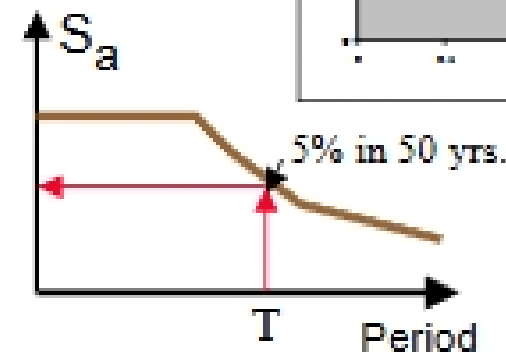
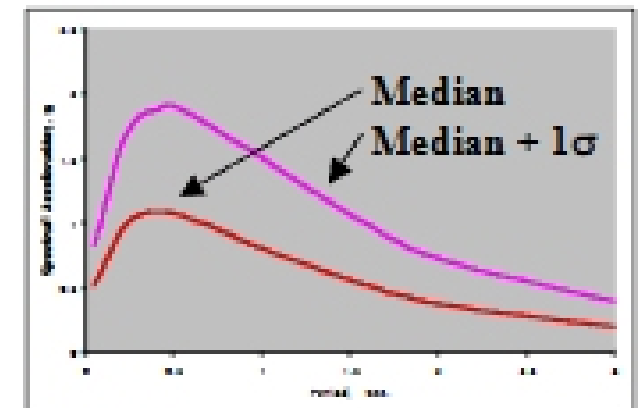
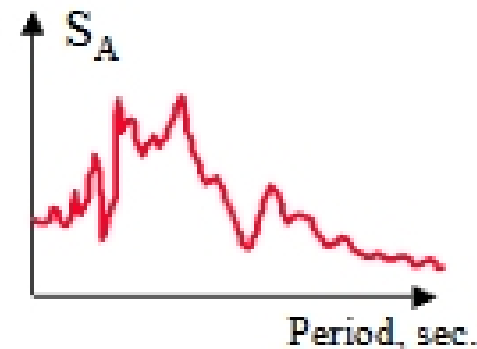
- Characterize ground motions and assess demands on various types of simple structures.
- Basis for computing design displacements and forces in SDOF and MDOF systems expected to remain elastic.
- Basis for developing design forces and displacements in nonlinear systems (two approaches):
 - Modified elastic spectrum to account for nonlinearity
 - Equivalent elastic SDOF system



Design Response Spectrum

Topics

- **Developing design spectra from site specific ground motion time histories**
- **Selection of damping values**
- **Plotting formats**
- **Analytic relations for developing Elastic Design Response Spectrum**
 - **Deterministic**
 - Statistical "attenuation" relationships
 - Simplified empirical relationships (e.g., Newmark-Hall methods)
 - **Uniform Hazard Spectrum**
 - Basic approach (From USGS hazard maps used in current codes)
 - Current spectra formulations found in codes (how do they relate to theory?)



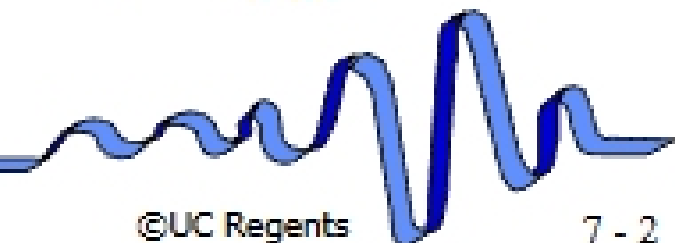
CEE 227 - Earthquake Engineering

U.C. Berkeley

Spring 2009

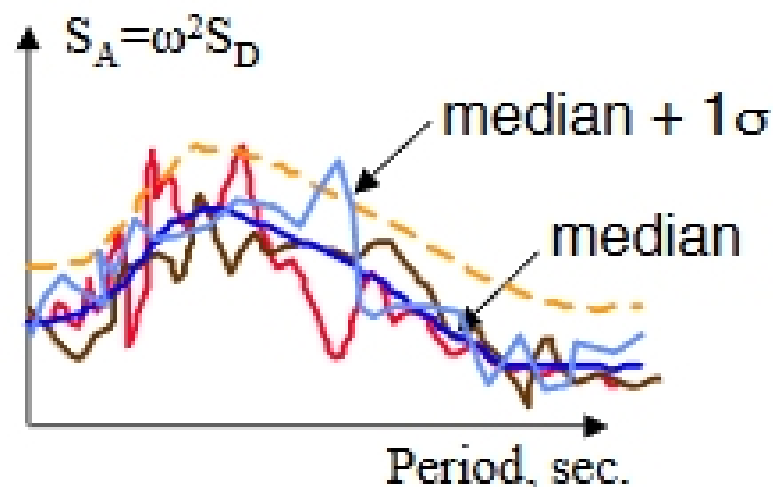
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Smooth Design Response Spectrum from Ground Motion Records

- Response Spectrum for actual ground motions are quite irregular.
 - **Don't use individual spectrum for design**
 - They can be used for analysis to assess response to a particular earthquake.



- Use suites of ground motions representing:
 - A specific deterministic design earthquake (e.g., $M = 7$ at 10 km)
 - Match a stipulated design response spectrum (e.g., match code spectrum)
 - A range of earthquakes types corresponding to the deaggregated seismic hazard at the site.
- The design response spectrum is obtained statically from all records." The resulting "median" spectrum will be relatively smooth. The COV or Standard Deviation (σ_{inv}) can be used to establish a design spectrum with a desired probability of exceedence.
- Note: Various programs do this automatically.

