Modification of Random Vibration Theory for the Near-fault Region

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Abstract

Standard random vibration theory (RVT) methods for estimating the horizontal spectral acceleration (PSA) amplitudes given the Fourier spectral amplitude (FAS) and ground-motion duration underestimate the PSA values for near-fault ground motions from large magnitudes. An empirical model that is unbiased for near-fault ground motions is developed using the statistical moments of the FAS and the duration as model input parameters, similar to standard RVT, but with a modification to also include magnitude and distance as input parameters. The data set used for the regression includes strong-motion recordings from active crustal regions in the NGA-West2 Pacific Earthquake Engineering Research (PEER) database from California earthquakes (M3.0-7.25) and global earthquakes (M5.0 – 7.9). The zeroth, first, and second spectral moments of the FAS of the 5%-damped oscillator response are used in the empirical model. The scaling with the moments of the FAS replaces the peak factor terms used in RVT. A parametric model for the 5-80% duration that depends on magnitude and distance is also developed to simplify the application of the model. Compared to the standard RVT approach, the conditional model significantly improves the estimation of near-fault PSA values estimated from the FAS. The conditional model is appropriate for use in converting non-ergodic FAS GMMs to non-ergodic PSA GMMs.

Full Text

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