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Effect of Randomness of Slip and Source Time Function on Pseudo-dynamically Simulated Ground Motion Characteristics

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Abstract

This paper presents the effects of randomization of slip and the parameters of source time function on the pseudo-dynamically simulated ground motion characteristics. In the case of numerical simulations, the radiation of seismic energy from the rupture plane as per Brune's model as well as to avoid the coherency effects is a challenging job for the simulators. The randomization of slip, rise-time, and peak-time of the source time function and the rupture arrival time, as well as the incorporation of fault-roughness and damage-zone, play important roles in seismic energy release from the rupture plane as well as in the reduction of coherency effects on the high-frequency seismic radiations. Inversion of earthquake data or statistical analysis of dynamic rupture simulations is used to estimate the slip distribution. The statistical approach assumes that the earthquake slip follows a random distribution on the fault plane. The simulation of pseudo-dynamic ground motion has been carried out using a fourth-order accurate staggered-grid time-domain 3D finite-difference method. The ground motions are simulated taking ten different slip patterns for a hypothetical strike-slip Mw 6.0 earthquake. In addition, for each slip pattern, a stochastic perturbation in the parameters of the source time function is introduced. The simulated results have been analyzed based upon some important parameters such as arias intensity, peak ground acceleration, peak ground velocity, and peak ground displacement. Considerable variation in the computed values for the aforesaid parameters is obtained with the change of slip patterns and parameters of the STF. A good match of the computed average pseudo-spectral acceleration (PSA) using the simulated ground motion with that obtained using NGA-West2 GMPEs is obtained in the frequency range 0.1–5.0 Hz and at an epicentral distance of 11 km.

Keywords: Pseudo dynamic rupture, Finite difference method, 3D ground motion simulation