

Extension of Stochastic Source Model to Broad-Band Strong Ground Motion Simulation in Layered Half-Space (Part 2)

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We developed a hybrid method for simulating broadband strong motions in layered half-spaces. As for the lower frequency range (less than around 1 Hz), we use the theoretical method by Hisada and Bielak (BSSA, Vol.93, p.1154-1168, 2003), which can simulate accurate near-fault effects, such as the directivity pulses and the fling steps from surface faulting, in layered half-spaces. As for the high frequency range (more than around 1 Hz), we developed a new method for simulating strong motions in layered half-spaces based on the stochastic source model. In the method, first, we divide a fault plane into sub-faults, and locate Boore's point source model (amplitude spectra; Boore, 1983) on each sub-faults. As for the phase spectra of the source model, we introduce random and coherent phases at higher and lower frequencies, respectively. The coherent phases are necessary to reproduce coherent waves in near sources, such as the directivity pulses and the fling step at lower frequencies. In addition, we use a hybrid radiation pattern, which is homogeneous and theoretical at higher and lower frequencies, respectively. As for Green's function, we used the complete Green's functions in layered half-spaces (Hisada, 1994, 1995), which can generate efficiently strong motions up to very high frequencies. The simulated waves from all the point sources are superposed to follow the omega-square rule. We applied the method to observed records, such as the Landers and Northridge earthquakes, and obtained excellent agreements.