S5-P001 Time: June 8 17:00-18:30

Effects of Various Source Parameters on Broad-Band Strong Motions (2) - Near-Source Directivity Effects -

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The proposed source model successfully simulates most of the well-known characteristics of the near-fault strong ground motions at broadband frequencies, i.e., permanent offsets in displacements, long-period pulses in velocities, and complex randomness in accelerations. The near-source directivity effects are also confirmed; the fault normal components are dominant over the fault parallel components, especially, at the forward rupture direction. However, the ratio between the fault normal and parallel components is roughly independent of frequency, which is contradictory to empirical models. This suggests that a 3-D faulting model is necessary to represent more realistic near-source strong motions at broadband frequencies.

The theoretical basis of the omega-squared model and the characteristics of near-source broadband strong ground motions are investigated using a 2-D source model with spatial variations in slip and rupture velocity. This is an extension of a study by Hisada (2000), who used 1-D source models for the same purpose. First, Hisada's slip velocity function (2000) is modified by superposing scalene triangles to construct Kostrov-type slip velocity functions with arbitrary combinations for the source controlled fmax and the slip duration. Then, it is confirmed that the Fourier amplitudes of these slip velocities fall off as the inverse of omega at frequencies lower than fmax (Hisada, 2000). Next, the effects of 2-D spatial distributions of slip and rupture time on the source spectra are investigated. In order to construct a realistic slip distribution, the hybrid slip model is proposed, which is the combination of the asperity model at lower wavenumbers and the k-squared model (Herrero and Bernard, 1994) at higher wavenumbers. The source spectra of the proposed 2-D models, which have the k-squared distribution for slip and rupture time, fall off as the inverse of omega, when the slip is instantaneous. This result also agrees with Hisada (2000).Therefore, the omega-inverse-squared model, which consists of the combination of the Kostrov-type slip velocity proposed here and the k-squared distributions for both slip and rupture time, not only is consistent with the empirical omega-squared model, but also provides the theoretical basis for constructing realistic 2-D source models at broadband frequencies. In addition, it is confirmed that the proposed source model successfully simulates most of the well-known characteristics of the near-fault strong ground motions at broadband frequencies, i.e., permanent offsets in displacements, long-period pulses in velocities, and complex randomness in accelerations. The near-source directivity effects are also confirmed; the fault normal components are dominant over the fault parallel components, especially, at the forward rupture direction. However, the ratio between the fault normal and parallel components is roughly independent of frequency, which is contradictory to empirical models. This suggests that a 3-D faulting model is necessary to represent more realistic near-source strong motions at broadband frequencies.