Regression formula of acceleration envelope

masanori Horike[1]; Koji Yamada[2]

[1] OIT; [2] Hanshin Consultants

The stochastic simulation method is often used as a convenient and practical method of generating high-frequency strong motions.

One is that horizontal motions generated by

this method are slightly overestimated and

vertical motions are considerably underestimated due to neglecting the near-field term and the intermediate term ofthe elastic wave Green's function.

This problem is solved by using the hybrid method that combines low-frequency motions generated by the finite difference method or the finite-element method and high-frequency motions by the stochastic simulation method. The other is that at longer source distances, earthquake motions generated by the stochastic method are small in amplitude and are short in duration. This is due to neglecting the effect of random inhomogeneity in propagating media. This defect become quite serious when we compute high-frequency strong motions radiated from inter-plate earthquakes. Thus, we improve the stochastic simulation method.

There are two approaches to incorporate the effects of random inhomogeneity. One is to numerically simulate earthquake motions in randomly inhomogeneous propagating media. However, reliable stochastic properties of random inhomogeneity are not known so that modeling of random media is practically impossible. Furthermore, even if modeling is possible, implementation of numerical simulation up to 10 Hz is practically impossible for huge memory size. Thus, in this study, we infer empirical relation of parameters controlling the envelope of high-frequency motions with magnitude, focal depth, fault type and source distance.

A shape of the envelope of high-frequency motions is expressed as a function of three variables, b, c, and a. Variable b controls the peak of envelope and variable c controls onset of the envelope. Variable a controls the duration. Variables b, c, and a are inferred from accelerations of KiK-NET borehole sites where the shear wave velocity is larger than 1.7km/s. An integration of expected value of accumulated square of acceleration is theoretically expressed as a product of incomplete gamma and complete gamma functions, which contain the three variables. The three variables are inferred by minimizing squared residuals between accumulated power of recorded accelerations and the theoretical equation.

We obtain the following results. Parameter a decrease with increasing source distance. The parameter for deep earthquake events decrease more rapidly than for shallow events. Parameter b decreases with parameter a.