S081-P010 Time: May 29 17:00-18:30

An Efficient Method for Computing Near-Source Strong Ground Motions Considering Surface Faulting in Layered Half-Spaces (Part 2)

Yoshiaki Hisada[1]

[1] Kogakuin Univ.

http://kouzou.cc.kogakuin.ac.jp/

Recent earthquakes, especially those with large surface faulting such as the 1999 Chi-Chi Taiwan earthquake, have demonstrated the necessity for a methodology for efficiently computing the near-source strong motion, which will include the surface faulting effects (the fling effects). In the previous study (Hisada and Bielak, 2001), we proposed a theoretical method for computing strong ground motions in an arbitrary flat-layered system from a seismic fault considering the fling effects. In this study, we propose some additional numerical techniques for evaluating accurately the static dislocations, and show various example results.

As pointed by Hisada and Bielak (2001), we have to be careful in evaluating the near-source strong motion including the static displacement, because 1) the Fourier amplitude of a step-like displacement diverges at the zero frequency, and 2) Green's function diverges on a fault surface. We can easily solve the first problem by calculating velocities in the frequency domain, and then, by integrating them in the time domain to obtain the displacements. As for the second problem, the static terms of dynamic Green's functions show sharp peaks within the area close to the observation point. Therefore, we can easily carry out the fault integration at any frequencies, by subtracting the static terms from the Green functions (Integration 1). We then obtain the accurate ground response, by adding the fault integration corresponding to the static terms. We carry out the fault integration of the static terms accurately using very dense integration points around the fault area close to the observation point (Integration 2).

As for the surface faulting, we have to evaluate Green's functions whose source points are near or on the free surface. When a depth of an observation point is close to the depth of a source point, the integrands of the wavenumber integrations of Green's function diverge with wavenumber. In Integration 1, since the static terms are subtracted from the dynamic integrands, the integrands of Green's function quickly converge with wavenumber. In Integration 2, we introduce the contour deformation method by Greenfield (1995) for evaluating static Green's functions, where the real wavenumber axis is extended into the complex axis considering Cauchy's theorem.

Finally, we investigated the fling effects using various fault models. We found that we needed to evaluate accurately the static terms to obtain the accurate near source strong motion, especially at low frequencies. Also, we found that the fling effects are dominant only for surface faults, but not buried faults. This result showed a distinct contrast with the directivity effects, which are effective even for the buried faults.