Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)
©2012. Japan Geoscience Union. All Rights Reserved.

SSS26-04 Room:304 Time:May 20 09:45-10:00

Correction for slip function and its implications

MASUDA, Tetsu[1*]

[1]ERI

Green's function method is useful for simulating strong ground motion. It is necessary to correct for the amplitude and dominant period difference between the bigger target earthquake and the small earthquake as the Green's function. Correction is based on the scaling relations that the slip rise time, as well as slip amount, is scaled by the source dimension. Correction functions of particular type have been proposed. Boxcar type function (Irikura, 1983), exponential time function (Onishi and Horike 2004) for slip velocity time function, or two-order rational function for radiated wave spectrum (Dan and Sato, 1998) is assumed to derive correction function, while Irikura (1986), Irikura et al.(1997), and Nozu (2002) directly specified the correction functions. The correction function spectrum takes a constant value N, which is the ratio of source dimension, in lower frequencies than a corner frequency ft relating to the target rise time T, and it is unity in higher frequencies than another corner frequency fg relating to the small earthquake rise time, and it falls off with increasing frequency between the two corners.

Seismic wave is evaluated by integrating slip velocity over the fault surface. Assuming the slip velocity is uniform over the rectangular fault and rupture propagates constantly, surface integral of slip velocity over a finite fault results in a product of two Sinc functions, one with argument of 2*pai*f*Tx, and another with argument of 2*pai*f*Ty, where Tx=(X/c - 1/Vx)*L/2 , Ty=(Y/c - 1/Vy)*W/2, f is frequency, L and W the source dimension, X and Y the direction cosine, R the distance, c the phase velocity, Vx and Vy the rupture velocity. The spectrum is flat in lower frequencies than fc, relating to square root of Tx*Ty, and it falls off from the corner proportionally to the squared frequency.

In Green's function method, instead of integrating slip velocity, waves of small earthquakes located at discrete points are summed up. The spectrum of summation is also flat in lower frequencies than the corner fc, and falls off similarly from fc, however in this case, it increases from a frequency fe=fc/N and keeps a constant level in higher frequencies.

The corner frequency fc is due to fault finiteness, and the spectrum decays from fc. If the corner ft is close to fc, the spectrum of synthesized wave by means of Green's function method falls off between these two corners steeper than the omega-squared model because both of the correction function and summation over the fault. The rise time is in many cases set to W/2Vr referring to numerical simulations by Day (1982). In this case, the corner frequency ft is close to fc, and consequently underestimation of spectrum contents is resulted between these two corners. Kataoka et al.(2003) pointed out that the shorter rise time is consistent with the observations.

The rise time W/2Vr is an approximation of total duration of slip near the center of fault. The slip velocity steeply increases after rupture arrives and decrease in a short time after it reaches the peek, and the peek decreases to zero at fault edge. Many studies of source process indicate that the rise time is as short as one tenth of total duration of rupture L/Vr.

Uniform slip velocity over an asperity area is usually assumed in a characteristic source model. The rise time W/2Vr is too long if applied all over asperity area, and shorter rise time is appropriate for the proposed correction functions. The correction function by Onishi and Horike or Nozu is consistent with the impulsive feature of slip velocity. A large value of exponent coefficient is preferable since it approximates the numerical results. In order to properly estimate seismic wave spectrum independent of the size of the Green's function, it is necessary to set a shorter rise time or to take a large value of exponent coefficient.

Keywords: Green' function method, slip time function, correction function, rise time