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Refinement of stochastic Green's function

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1. Introduction.
Green's function is used as a tool to calculate strong ground motions from source models. When an empirical Green's function is used, the magnitude is fixed to the observed size, and therefore, sub-fault size is also fixed to the corresponding dimension. Stochastic Green's function is free from this restriction, and sub-fault size is arbitrarily set. We thereafter concentrate on stochastic Green's function.
The followings are required of stochastic Green's function:
(1) The amplitude spectrum coincides with the model.
(2) The amplitude and shape of spectrum, PGV and PGA are same regardless of sub-fault size.
The entire fault is subdivided into N sub-faults. The sub-fault slip is limited by short sub-fault dimension, while the slip for the large earthquake must be larger, and the rise time may be changed for the appropriate Green's function.
The ratio of spectral amplitude of corrected Green's function to that of sub-fault is set equal to square root of N in lower frequencies and to unity in higher frequencies than the corner frequency fce of sub-fault, fce depending on the sub-fault dimension. The rise times have been set using the entire fault dimension and rupture velocity. The corner frequency fcr resulted from the rise time is square root of N times lower than that of sub-fault. The spectral amplitude of conventional correction function decays proportionally to the inverse of frequency between the two corner frequencies. The synthetic spectrum decay, therefore, in this frequency range is inversely proportional to the cube of frequency. Thus, when N is large, the above two requirements are not satisfied.
This report proposes an alternative approach to set the correction function for slip and the characteristic duration of Green's function.

2. Rise time of Green's function.
The conventional rise time corresponds to total duration of motion from the final fault extension. The rise time at any point on the fault is shorter than that value. A revision to meet the above requirements is to choose the sorter rise time which gives a corner frequency close to fce of sub-fault. Since the spectral amplitude beyond fce should be the same with that of sub-fault, the amplitude of corrected spectrum must decays steeply beyond fcr and until fce. The following is one such form for corrected Green's function:
G(t)=g(t,fce)+At^m*exp(-Ct) (1)
where t is time, g(t,fce) the Green's function before correction, m a positive integer, and A and C positive numbers related to fcr. The spectral amplitude decay is proportional to the (m+1)-th power of frequency beyond fcr and until fce. The rise time is taken so that fcr is close to fce, and m is taken sufficiently large so that the Green's function decays steeply between the two corners. Thus, the synthetic spectrum consistent with the model is obtained.

3. Duration of Green's function.
Duration of motion of synthetic wave is the sum of duration needed for rupture to propagate the

entire fault and duration of Green's function. The duration of Green's function is set as the product of inverse of corner frequency of sub-fault and a factor Cw, which is proportional to sub-fault dimension divided by rupture velocity. As number of sub-faults N increases, the duration of Green's function decreases proportionally to the inverse of N, and total duration of synthetic motion decreases. The corrected Green's function (1) produces the synthetic wave coincide with the model spectrum regardless of number of sub-faults. The shorter duration consequently results in the larger amplitude in the time domain.
In order to assure the same level of amplitude and duration of motion in spite of number of sub-faults, the factor Cw for the Green's function duration is adjusted according to the number of sub-faults N. Thus, the amplitude in time domain is obtained independent of number of sub-faults.

Keywords: stochastic Green's function, rise time, corner frequency, duration of motion, sub-fault