A hybrid FDM-BIEM approach for dynamic rupture simulation: Part II

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We have proposed previously a hybrid method in which the stress kernels of boundary integral equation method (BIEM) is evaluated numerically by using finite difference method (FDM) (Kame, Aochi and Ducellier, SSJ Fall Meeting, 2007). Our purpose is to simulate a spontaneous rupture process in a heterogeneous medium, which cannot be directly formulated in BIEM.

Here we first confirm that this approach works sufficiently for the rupture propagation on a plane fault in a two-dimensional infinite, homogeneous medium without any additional technique. It is then found that FDM calculation needs about 100 times finer grids for a corresponding BIEM element. It is also found that we have to tune up carefully the source parameters so that the of the numerically evaluated stress kernels keep an energy dispersion invariance that is theoretically expected. Although the numerical cost is expensive, our approach is useful when analytic representations of BIEM kernels are not available.

Secondly we test a trial case of a plane fault embedded parallel to the ground surface. It may be regarded as an extremely gradual thrust fault for studying the interaction between the fault and the ground surface. Our hybrid method approach is again valid for this case in that the numerically evaluated stress kernels conserves the spatiotemporal symmetry in terms of the interacting ground surface so that they are precise enough to simulate rupture propagation in the half-space. This is a significant example not only to verify our hybrid method but to investigate rupture dynamics in the presence of structural heterogeneity.