G061-005 Room: C409 Time: May 29 10:10-10:30

Numerical Modeling of Dynamic Rupture Propagation along a Fault: Which Parameters are Critical?

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There are three important parameters in numerical modeling of dynamic faulting: 1) fault geometry, 2) constitutive relation (friction law), and 3) initial stress field. We demonstrate how these parameters affect a dynamic rupture simulation. To show that, we use a boundary integral equation method (Fukuyama and Madariaga, 1998, BSSA) and apply it to a simple fault model.

For the fault geometry, aftershock distribution might be a good information source. However, we could obtain this information only after a big earthquake. Distribution of active fault traces is an alternative for shallow strike slip earthquakes. However, sometimes there are a lot of blind faults that appear during the earthquake (Fukuyama et al, 2001,). We will show how these fault geometries are included in the numerical simulation and discuss the effect on fault rupture dynamics (Fukuyama, et al. 2002, SSJ faull meeting).

As for the constitutive relation, slip-weakening friction law is considered to play a major role during a high-speed rupture (e.g. Ohkubo and Dieterech, 1989, JGR). In slip-weakening law, two parameters (critical strength drop tb and critical slip-weakening distance Dc) control the rupture (Fukuyama and Madariaga, 2000, PAGEOPH). However, since the fracture energy, which is proportional to the product of tb and Dc, controls the rupture velocity, it becomes difficult to estimate tb and Dc separately from traditional waveform inversion using seismic waveform array data (Guatteri and Spudich, 2000, BSSA). However, if near-field waveforms (or waveforms on the fault) are available, it becomes possible to estimate Dc (Mikumo et al., 2001, AGU, Olsen et al., 2001, AGU).

The one of the most difficult parameters to estimate at this moment is the stress field. From the stress tensor inversion of earthquake focal mechanisms, it becomes possible to estimate the direction of stress tensors and the ratio of its principal components (Kubo, Fukuyama, Kawai and Nonomura, 2002, submitted to Tectonophys.). The result suggests a rather homogeneous stress field. It is also possible to estimate the relative stress drop during the earthquake (e.g. Ide and Takeo, 1997, JGR), which is quite heterogeneous in space. The shear stress distribution on the fault is closely related to the fault geometry. Thus we can propose the hypothesis that stress field is relatively homogeneous and local stress variation is cased by the geometry of the fault. Of course there should exist a locally heterogeneous stress field, however, this assumption seems to work for some earthquakes (e.g. Aochi and Fukuyama, 2002, JGR in press). In this case, it would be important to calibrate the stress by using the result of in-situ downhole measurements.