Dynamic Rupture on Non-planar Faults and Surrounding Stress Field

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In order to investigate the physical process of earthquake dynamic rupture, fault geometry and stress field become important. Since the orientation of principal stress around the fault before the earthquake seems rather uniform, orientations of fault planes control the shear and normal stress applied on the fault (Aochi and Fukuyama, 2002, JGR; Aochi et al., 2003, G-cubed). This suggests that a non-planar fault modeling could forecast the dynamic rupture of earthquakes if the information on stress field and constitutive relation on the fault is given. Or inversely, the dynamic rupture modeling could provide the information on the stress field before the earthquake.

Fukuyama et al. (2002, AGU) proposed a new method to compute a dynamic rupture propagation on an arbitrary shaped fault with curvatures and branches. In this method, faults are modeled as a sum of triangular elements. Based on the boundary integral equations for arbitrary shaped fault (Tada et al., 2000, Comp. Mech.), discretized kernels for triangular elements are derived. Following Fukuyama et al. (2002, PAGEOPH), the dynamic rupture is computed by assuming a pre-defined shaped slip-weakening friction and initial stress distributions.

Using this technique, we first modeled a dynamic rupture on a non-planar fault under the pre-defined stress condition. Using this model, we then investigated the feasibility to estimate the stress field from the rupture process by assuming the constitutive relation are known. This forward modeling analysis suggests that the estimated kinematic slip model of large earthquake rupture can provide the information on the stress field before the earthquake.