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Effects of off-fault damage on the tendency of fault branching

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Fault zones are an elastic medium with distributed damage varying the elastic stiffness of the medium. Considering effects of inelastic behaviors of fault zones is important for understanding physics of macroscopic rupture dynamics. Our main issue is to evaluate these effects on a spontaneously propagating mode II crack on a bimaterial interface (the main fault) and a branching fault.

We develop an explicit finite element code to model dynamic rupture process in a damaged medium. An equation of motion and a kinetic equation for damage evolution introduced by Lyakhovsky et al., 1997 are solved. Slip on the main and branching faults is implemented by split-nodes with a slip-weakening friction law. Outer boundaries are absorbing boundary. We assume homogeneous prestress.

We solve the dynamic rupture problem with the branching fault in homogeneous prestress with various values for the rupture velocity, the branching angle between the main and the branching angle, the material contrast, and the coefficients of damage evolution. We find that the damage is enhanced around crack tip when the rupture velocity is close to the generalized Rayleigh velocity. When the rupture front approaches a branching point, damage evolution at the branching point affects the tendency of fault branching.

Keywords: dynamic rupture propagation, branching fault, off-fault damage