Supershear rupture induced by step over geometry

*Feng Hu[1], Hengxin Ren[2], Xiaofei Chen[1,2]

1. Univ. of Sci. &Tech. of China, 2. Srn. Univ. of Sci. & Tech.

Based on dynamic rupture simulations on strike-slip step overs in a 3-D full space where the initial shear stresses preclude a supershear transition according to the Burridge-Andrews supershear transition mechanism, we show that rupture speeds can transit from subshear on the primary fault to supershear on the secondary fault for both compressional and extensional step overs. The low normal stress zone and the high shear stress zone, which radiate from the end of the primary fault if its rupture arrest is sudden, coincides beyond the fault step, and determine the supershear rupture occurrence on the secondary fault. However, a low shear stress zone traveling at the shear wave speed is also radiated, making the rupture speed return to subshear in most cases. Sustained supershear rupture are also possible on compressional step overs under certain conditions. Self-arresting ruptures are observed in the overlap area on the secondary fault. In the homogeneous half-space model where supershear rupture exists on the primary fault, because of the free-surface, the rupture speed on the secondary fault rapidly transits to subshear near the fault step if its width exceeds a critical value. The distribution of peak ground velocities are also investigated.

Keywords: supershear ruptures can be induced by a fault step over, stress waves radiated from the end of the primary fault control supershear transition on secondary fault segments, rapid rupture speed transitions at step overs in a half-sapce

