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Dynamic rupture processes on two orthogonal but not conjugate fault segments

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The coseismic ground tilt observed at IWTH25 station during the 2008 Iwate-Miyagi earthquake (Fukuyama et al, 2008, ASC meeting) supported the existence of the conjugate fault and indicated that the conjugate fault should rupture simultaneously to the main rupture (Fukuyama, 2009, SSJ meeting). The simultaneous ruptures on the conjugate faults require that a rupture initiates at the joint of two faults and propagates to the both faults (Fukuyama, 2009, SSJ meeting).

The 2009 Suruga-bay earthquake had the aftershock distribution consisting of two planes, which has the SE- and NE-dipping planes for the southern and northern source areas, respectively, and the hypocenter of the main shock was located at the SE-dipping plane (Obara et al., 2009, SSJ meeting). The normal vectors of the two planes are almost orthogonal. Using the fault plane model that consists of the SE-dipping fault segment with a hypocenter and the NE-dipping fault segment connecting with the other segment at the point 5 km west of the hypocenter, Suzuki et al. (2009, AGU fall meeting) estimated the rupture process using the near-source strong-motion data. The estimated rake angles suggested that the SE-dipping fault segment had right-lateral strike slip, and that the NE-dipping segment had reverse slip. Thus, the two fault segments were geometrically orthogonal, but were not conjugate. The rupture process of the 2009 Suruga-bay earthquake was different from the one of the 2008 Iwate-Miyagi earthquake, and the rupture had not to start at the joint of two fault segments.

In this study, we investigate a physical possibility of coseismic slip on two orthogonal but not conjugate fault segments, using dynamic rupture simulations. The 3-D finite-difference method of Kase and Day (2006, GRL) is improved for the simulation. Varying the angle between two segments, we calculate spontaneous rupture processes on segments, and examine whether a rupture propagating to the joint can jump to the other segment.

Keywords: orthogonal, conjugate, multiple-segment rupture, numerical simulation, dynamic rupture, finite-difference method