Development of a method for dynamic source inversion using Extended Kalman Filter

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The dynamic rupture process on the seismic fault depends on a stress field near the fault plane which is controlled by several dynamic parameters. We introduce a method for dynamic source inversion to estimate the dynamic parameters.

Two relationships are assumed, which are slip-dependent constitutive law and equilibrium equation near a fault plane. The constitutive law is modeled on the basis of two parameters, which are breakdown displacement and breakdown stress drop. The boundary integral equation introduced by Fukuyama and Madariaga (1998) is used as the equilibrium equation. An explicit formulation for a slip displacement at a time t0 is obtained by eliminating the stress terms from the two equations, which includes dynamic parameters and time history of slip displacement before t0. It is regarded as the state equation of non-linear discrete-time stcastic system.

Representation theorem is able to be regarded as observation equation. The observation equation of liner discrete-time stcastic system, which relates slip displacement with observed ground motion is derived based on the representation theorem and causality. The inversion analysis can be performed using the state and observed equations.

Then a dynamic inversion process is formulated as Extended Kalman Filter. The dynamic parameters estimated by the proposed method are two friction parameters and initial stress values.

Reference,

Fukuyama, E. and R. Madariaga : Rupture dynamics of a planar fault in a 3D elastic medium : rate- and slip-weakening friction, BSSA, 88, pp.1-17, 1998.