

Theoretical frame work of kinematic source inversion based on a mesh refinement algorithm

Hiroyuki Goto[1]; Takahiko Uchide[2]; Yayoi Ishii[3]; Sumio Sawada[1]

[1] DPRI, Kyoto Univ.; [2] Dept. EPS, Univ. of Tokyo; [3] SHIMIZU Corporation

It is important to investigate source rupture processes of major earthquakes for assessing ground motions during future hazardous earthquakes. A kinematic source inversion method is a helpful tool for empirically characterizing large earthquakes. However, the source inversion analyses by different authors often obtained varied solutions. Even in a blind test giving an exact model of subsurface structure, the results estimated by several researchers vary a lot from the true distributions (Mai et al., 2007).

The layout of fault elements is required to match with a resolution based on arrangement of observation sites, geometry of faults, subsurface structures and reliable frequency bands. A non-uniform element layout according to the resolutions (Page et al., 2009) may give an appropriate solution under given conditions because the resolution should not be uniform over a fault. In this study, we discuss an element refinement algorithm in order to evaluate an appropriate element layout and slip distribution for the observed data sets.

We start by preparing a fault model composed of a small number of coarse elements. Our element refinement algorithm obtains an appropriate element layout by dividing elements of the fault model into small elements step by step. At each step, the element with the largest resolution is to be divided. The resolution is directly evaluated by a resolution matrix (Page et al., 2009), however, especially for inversion analyses using strong-motion data, the computational cost of the resolution matrix is so expensive. Therefore Ishii et al. (ASC, 2008) proposed a method for the evaluating the resolution based on the diagonal components of the Hessian matrix of an objective function. In this paper, we design another method using the off-diagonal components of the Hessian matrix, which indicates the trade-off among the model parameters representing the slip at the elements. The iterative refinement procedure is stopped when we obtain an optimal element layout minimizing AIC. Simple synthetic tests verify the validity and robustness of our algorithm.