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Investigating ground motion of dip-slip fault based on pseudo dynamic source model

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1. Introduction

Ground motion prediction is an important element in seismic hazard analysis. However, the availability of recorded strong ground motion data is limited, particularly for large events in near-source regions. Recently, several physics-based ground motion simulation approaches have been developed, which may be useful for understanding the effect of earthquake source on near-source ground motion characteristics. In this study, we investigated the characteristics of near-source ground motions of dip-slip with pseudo-dynamic source models

2. Methods and Results

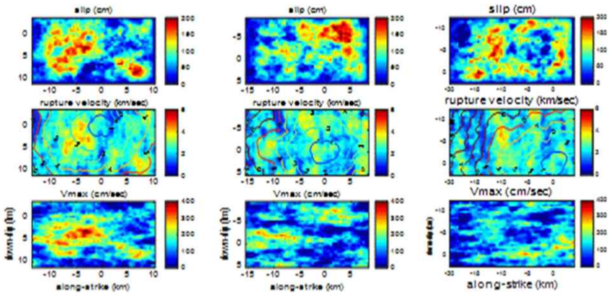
We simulated ground motions for M_w 6.5 normal fault events and reverse fault events using pseudo-dynamic source models derived from multiple sets of input source statistics, and investigated the characteristics of near-source ground motions relative to the input source statistics.

2.1 pseudo dynamic source models

Song *et al*. [1, 2] and Song [3] proposed characterizing earthquake rupture processes within a framework of the 1-point and 2-point statistics of key kinematic source parameters. In brief, their approach involved assigning a set of random spatial fields to a finite-fault plane to model the spatial distribution of several key kinematic source parameters, such as slip, rupture velocity (*V*r), and peak slip velocity (*V*max). In other words, one random field was assigned to each source parameter, and one random variable (i.e., one element of the random field was assigned to every subfault patch on the fault). If there are three source parameters, there are also three random fields. The number of random variables for each random field is equal to the number of subfault patches on the finite fault. The 1-point statistic is a marginal probability density function at a given point on the fault. If a Gaussian distribution is assumed, then the mean and standard deviation are the two main representative parameters that control the possible range of values for each source parameter. The 2-point statistic is comprised of both auto and cross correlation. Autocorrelation controls the heterogeneity of each source parameter, while cross-correlation controls the coupling between source parameters. Once the 1-point and 2-point statistics are modeled for a certain event, stochastic modeling can generate finite-source rupture scenarios.

We initially generated 30 scenario earthquakes via pseueo dynamicsource modeling for each input source statistics models. The slip velocity function (SVF) proposed by Tinti *et al*. [4] was adopted to compute the spatio-temporal evolution of earthquake rupture along the fault (Figure 1).

Figure. 1. Dip slip fault modeling examples for the Mw



6.6 target event.

2.2 Ground Motion modeling

Pseudo-dynamically generated finite-source models were combined with Green's functions computed by the FK method (Zhu and Rivera, 2002) [5]. The same 1D velocity model used in *Song et al.* (2014) [2] was adopted for the Green's function calculation. Then, we generated three-component (fault-normal, fault-parallel, and vertical) synthetic seismograms that were effective up to 3 Hz.

2.3 Characteristics of gourd motions

As a result of comparing the peak ground velocity of the ground motion simulated at each observation point for 30 models of normal fault and and reverse fault earthquake sources.

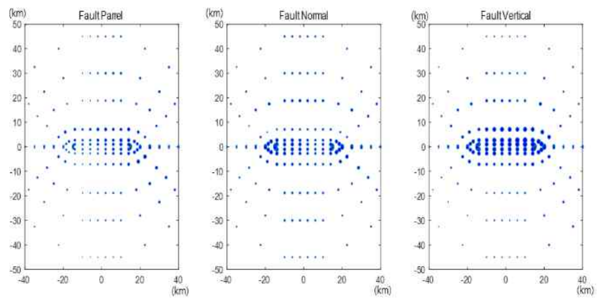


Figure 2. The location of 168 stations. The circle size of each station indicates the mean PGV (Peak ground velocity) of 30 scenario earthquake using source statistics model.

The peak amplitude of the ground motion was larger in the hanging wall of the fault than in the foot wall of the fault (Figure 2). It shows that hanging wall effect.

3. Conclusions

The characteristics of near-source ground motions controlled by finite-source processes were studied, utilizing pseudo-dynamic source modeling that were based on the 1-point and 2-point statistics of earthquake source parameters. The sensitivity of near-source strong ground motions to the change of the 1-point and 2-point perturbation of pseudo dynamic source statistic model were analyzed A large number of near-source ground motions using dip slip pseudo-dynamic models of M_w 6.5 and 6.6, derived from multiple sets of input source statistics were simulated. The near-source ground motions are more significantly affected by hanging wall effect. The statistical framework for generating earthquake rupture scenarios improves simulation-based ground motion prediction, and consequently may help to achieve more accurate seismic hazard analysis, in particular in the near-field of moderate-to large earthquakes where data-constraints, and hence ground motion prediction schemes, are limited. For further studies, we plan to analyze the precise correlations between various fault shapes and fault rupture parameters.

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