THE NEAR FAULT GROUND MOTION SIMULATION FOR THE TOTTORI-KEN SEIBU EARTHQUAKE CASE

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1. INTRODUCTION

In this study, it is objected to simulate near field strong ground motions due to fault rupturing in the Tottori Earthquake (October 6, 2000). The ground motions are simulated by the convolution scheme in time for source function and in space along rupture direction with the Green's function method based on the kinematic dislocation model. The synthetic motions based on the inversion information from the observed data are compared with the Koufu and Nichinan station records of the Tottori Earthquake.

Figure 1. The location of the observed record stations and ruptured fault

2. FAULT RUPTURE MODEL

For the near field ground motion simulation, a slip rupturing over a certain area of a fault is considered. According to waveform inversion results of [Yagi & Kikuchi, 2000] the fault rupture model was formed. The traced fault length on the ground surface was about 20 km along the strike direction (ϕ =150°) and the width was about 10 km along the dip direction (δ = 87°). The focal depth was determined 11 km. The averaged dislocation was about 2.4 m. Main rupture started at 2.5 sec. time intervals on the 20 km X 10 km rectangular fault. The locations of the observed record stations and ruptured fault are shown in Figure 1. Following the waveform inversion results, a source model was used in this study as shown in Figure 2. The model is located in a two layered soil. Its parameters are assumed as in Table 1, 2 and 3. The targets for the simulations are the ground motions at the Koufu and Nichinan record stations.

Source mechanism studies have shown that the rupture propagation was upward and bilateral. Among the proposed rupture models, radial proceeding model of a constant slip rate which is called as the ramp function model has been used.

For the numerical computation, a fictitious rigid base is assumed at the depth of 104.5 km. The thin layer subdivision of the soil layers is made for the bottom layer.

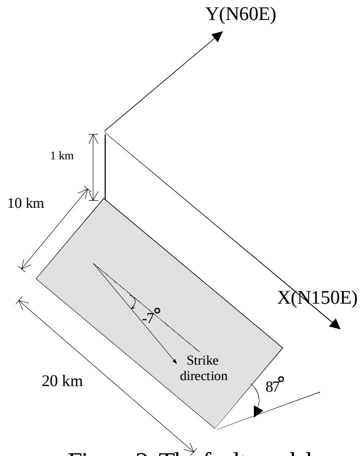

Figure 2. The fault model

3. SIMULATON METHOD

The kinematic fault rupture mechanism (dislocation theory), replaced by the equivalent force action on the fault area, is solved for the near-source strong ground motion simulation. The 3-dimensional wave analysis is formulated for an elastic media that includes the fault rupturing. The Laplace transform with respect to time and the Fourier transforms with respect to space on the horizontal plane are used for the moving Green Function computation. For the rupture process, the double time convolution integral was implemented by the slip function and space propagation. The inverse Laplace transform is performed analytically and the inverse Fourier transform is carried out numerically when replaced by the discrete wave number method. The detail explanation can be found in Takemiya, *et al.* (1998) Takemiya and Goda (1999).

Table 1. Seismic Parameters

(Strike, Dip, Rake) (degree)	(150, 87,-7)
Fault Area (km2)	20km*10km
Rupture Velocity(Vr)	2.3 (km/sec)
Rise Time(Tr)	2.2 (sec)

Table 2. Soil Parameters

Layers No.	Thickness (km)	S Wave Velocity (km/sec)	Poisson's Ratio ν	Density ρ (10^9t/km^3)
1	1.0	1.0	0.270	2.3
2	Infinite	3.5	0.240	2.8

Table 3. Parameters for computation

Base Depth(km)	104.5
Numbers of Sub-division	112
Fundamental Wave Length(km)	204.8
Time Step Numbers	300
Time Increment(s)	0.1

4. SIMULATION RESULTS

It is focused in this study to simulate the Koufu and Nichinan station records. Following the available source information from the inversion analysis, a rectangular fault is used with the associated seismic parameters as shown in Table 1, 2 and 3. The computation results are filtered in order to extract only the essential response features. The trapezoidal filtering window is used for the final evaluation of displacement, velocity and acceleration responses, which specifies as (0.05-0.1 Hz) for high-pass and (4.0-5.0 Hz) for low-pass cutoff frequencies. Figure 3 compares the resulting time histories of observed and simulated motions of displacements, for Koufu and Nichinan station records NS components. The peak values occur at the same time for both observed and simulated motions. It can be said that observed and simulated motions have a good matching in the displacement-time history, and the major characteristics of the observed records can be almost caught from simulated ones.

KEY WORDS: Near Fault Strong Ground Motion Simulation,
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The discrepancies between observed and simulated motions can be attributed to the local site effects, which can be corrected through seismic wave propagation studies. In Figure 4, the response spectrums of observed and simulated displacement, velocity and acceleration records for 5% damping are presented. The conformity between the observed and simulated motions can be seen in all directions.

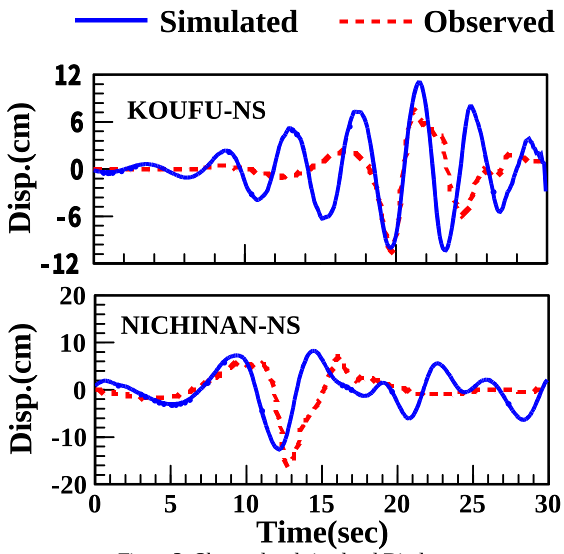

Figure 3. Observed and simulated Displacement-Time history for Koufu and Nichinan station s.

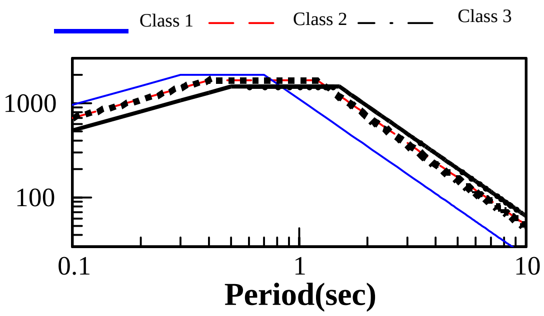

Figure 5. Type II Standard Acceleration Response Spectrum

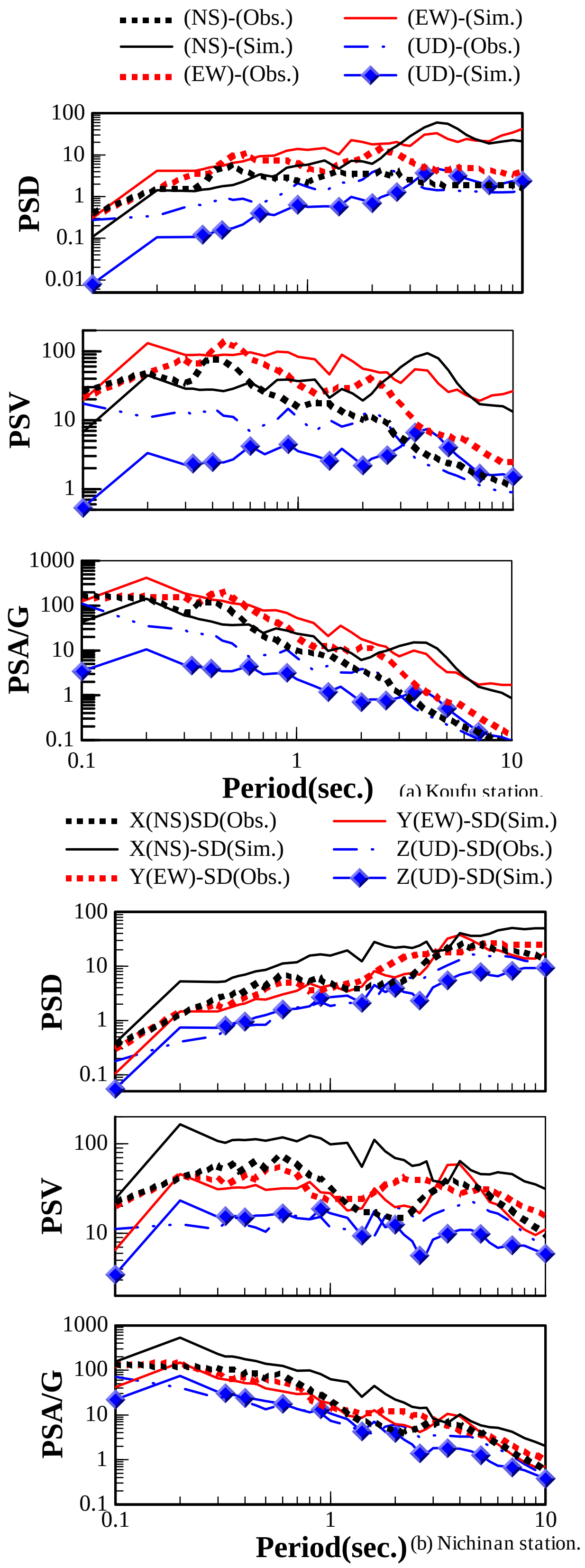

Figure 4. The response spectra of observed and simulated displacement, velocity and acceleration records for Koufu and Nichinan station s.

In Figure 5, Type II Standard Acceleration Response Spectrum for seismic design of highway bridges in Japan is shown. Considering the Koufu and Nichinan stations records as near fault motions and are obtained in alluvium soil conditions, the PSA of these two stations in Figure 4 are in conformity with the Standard Acceleration Response Spectrum for Class III ground in Figure 5.

5. CONCLUSION

The near field strong ground motions were simulated for Tottori Earthquake(2000).

Regarding the simulation of Koufu and Nichinan station records, radial proceeding model was used as a rupture model. Simulated and observed ground motions showed a good agreement on displacement component in all directions.

The response spectrum calculations showed that observed and simulated motions have a good matching especially in the major part of the motions. Type II Standard Acceleration Response Spectrum shows conformity with the PSA of the observed and simulated motions.

6. REFERENCES

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