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SSS35-10 Room:103 Time:May 23 15:00-15:15

Several issues revealed from benchmark tests for strong ground motion simulations (Part 3: SGF)

Kenichi Kato[1*], Yoshiaki Hisada[2], Susumu Ohno[3], Arihide Nobata[4], Atsushi Morikawa[1], Yu Yamamoto[5]

[1]Kobori Research Complex, [2]Kogakuin Univ., [3]Tohoku Univ., [4]Obayashi Co., [5]Taisei Co.

1. Introduction

Stochastic Green's function method is widely used to generate strong ground motions in high frequency range, and applied to simulate the input ground motions for designing aseismic buildings/structures. Since random phases are used in generating time histories in this method, it is important to know the range of variation among synthesized results under the same source, path and site conditions. To quantitatively know the range of the variation, benchmark tests for the strong motion simulation methods have been performed as three years project since 2009 (Kato et al., 2011, 2012, 2013). The purpose of this paper is to reexamine the results of previous benchmark tests, and to reveal several issues and problems for strong ground motion simulations based on the stochastic Green's function method. We also show the plan of the new benchmark tests to resolve the issues through the simulation of observed strong ground motion records.

2. Outline of the results of previous benchmark tests and several issues to be resolved

The previous benchmark tests consist of 6 steps. Very simple point source models in homogeneous and two-layered subsurface structures are used in Step 1, and extended sources are used in Step 2. Radiation coefficient of the source is assumed to be frequency independent, and only SH wave is considered. Since random phases are used in generating time histories, synthesized amplitude shows variation in particular frequencies. We do not know how many random phases should be generated to obtain the average spectra. We also find the serious sags in the Fourier amplitudes in the middle frequency range, around 1Hz, as compared with the omega-squared model, which have to be improved (Kato et al., 2011).

In Steps 3 and 4, more complicated analytical conditions are considered. Frequency dependent radiation coefficient of the source is applied. Since oblique incidences of both SH and SV waves are considered, vertical component is also generated. We also apply the exact Green's function to the Step 4 based on the wavenumber integral method. There exist amplitude and phase differences in the period range longer than 1s. This differences stem from the excitation of surface wave, which can't be considered in Stochastic Green's function method (Kato et al., 2012).

In the Steps 5 and 6, the Kanto sedimentary basin for the 1923 Kanto earthquake (M7.9) is considered as an actual source and structure model. Strong ground motions from the asperity are synthesized in Step 5, and those from characterized source model are synthesized in Step 6. The spectra from Stochastic Green's function method are underestimated in the range longer than 0.5s. It is suggested that the assumption of oblique incidences of plane waves and frequency dependent radiation coefficient of the source may not be practical (Kato et al., 2013).

3. Outline of the new benchmark tests

We plan the new benchmark tests, Step 7, focusing on the validity of oblique incidences of plane waves and frequency dependent radiation coefficient. Target event is the 2004 Kii-hanto-nantou-oki earthquake (fore shock), and strong ground motions recorded at K-NET and KiK-net stations are simulated. Fig. 1 shows the epicenter and the location of stations, and Table 1 shows analytical conditions. Preliminary results from several models will be presented at the conference. Please check the following web site for more details. http://kouzou.cc.kogakuin.ac.jp/test/home.htm

Acknowledgments:

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References:

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Kato et al., AIJ J. Technol. Des. Vol. 18, No.38, 67-72, 2012.
Kato et al., AIJ J. Technol. Des. Vol. 19, No.41, 37-42, 2013.

Keywords: Strong motion prediction methods, Benchmark tests, Stochastic Green's function method, Random numbers, the 2004 Kii-hanto-nantou-oki earthquake

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Table 1 Benchmark tests for stochastic green's function method

<table>
<tr><td></td><td colspan="4">ステップ7：2004年紀伊半島南東沖の地震(前震)</td></tr>
<tr><td>モデル名</td><td>S71</td><td>S72</td><td>S73</td><td>S74</td></tr>
<tr><td>地盤</td><td colspan="3">多層地盤（岩盤、平野内）</td><td rowspan="2">経験的地盤増幅率(野津・長尾、2005)</td></tr>
<tr><td>入射角</td><td colspan="2">斜め入射</td><td>鉛直入射</td></tr>
<tr><td>Q値</td><td colspan="4">振動数依存のQ値（岩盤、平野内）</td></tr>
<tr><td>震源</td><td colspan="4">点震源</td></tr>
<tr><td>ﾗﾃﾞｨｴｰｼｮﾝ (SH & SV)</td><td>振動数(f)依存</td><td colspan="3">振動数(f)一定</td></tr>
<tr><td>破壊開始時間</td><td colspan="4"></td></tr>
<tr><td>有効振動数</td><td colspan="4">0～20 Hz</td></tr>
<tr><td>出力点</td><td colspan="4">関東、濃尾、大阪平野内のK-NET、KiK-net地点(図1)</td></tr>
<tr><td>出力成分</td><td colspan="2">NS, EW, UDの3成分</td><td colspan="2">NS, EWの2成分</td></tr>
<tr><td>乱数の設定</td><td colspan="4">各自の乱数３パターン</td></tr>
</table>

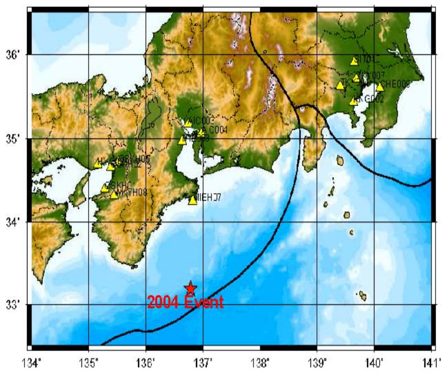

Fig.1 Epicenter of the 2004 Kii-hanto-nantou-oki earthquake and stations for calculation