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Benchmark Tests for Strong Ground Motion Simulations (Part 11:Stochastic Green's Function Method, Step 5 & 6)

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Benchmark tests for the strong motion simulation methods have been performed as three years project since 2009. This paper focuses on the results using stochastic Green's function method.

We have carried out simple benchmark tests in 2009; one is a point source (step 1) and the other is extended sources (step 2) in homogeneous and two-layered subsurface structures. Radiation coefficient of the source is assumed to be frequency independent, and only SH wave is considered. Site amplification is calculated assuming normal incidence of SH wave. Six groups of researchers/engineers were participated in by using their own methods/codes. Since the simple model is used in the steps 1 and 2, all the results calculated by six teams generally show good agreements to each other (Kato et al., 2011). In steps 3 (point source) and 4 (extended source), more complicated analytical conditions are considered. For example, 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 in addition with horizontal components. All the results of the point sources and the extended sources from five participants generally show good agreements to each other in spite of complicated analytical conditions. Synthesized amplitude shows variation in particular frequencies, because random numbers are used in generating time histories. When applying the stochastic Green's function method, this variation should be in mind (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. Variable slip model by Sato et al. (2005) is characterized to two asperities and background regions as shown in Fig.1. Table 1 shows analytical condition. The model S51 in Table 1 assumes the point source located within the asperity 1. Since random numbers used in generating time histories are given in advance, synthesized strong ground motions at ASK and ECJ from all four participants coincide with each other. This agreement indicates that the frequency dependent radiation coefficient of the source is properly applied and site response by oblique incidences of both SH and SV is accurately calculated. The model S61 in Table 1 assumes extended source and strong ground motions are synthesized at 4 sites. The response spectra from four participants show good agreement to each other. The response spectra are also compared with those from empirical attenuation model. Although the response spectra shorter than 0.2 sec correspond with each other, the spectra longer than 0.2 sec from stochastic Green's function method show systematically smaller amplitude than that from empirical attenuation model. By comparing the synthesized strong motions from theoretical method such as the wavenumber integration method and thin layer method under the same subsurface structure, the applicability of hybrid approach will be discussed. 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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Keywords: Strong motion prediction methods, Benchmark tests, Stochastic Green's function method, Random numbers, Point source, Fault model

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Table 1 Benchmark tests for stochastic green’s function method

	ステップ5（点震源）		ステップ6（面震源）	
モデル名	S51（必須）	S52（必須）	S61（必須）	S62（任意）
対象地震	1923年関東地震(Mj7.9)のアスペリティ		1923年関東地震(Mj7.9)	
震源のモデル化	アスペリティ内の1要素を点震源として用いる		Sato *et al*. (2005)のすべり分布の特性化モデル	Sato *et al*. (2005) のすべり分布を使用した不均質モデル
地盤	関東平野の３次元深部地盤モデル（長周期地震動予測モデル、2009試作版）を用い、観測点直下の平行成層地盤を使用			
減衰	あり			
乱数位相	指定	各自の乱数位相3パターン		
有効振動数	0～20Hz			
出力点	4地点(岩盤サイト：浅川、堆積層サイト：清瀬、越中島、本郷)			

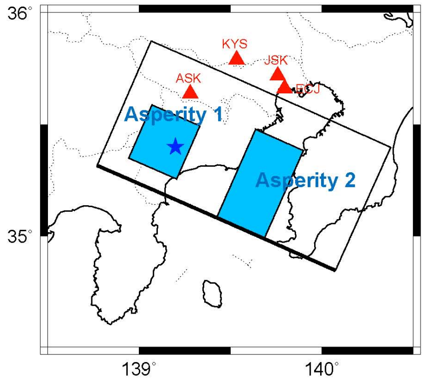

Fig.1 Characterized fault model and stations for calculation