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Benchmark Tests for Strong Ground Motion Simulations (Part 6: Theoretical Methods, Step 3 & 4)

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We have been conducting a series of benchmark tests of the strong motion simulation methods for three years since 2009. We chose the three most popular methods for this purpose: the theoretical methods (the wavenumber integration method, the discrete wavenumber method, and the thin-element method), the stochastic Green function method, and the numerical methods (the finite difference method and the finite element method). In this presentation, we show the results of the theoretical methods for the steps 3 and 4; the former is a point source and the latter is extended sources in flat-layered structures, as shown in the tables 1 and 2.

We have obtained the following conclusions. All the results show good agreements in the assigned frequency range (0 - 5 Hz). However, the results for no-damping media show slight differences at very high frequencies, because some groups used very high-Q values, whereas the other group used the Phinney method. In addition, there are slight differences for the a point source on the free surface and the surface faulting model. This is because that the some use the exact surface source model, and the other used the source slightly under the surface.

Please check the following web site for more details.

http://kouzou.cc.kogakuin.ac.jp/benchmark/index.htm

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Table 1 Benchmark tests for the 2010 theoretical methods (Step 3 and 4)

	ステップ３（締切:2010/9/1）		
モデル名	T31	T32	T33
地盤	４層地盤		２層地盤
減衰	あり		なし
震源	点震源（深さ２km：ガウス型関数）		点震源（深さ０km：ガウス型関数）
有効振動数	0～5 Hz		
出力点	+002, +006, +010, +030, +050, +100 km（計６点）		

	ステップ４（締切:2010/11/1）			
モデル名	T41	T42	T43	T44
地盤	２層地盤			
減衰	あり			なし
震源	横ずれ断層（上端深さ２km：中村-宮武関数）			横ずれ断層（上端深さ０km：中村-宮武関数）
破壊伝播	1km²間隔一定	1km²間隔ゆらぎ	連続	
有効振動数	0～5 Hz			
出力点	±002, ±006, ±010, ±030, ±050, ±100 km（計 12 点）			
提出波形	１波形	３波形	１波形	

Table 2 Material Properties for the four layered model

Layer	Thickness (m)	Vp(m/s)	Vs(m/s)	Density(kg/m³)	Qp	Qs
1	200	1,600	400	2,000	20f	20f
2	400	2,600	1,000	2,400	30f	30f
3	1,000	4,000	2,000	2,600	40f	40f
4 (Half-Space)	∞	6,000	3,464	2,700	70f	70f

注１：Ｑ値のｆは振動数(Hz)　注２：２層地盤モデルの場合、第３層を厚さ１ｋｍとする

Keywords: Strong Ground Motion Simulations, Benchmark Test, Theorecical Methods, Wavenumber Integration Method, Discrete Wavenumber Method, Thin Layer Method