R&D field: Earth science

Simulation of Seismic-Wave Propagation and Strong Ground Motions

- Program name: Seism3D
- Developer
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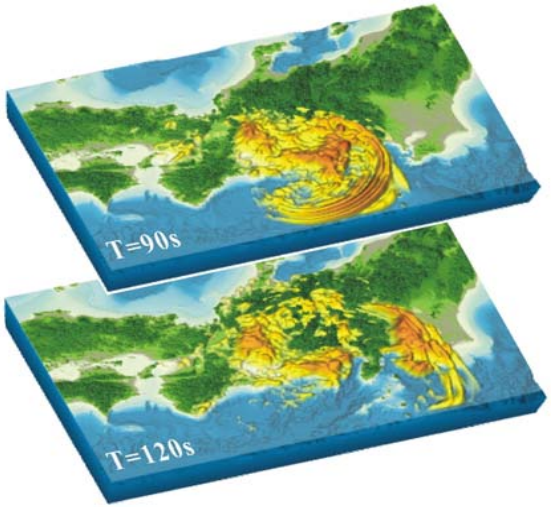
- Abstract
  - Strong ground motions caused by large earthquakes are evaluated based on numerical simulation of seismic-wave propagation in heterogeneous structure.
  - Seismic-wave propagation is calculated by solving equation of motions and stress-strain constitutive equations by using the finite-difference method (FDM).
- Algorithm
  - FDM using a 2nd- and a 16th-order staggered-grid scheme in time and space, respectively.
  - FORTRAN77.
  - One-dimensional domain decomposition in vertical direction. A hybrid parallel computation using OpenMP and MPI for intra- and inter-node parallelism, respectively.
- Current computation size
  - Grid point: 2048 × 1024 × 1024.
  - Sustained performance 6.1 TFlops (240 nodes of Earth Simulator).
  - Memory 740 GB and disk 0.1 TB.
- Future computation size in 2010
  - High resolution (grid points: 5x5x5=125 times, and therefore 25-times computation amount per node because of one-dimensional decomposition).
  - Memory 92.5 TB and disk 12.5 TB.



Expected ground motion for future Tokai hypothesis earthquake (computed on the Earth Simulator)

- Expected results
  - Prevention of earthquake disasters posed by large earthquake by calculating broad-band seismic waves which cause impact to various type of modern artificial structures such as wooden-frame house and skyscraper.
  - Simulation results illustrate the pattern of shaking intensity and therefore the possible damage expecting for future earthquake.
  - The synthetic seismograms are directly applied for designing proper building code for shake-proofed civil infrastructures.
- Reference
  - http://www.eri.u-tokyo.ac.jp/furumura/cmes2004.pdf