高性能計算を使った地震災害・被害シミュレーション

Application of High Performance Computing to Earthquake Hazard and Disaster Simulation

*堀 宗朗^{1,2}、市村 強¹、Wijerathne Lalith¹、大谷 英之²、陳 健²、藤田 航平² *Muneo Hori^{1,2}, Tsuyoshi Ichimura¹, Lalith Wijerathne¹, Hideyuki Ohtani², Jian Chen², Kohei Fujita²

1. 東京大学地震研究所、2. 理化学研究所計算科学研究機構

1.Earthquake Research Institute, The University of Tokyo, 2.Advanced Institute of Computational Science, RIKEN

The utilization of high performance computing (HPC) is a key issue for more rational prediction of earthquake hazard and disaster. In principle, all physical processes of the seismic wave propagation and the resulting structural seismic responses are described in terms of sold wave equations, and it is a solution to numerically solve the equations using an analysis model of high fidelity. High performance computing solves uncertainty of material properties that appear in the solid wave equations by considering a suitable stochastic distribution and using ensemble computing.

This presentation explains recent achievement of applying HPC to earthquake hazard and disaster simulation. Explained are two targets, namely, the seismic structural response of an important structure and the urban earthquake disaster simulation. K computer, the supercomputer in Japan, is used to solve the wave equations of these two targets.

As for the seismic structural response analysis, the numerical treatment of non-linear material properties that include the occurrence and propagation of multiple-cracks is a bottleneck of applying HPC. A new discretization scheme is developed for crack which is discontinuity of displacement function. General purpose numerical analysis methods are being developed which are applicable to structures.

Urban disaster simulation is a challenge for HPC, because an analysis model is an urban area of a few kilometer dimension, which requires large-scale computation and automated model construction. In particular, a fast solver is implemented into a finite element method to solve the wave equation for a model of 100,000,000,000 degree-of-freedom, and a robust and flexible system is developed so that various digital data of an urban area are converted to a set of analysis models.

キーワード:高性能計算、地震災害、地震被害 Keywords: high performance computing, earthquake hazard, earthquake disaster