Large-scale earthquake simulation with supercomputing and data-learning

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Advanced observations have been carried out and various observation data have been accumulated. In order to make the best use of such valuable observation data, technological innovation is required to improve the analysis capability. Although seismic phenomena are diverse and have different length scales and resolutions, from the viewpoint of mathematical problems, many behaviors of seismic phenomena can be modeled as static/dynamic, nonlinear/linear responses of solids. Although the "constitutive laws" and "senses" differ depending on the target phenomenon, many phenomena can be attributed to these forward and inverse analysis problems, and the advancement of analysis methods that can solve such problems will play a major role in improving analysis capabilities. Since the above is a mathematical problem in which stress-free boundary conditions and geometry have a strong influence on the solution, the finite element method based on unstructured elements is one of the suitable methods, but it will be a large-scale problem due to the large size of the target problem and the high resolution required to ensure the reliability (convergence) of the solution. Therefore, it is necessary to develop a new method to solve the problem by efficiently synchronizing a large number of computer nodes, while solving the bottleneck caused by the fact that the core kernel of the finite element method is the random memory access dominant type, which is incompatible with modern computer architecture. In this talk, we present a large-scale earthquake simulation method that combines supercomputing and data-learning and show application examples on a supercomputer (e.g., Fugaku), which demonstrate the effectiveness of approaches of combining supercomputing and data-learning.

Keywords: large-scale simulation , supercomputing and data-learning, finite element method

