PARALLEL FINITE ELEMENT ANALYSIS PLATFORM FOR THE SOLID EARTH PROBLEMS: GeoFEM

H. Okuda[a], **G.Yagawa**[a] and **H. Nakamura**[b]

[a]Department of Quantum Engineering and Systems Science
The University of Tokyo
7-3-1 Hongo, Bunkyo, Tokyo 113-8656, Japan
{okuda, yagawa}@q.t.u-tokyo.ac.jp

[b]Research Organization for Information Science & Technology (RIST)
2-2-54 Naka-Meguro, Meguro, Tokyo 153-0061, Japan
nakamura@tokyo.rist.or.jp

GeoFEM has been developed as a finite element solid earth simulator using the Earth Simulator (ES) (35.61 Tflops/peak according to the Linpack benchmark test). It is composed of a platform and some pluggable 'analysis modules' for structural, electromagnetic thermal fluid, and wave propagation simulations. The platform includes three parts: parallel I/O interface, iterative equation solvers and visualizers. Parallel solvers have got very high performance on the ES. When using up to 176 nodes of the ES, the computational speed of the static linear analysis by the optimized ICCG (Conjugate Gradient method with Incomplete Cholesky Preconditioning) solver, has reached 10.4 TFLOPS (31.8% of peak performance of 512 nodes). Parallel visualizer can provide many visualization methods for analysis modules covering scalar, vector and tensor datasets, and have been optimized in parallel performance. The analysis modules have also been vectorized and parallelized suitably for the ES and coupled on memory with the parallel visualizer.

GeoFEM [1, 2] challenges for long-term prediction of the activities of the plate and mantle near the Japanese islands through the modeling and calculation of the solid earth problems, including the dynamics and heat transfer inside the earth. In the presentation, the geomagnetic field generated by the motion of an electrically conductive fluid in the Earth's outer core, and the stress accumulation in the vicinity of the faults about the North East Japan will be presented. Also, the computational performance on the Earth Simulator will be discussed.

References

[1] http://geofem.tokyo.rist.or.jp
[2] H.Okuda, G.Yagawa, K.Nakajima, and H.Nakamura, "Parallel Finite Element Solid Earth Simulator: GeoFEM", *Proc. Fifth World Congress on Computational Mechanics (WCCM V)*, July 7-12 (2002) Vienna, Austria, ISBN 3-9501554-0-6, http://wccm.tuwien.ac.at, Vol.1, 160–166.