Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PEM35-05 会場:503 時間:5 月 2 日 16:30-16:45

磁気圏 MHD シミュレーションコードの Xeon Phi に対する最適化
Optimization of Magnetohydrodynamic Simulation Code for Planetary Magnetosphere to Xeon Phi

深沢 圭一郎 [1*]
FUKAZAWA, Keiichiro[1*]

[1] 九州大学情報基盤研究開発センター
[1]Research Institute for Information Technology, Kyushu University

For investigating the global structures of plasma, such as the planetary magnetospheres, the Magnetohydrodynamic (MHD) equations are often used, in which full kinetics of plasma are neglected by taking the moments of the Vlasov equations. The MHD equations are highly nonlinear and are very complex to solve by hand calculations. Thus computer simulations play essential roles in studies of global magnetosphere.

The numerical MHD code for the magnetosphere has been optimized for vector-type supercomputers for a long time because the MHD code is a kind of fluid code and most of supercomputers with vector processors have high performance to solve the fluid codes in 1990's. These codes often have achieved a very high computational efficiency (the ratio of the effective performance to the theoretical performance). However, almost 100% of the "Top 500" supercomputer systems in the world adopt the massively parallel scalar type processors and more than 85% of systems consist of the x86 processor architecture in these days. The other scalar type computers are POWER and SPARC architectures. Recently the new coprocessor Xeon Phi which has many cores (˜60 cores) of X86 architecture is introduced to the supercomputer system and achieved good performance of the Linpack benchmark.

In this study I evaluate the performance of MHD code for the planetary magnetosphere on the single Xeon Phi coprocessor. For the performance evaluation, I use the three-dimensional domain decomposition method and a cache-hit type of three-dimensional domain decomposition method with the flat MPI and hybrid MPI. As the results, I found that normal three-dimensional decomposition of the MHD model with the hybrid MPI is suitable for Xeon Phi coprocessor and achieved computing performance efficiency of ˜7%. Furthermore, I add the optimization to the MHD code based on the Xeon Phi architecture and obtained the computing performance efficiency of almost 10% which is the double performance of FX10 single node.