

Simulation Development of Planetary Magnetosphere toward Exascale Computing Era

Keiichiro FUKAZAWA¹, Yuto KATO², Yohei MIYAKE³, and Takeshi NANRI⁴

1. Academic Center for Computing and Media Studies, Kyoto University
2. Graduate School of Science Geophysics, Tohoku University
3. Graduate School of System Informatics, Kobe University
4. Research Institute for Information Technology, Kyushu University

In this study we have introduced Halo thread to our MHD simulation code and evaluated the performances. Halo thread is an extended communication thread and performs the halo communication and the related calculation of halo communication. The other threads only do the calculation without the region of halo communication. To divide the role on the thread, there is no synchronization between the thread and the overlap of Halo thread and calculation threads is available. This bring the good scalability using many processes.

In variations of grid points and number of thread, we obtained the satisfactory performance with Halo thread when the calculation size per thread is small. In the evaluation of strong scaling, Halo thread achieved reliable performance since the amount of calculation decreases when the number of process increases. To see the elapse time of Halo and calculation threads in detail, we found the condition of effective performance with Halo thread when the elapse time of calculation and Halo thread are equivalent. This means that Halo thread is effective when the calculation growth rate caused by introducing Halo thread is shorter than the rate of communication without the Halo thread.

From this study we found the effective condition of Halo thread. To extend the coverage of Halo thread we need to optimize the operation of Halo thread. For instance, there is a scope to overlap the calculation and communication on Halo thread. Then the elapse time of Halo thread become shorter and we will achieve good scalability with many processes. Considering this situation, we have developed Halo functions which can perform the halo communication effectively and evaluated the performance. From performance measurements, we have obtained 84 % performance increase in the communication itself and 8 % better performance in total simulation time compared to the regular halo communication.