PEM35-P04　　　　　　会場:503　　　　　　　　時間:5 月 2 日 16:15-17:30

動的負荷分散技法 OhHelp を適用した電子ハイブリッドコードの性能評価
Electron hybrid code simulations with OhHelp load balancer

加藤 雄人 [1]* ; 三宅 洋平 [2] ; 中島 浩 [3] ; 臼井 英之 [2] ; 大村 善治 [4]
KATOH, Yuto[1]* ; MIYAKE, Yohei[2] ; NAKASHIMA, Hiroshi[3] ; USUI, Hideyuki[2] ; OMURA, Yoshiharu[4]

[1] 東北大学大学院理学研究科地球物理学専攻, [2] 神戸大学大学院システム情報学研究科, [3] 京都大学学術情報メディアセンター, [4] 京都大学生存圏研究所
[1]Department of Geophysics, Graduate School of Science, Tohoku University, [2]Graduate School of System Informatics, Kobe University, [3]Academic Center for Computing and Media Studies, Kyoto University, [4]Research Institute for Sustainable Humanosphere, Kyoto University

A spatially one-dimensional electron hybrid code has been developed for the study of the generation process of whistler-mode chorus emissions and relativistic electron acceleration in the Earth's inner magnetosphere [1-3]. In the electron hybrid code, we treat cold electrons as a fluid and energetic electrons as particles by the Particle-in-Cell (PIC) method. Since we assume an inhomogeneous background magnetic field in the simulation system so as to treat the bounce motion of energetic electrons along a magnetic field line, the distribution of energetic electrons in the system is non-uniform and energetic electrons move around the magnetic equator assumed at the center of the simulation system. While the electron hybrid code has been parallelized through the particle decomposition method, we need to improve the scalability of the electron hybrid code so as to use a large simulation system and billions of particles for simulations under initial conditions corresponding to the real magnetosphere.

In the present study, we have developed a spatially one-dimensional electron hybrid code domain-decomposed by OhHelp [4]. The OhHelp is a library which enables us to conduct PIC simulations by achieving both dynamic load balancing and scalability. The efficiency and scalability of OhHelp have been confirmed by a 3D full PIC simulations [5]. We show the efficiency and scalability of the developed code tested on the system A (Cray XE6) of Academic Center for Computing and Media Studies, Kyoto University. We compare the performance of the developed code and those of the code with the particle decomposition.

[1] Katoh Y., Y. Omura, Computer simulation of chorus wave generation in the Earth's inner magnetosphere, Geophys. Res. Lett., 34, L03102, doi:10.1029/2006GL028594, 2007.
[2] Katoh, Y., Y. Omura, and D. Summers, Rapid energization of radiation belt electrons by nonlinear wave trapping, Ann. Geophys., 26, 3451–3456, 2008.
[3] Katoh, Y. and Y. Omura, Effect of the background magnetic field inhomogeneity on generation processes of whistler-mode chorus and hiss-like broadband emissions, J. Geophys. Res. Space Physics, 118, 4189-4198, doi:10.1002/jgra.50395, 2013.
[4] Nakashima, H., Y. Miyake, H. Usui, and Y. Omura, OhHelp: A Scalable Domain-Decomposing Dynamic Load Balancing for Particle-in-Cell Simulations, Proc. 23rd Intl. Conf. Supercomputing, 90-99, 2009.
[5] Miyake, Y., H. Usui, and H. Nakashima, Development of a Scalable PIC Simulator and Its Application to Spacecraft-Plasma Interaction Problems, Proc. JSST 2012, OS6-8, pp. 262?267, 2012.

キーワード: 動的負荷分散技法, 粒子コード
Keywords: dynamic load balancer, PIC simulation