Development of a Non-thermal Fluid Simulation Code with Minimizing the Dependence on Artificial Physical Modeling

Project Representative

Shin-ichi Ohki

Terrabyte Co.,Ltd.

Authors

Shin-ichi Ohki[*1], Toshihiko Kikuchi[*1], Hiroshi Matsuoka[*2], Noriko Kikuchi[*3], Kenichi Itakura[*4], Yuichi Hirokawa[*4], Noriaki Nishikawa[*4], Misako Iwasawa[*4], Toshiyuki Asano[*4], Hiromu Saito[*1], Koremitsu Ogata[*1]

＊1 Terrabyte Co.,Ltd.

＊2 Tohoku University

＊3 Science Service, Inc.

＊4 Japan Agency for Marine-Earth Science and Technology

Abstract

The aim of the project is to develop a new simulation code of non-thermal fluid having high-resolution as a reliable optimum-design tool used for various industrial fields. We demonstrated an ultra-high-resolution simulation over 100 billion lattice sites by using a multi-speeded lattice-gas-automaton method with "a Face-Centered Hyper-Cubic 54-velocities model". The model enabled us to execute such a large-scale simulation by using relatively small main storage (about 8TB) in the 64-nodes of ES2. In case of SX-ACE, the same large-scale simulation applied to the whole transient process of developing Karman's vortex (170 thousand time steps) is estimated to take about two weeks by using 512 nodes (2048 MPI). In addition, new collision rules of virtual particles for simulating multiphase flow or high Re-number-flow were tried to be included to the code. A potential merit of the model is the capability of minimizing the artificial assumptions included in its physical modeling, compared with the conventional CFD-method, and to improve simulation-precision in the process of manufacturing-evaluations for designing aircrafts, automobiles, ships and so on. Thus, the simulation code developed here will make a contribution for reducing environmental load such as carbon dioxide emissions.

Keywords: large-scale simulation, multi-speeded lattice-gas-automaton method, non-thermal fluid simulation, simulation with ultra-high-resolution