Parallel Multigrid with Adaptive Multilevel hCGA on Manycore Clusters

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ABSTRACT

The parallel multigrid method is expected to play an important role in large-scale scientific computing on post-peta/exa-scale supercomputer systems, and it also includes serial and parallel communication processes which are generally expensive. In the previous work [1], new format for sparse matrix storage based on sliced Ellpack-Itpack (ELL) format was proposed for optimization of serial communication in data transfer through memories, and hierarchical coarse grid aggregation (hCGA) was introduced for optimization of parallel communication by message passing. The proposed methods were implemented for pGW3D-FVM, a parallel code for 3D groundwater flow simulations using parallel conjugate gradient (CG) solver with multigrid preconditioner (MGCG). The parallel MGCG solver using the sliced ELL format and hCGA provided excellent performance improvement on the Fujistu FX10 supercomputer system at the University of Tokyo [1]. Because the hCGA can only handle 2-hierarchica-levels, we are developing AM-hCGA (Adaptive Multilevel hCGA) for multiple hierarchical levels (more than three) [2]. In this presentation, we will present preliminary results of AM-hCGA on the Oakforest-PACS, Joint Center for Advanced High Performance Computing (JCAHPC) [3], which consists of 8,208 nodes of Intel Xeon Phi (Knights Landing). Effects of pipelined algorithms on conjugate gradient method [4] are also evaluated.

REFERENCES