ppOpen-HPC: Open Source Infrastructure for Development and Execution of Large-Scale Scientific Applications on Post-Peta-Scale Supercomputers with Automatic Tuning (AT)

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ABSTRACT

Recently, high-end parallel computer systems are becoming larger and more complex. It is very difficult for scientists and engineers to develop efficient application codes, which make use of potential performance of these systems. We propose an open source infrastructure for development and execution of optimized and reliable simulation codes on large-scale parallel computers. This infrastructure is named "ppOpen-HPC, where "pp" stands for "post-peta-scale", as shown if Fig.1 [1]. Target system is post-peta-scale supercomputer system with heterogeneous computing nodes which consist of multicore CPU's and co-processors/accelerators. Peak performance is O(10) PFLOPS, and number of cores is O(10^6). Target system will be installed at Information Technology Center, the University of Tokyo (ITC/U.Tokyo) in FY.2015. ppOpen-HPC supports more than 1,500 users of supercomputer systems of ITC/U.Tokyo to switch from homogeneous multicore clusters to post-peta-scale system with heterogeneous computing nodes.

"ppOpen-HPC" is five-year project (FY.2011-2015) and a part of "Development of System Software Technologies for Post-Peta-Scale High Performance Computing" funded by JST/CREST (Japan Science and Technology Agency, Core Research for Evolutional Science and Technology). The infrastructure consists of various types of libraries for scientific computations. Source code developed on a PC with a single processor is linked with these libraries, and generated parallel code is optimized for post-peta-scale system. The framework covers various types of procedures for scientific computations, such as parallel I/O of data-sets, matrix-formation, linear-solvers with practical and scalable preconditioners, visualization, adaptive mesh refinement and dynamic load-balancing, in various types of computational models, such as FEM, FDM, FVM, BEM, and DEM. This type of framework will provide dramatic efficiency, portability, and reliability in the development and execution of scientific applications. It reduces both of number of steps of the source code and the duration for parallelization and optimization of legacy codes. Automatic tuning (AT) technology enables automatic generation of optimized libraries and applications under various types of environments.

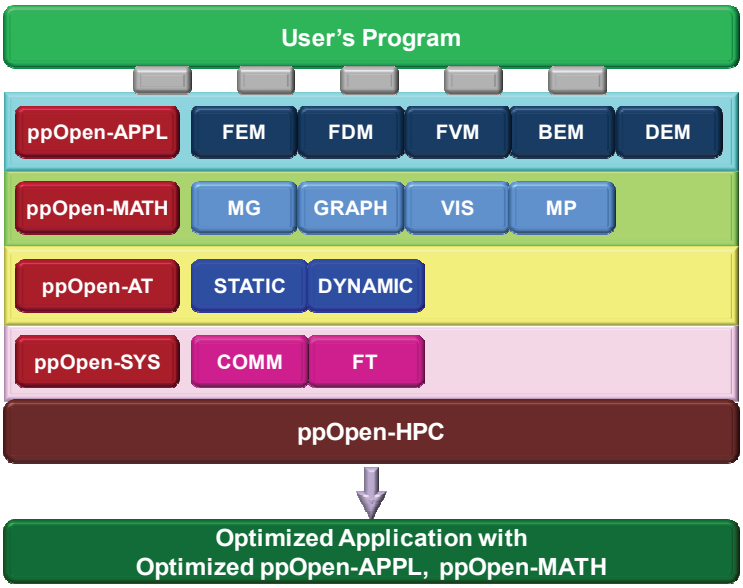

Figure 1. Description of ppOpen-HPC

REFERENCES

[1] Nakajima, K., Satoh, M., Furumura, T., Okuda, H., Iwashita, T., and Sakaguchi, H.: ppOpen-HPC: Open Source Infra-structure for Development and Execution of Large-Scale Scientific Applications with Automatic Tuning, IPSJ SIG Technical Reports (in Japanese), IPSJ-HPC11130044, 2011.