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# Parallel Performance of Particle Method in Many-Core System

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We present a computational performance of the smoothed particle hydrodynamics (SPH) simulation on three types of current shared-memory parallel computer devices: many integrated core (MIC: Intel Xeon Phi) processor, graphics processing units (GPU: Nvidia Geforce GTX Titan), and multi-core Central Processing Unit (CPU: Intel Xeon E5-2680 and Fujitsu SPARC64 processors). We are especially interested in the efficient shared-memory allocation methods with proper data access patterns on each chipset. We first introduce several parallel implementation techniques of SPH code for shared-memory system. Then they are examined on our target architectures to find the best algorithms for each processor unit. In addition, the computing and the power efficiency, which are increasingly important to compare multi device computer systems, are also examined for SPH calculation. In our bench mark test, GPU is found to mark the best arithmetic performance as the standalone device and the most efficient power consumption. The multi-core CPU shows the best computing efficiency. On the other hand, the computational speed by the MIC on Xeon Phi approached to that by two Xeon CPUs. This indicates that using MIC is attractive choice for the existing SPH codes parallelized by OpenMP to gain the computational acceleration by the many many-core processors.

Keywords: high-performance computing, many core, SPH, Parallel Computing, Performance analysis, Shared memory