Ji, Zhe; **Fu, Lin**; **Hu, Xiangyu Y.**; **Adams, Nikolaus A.**

A new multi-resolution parallel framework for SPH. (English) Zbl 1440.76112

Comput. Methods Appl. Mech. Eng. 346, 1156-1178 (2019).

Summary: In this paper we present a new multi-resolution parallel framework, which is designed for large-scale SPH simulations of fluid dynamics. An adaptive rebalancing criterion and monitoring system is developed to integrate the CVP partitioning method as rebalancer to achieve dynamic load balancing of the system. A localized nested hierarchical data structure is developed in cooperation with a tailored parallel fast-neighbor-search algorithm to handle problems with arbitrarily adaptive smoothing-length and to construct ghost buffer particles in remote processors. The concept of "diffused graph" is proposed in this paper to improve the performance of the graph-based communication strategy. By utilizing the hybrid parallel model, the framework is able to exploit the full parallel potential of current state-of-the-art clusters based on Distributed Shared Memory (DSM) architectures. A range of gas dynamics benchmarks are investigated to demonstrate the capability of the framework and its unique characteristics. The performance is assessed in detail through intensive numerical experiments at various scales.

MSC:

76M28 Particle methods and lattice-gas methods
65M75 Probabilistic methods, particle methods, etc. for initial value and initial-boundary value problems involving PDEs
65Y05 Parallel numerical computation

Keywords:

smoothed particle hydrodynamics; compressible fluid dynamics; centroidal Voronoi particle method; high-performance parallel computing; fast neighbor search; edge coloring

Software:

Intel TBB; GADGET ; Voro++; PPM; DualSPHysics; CUDA; NDSPMHD; BGL; Boost; POOMA

Full Text: DOI

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