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Shared Memory OpenMP Parallelization of SPH Program and Its Application to Solid Fluid Interaction

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Smoothed Particle Hydrodynamics(SPH) is a meshless Lagrangian method, originally developed for astrophysics, and has been widely used in other aspects, such as fluid dynamics, solid impact and fracture, electromagnetism, explosion and so on. Given the advantage of dealing with large deformation problems, the SPH method is suitable to simulate the response of fluid under high-speed transient impact load. However, to describe the detailed phenomena and mechanism of SFI (Solid Fluid Interaction) problem, the application of the SPH method comes at the price of computational sources and efficiency cost. Therefore, the SPH codes are required to be parallelized to obtain better performance.

In this paper, the parallel computing is performed based on SMP system. The simulation of the SFI problem is realized by placing OpenMP directives into the source codes. The parallel framework of SPH method is presented in Figure 1. To avoid data races in the update stage, the domain decomposition method is used. Prior to parallelizing the program, the time consumption of the serial SPH program is tested. For parallel computing, different sub-thread parallel computation is realized with a good speedup performance. The size of model and the number of thread are discussed as well.

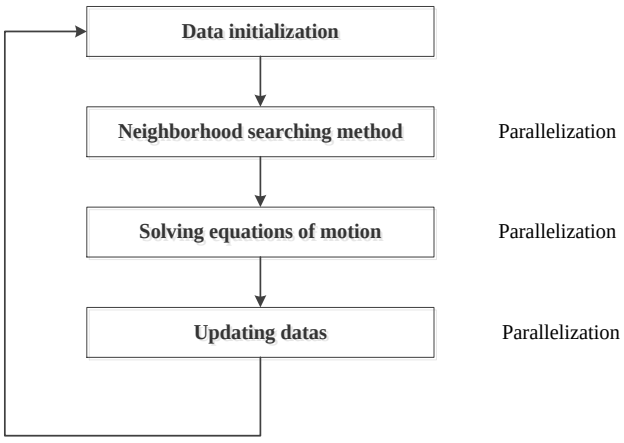

Figure 1 Parallel framework.

For SFI the wedge water entry problem is simulated to validate the parallel computing. Pressure prediction and the evolution in time of the body are compared with analytical and experimental results. The accurate pressure field on the solid boundary needs further study.

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