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A dynamic load balancing algorithm for CFD–DEM simulation with CPU–GPU heterogeneous computing

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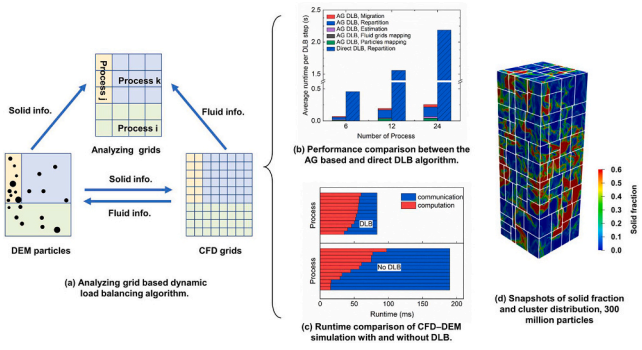
HIGHLIGHTS

- A new dynamic load balancing for CFD–DEM simulations in CPU–GPU
- Analyzing grid method is developed to estimate computational loads
- Kalman filtering and linear weighted method are used to solve weight coefficients
- This dynamic load balancing algorithm significantly speed up CFD–DEM simulations

GRAPHICAL ABSTRACT



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ABSTRACT

Computational fluid dynamics combined with discrete element method (CFD–DEM) is widely adopted to study particle–fluid multiphase systems. However, due to the global dynamical evolution and the naturally non-uniform distribution of particles, the computational load in parallel computing varies dynamically in each process, leading to significant load imbalance. Thus, a dynamic load balancing (DLB) algorithm is proposed for parallel CFD–DEM simulations in the CPU–GPU heterogeneous architecture. A type of computing load analyzing grid (AG) is developed which covers the entire simulation region. Then Kalman filtering and linear weighted method is used to solve the weight of fluid grids and particles. The domain decomposition scheme is updated according to the weights of AGs dynamically. This DLB method is tested for gas–solid fluidized beds and periodic gas–solid systems of different scales. Results show that the DLB algorithm can significantly speed up CFD–DEM simulation and the highest performance is 2.28 times faster with DLB.

1. Introduction

Particle–fluid multiphase systems are widely used in the chemical,

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