Coarse-graining method for particulate systems implemented on GPUs

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ABSTRACT

Nowadays, the discrete element method (DEM) is used extensively when modeling particulate systems. DEM accesses to all the detail of the granular system, *i.e.*, positions, velocities, and forces acting on each particle. However, in many engineering applications, the number of particles is considerable and to extract bulk continuum fields (density, velocity, and stress) is practically mandatory. Thus, coarse-graining techniques are typically applied to the particle data provided from DEM simulations, and the bulk continuum fields are obtained. In this work, we present the algorithm and implementation details of a new coarse-graining post-processing tool that uses both CPU and GPU resources for computations. Using both parallel computing and dynamic programming approaches, we have managed to create a program that compromises memory efficiency and processing time. Our implementation can handle polydisperse spherical and non-spherical particles resolved in rectangular and cylindrical geometries. We also discuss the performance of this hybrid CPU/GPU approach in comparison to a similar routine but in OpenMP. We present macroscopic fields obtained from steady granular flow down an incline (spherical and non-spherical particles) and intruders penetrating a dense granular bed.