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ABSTRACT

Numerical modelling of granular materials classically adopt Discrete Element Methods (DEM) that provide a direct description of their discrete nature, together with all mechanical traits related with the latter. The Level Set-Discrete Element Method (LS-DEM) recently pushed DEM even closer to generic shapes, possibly mimicking real particles of a granular material [1]. LS-DEM relies onto a discrete form of the signed distance function to a particle's surface, indirectly describing the latter as the zero level set of the former, as well as onto boundary nodes being exactly located on a grain surface for the purpose of contact treatment.

The precision of LS-DEM is logically impacted by the resolution of the particle-attached grids and by the number and locations of boundary nodes. Computational costs then increase with the required precision and these are investigated by comparing LS-DEM with respect to DEM in the ideal case of spherical particles where a reference solution can be obtained, for a LS-DEM implementation based on the YADE code [2]. On the one hand, memory (e.g. RAM) cost increases, in line with the grid resolution mostly, from the order of megabytes to the order of gigabytes for a 3D REV. On the other hand, time costs are directly impacted by the loop over boundary nodes during contact treatment, turning the duration of a sequential triaxial simulation from hours into days [3]. This logical surge, by two or three order of magnitudes, of computational costs can nevertheless be alleviated by a simple OpenMP parallelization [3] and, possibly, algorithmic modifications [4].

Coming along increased computational costs, the versatility of the method is finally evidenced looking at the mechanical behaviour of superquadric particles, whose LS-DEM simulation is shown to be lighter than an alternative non-spherical description based on polyhedra.

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