DEM simulations of granular media made of non-convex particles

Andriarimina Daniel Rakotonirina[†,*], Anthony Wachs[†], J.-Y. Delenne[††] and Farhang Radjai[††]

[†] IFP Energies Nouvelles, Fluid Mechanics Department,
Rond-point de l'Echangeur de Solaize, BP 3, 69360 Solaize, France
e-mail: andriarimina-daniel.rakotonirina@ifp.fr
[††] University Montpellier 2, CNRS, LMGC UMR 5508, Place Eugène Bataillon,
F-34095 Montpellier Cedex, France.

ABSTRACT

Large-scale simulation using the Discrete Element Method (DEM) is a matter of interest since it allows a better understanding of the flow dynamics of granular media involved in many industrial processes and environmental flows. In industry, it leads to an improved design and an overall optimization of the corresponding equipment and process. Most of DEM simulations in the literature have been performed using spherical particles and very few studies dealt with non-spherical ones, even less with non-convex ones. However, spherical or convex particles do not always represent the real shape of particles. In fact, more complex shaped particles are found in many industrial applications as, e.g., catalytic particles in chemical reactors. Their shape influences markedly the behaviour of these systems [1]. The aim of this study is to go one step further into the understanding of the flow dynamics of granular media made of non-convex shaped particles. Our strategy is based on decomposing a non-convex shaped particle into a set of convex ones. Hence, our novel method can be called “glued convex method”, referring to the popular “glued spheres” method [2]. As a consequence, all the features involved in DEM simulations of convex particles can be applied to the components of the “glued convex” particle such as the contact detection strategy based on a Gilbert-Johnson-Keerthi algorithm [3,4] and the linked-cell spatial sorting which accelerates the resolution of the contact [5]. A particular care is dedicated to the management of the multiple contact problem [2,6]. Our simulations are performed with our in-house high fidelity code Grains3D [7]. Grains3D has already shown to supply accurate solutions for arbitrary convex shaped particles [7]. We illustrate the extended capabilities of Grains3D for the simulation of non-convex shaped particles on the filling of a catalytic reactor and the flow in a rotating drum.

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