A comparison between continuum and discrete modelling of granular material

Ilaria Iaconeta*, Antonia Larese*†, Miguel Angel Celigueta* and Eugenio Oñate*†

*Centre Internacional de Mètodes Numèrics en Enginyeria (CIMNE)
web page: http://www.cimne.com
† Universitat Politècnica de Catalunya (UPC)
C. Gran Capián s/n, Campus Norte UPC, 08034 Barcelona, Spain
e-mail: iiaconeta@cimne.upc.edu, web page: http://www.cimne.upc.edu/

ABSTRACT

The duality of the behaviour of granular matter has represented an issue of increasing scientific interest during the last decades. Neverthless, the fact that granular materials can behave as a solid or as a fluid, depending on the forces these are subjected to, is still an open question. On the other hand whether it is preferable a continuum or a discrete modelling of these materials still need further investigations.

In the present paper the problem of determination of angle of repose of a granular material is considered. The problem is analysed by means of two numerical methods a discrete and a continuum one to allow a comparison between the different approaches.

The first method is represented by the Discrete Element Method (DEM) based on the assumption to consider the material as discontinuous. The mechanical behaviour of the material is described by using rigid inelastic particles, allowing a small overlap to take into account the contact deformation.

The second method is represented by the Particle Finite Element Method (PFEM), a Lagrangian formulation of the finite element method. The mechanical behaviour of the material is described by the use of a non-Newtonian modified Bingham law.

A comparison of both methods is done to validate them with experimental results in both 2 and 3D.

Furthermore, a direct comparison between DEM and PFEM allows highlighting the implications of a different definition of the constitutive relation of the same material at local scale (the contact level) and macro-scale.