Effect of Particle Shape in Simulation of Particle Flows by Distinct Element Method

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Abstract

Numerical simulations of granular flows based on the Distinct Element Method (DEM) commonly use spherical particles for ease of contact mechanics calculations and for having fast contact searching algorithms. However, for irregularly shaped particles, rotation is not only affected by friction but also by mechanical interlocking (Cleary, 2010). Only tangential forces lead to the rotation of spherical particles, whereas for irregularly shaped particles, rotation can be as a result of both normal and tangential contact forces (Favier *et al.*, 2001). Mechanical interlocking of irrregularly shaped particles can be simulated in DEM by (i) limiting the rolling friction of spherical particles (Morgan, 2004), (ii) using overlapping spheres (Favier *et al.*, 2001), (iii) using polyhydra (Potapov and Campbell, 1997). The first two method have been critically evaluated for the flow of corn seeds and spray-dried powders. A comparison is made of the estimated solid fraction and the tangential and radial velocity distributions of the particles from DEM and those measured experimentally. The shapes of the corn seeds and spray-dried powders have been captured using X-Ray micro tomography, and ASG2013 software has been used to generate the coordinates of the overlapping spheres. It is shown that the approximation of particle shape is only critical for dense shearing flows. The use of polyhydra enables particle fracture to be simulated more realistically, but necessitates implementation of fracture mechanics to be predictive. In this paper the results of our evaluations are reported.

Keywords: Particle Shape; DEM; rolling fraction, clumped, overlapping, dense shearing flows

References:

1) P. W. Cleary, Particuology 8, 106–118 (2010).
2) J. F. Favier, M. H. Abbaspour-Fard, and M. Kremmer, Journal of Engineering Mechanics 127, 971–977 (2001).
3) J. K. Morgan, Pure and Applied Geophysics 161, 1877–1891 (2004)
4) A.V. Potapov, C.S. Campbell, CS, Powder Technology, 94, 109-122 (1997)