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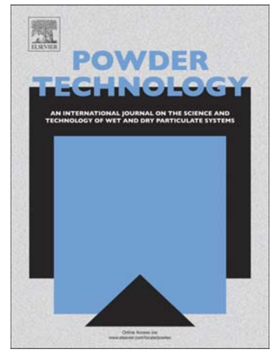

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Particle shape effects on fabric of granular random packing

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Abstract

A numerical investigation of particle shape effects on fabric of granular packing is carried out using the three dimensional discrete element method with a superellipsoid model. A broad range of particle shapes controlled by two shape parameters (i.e., aspect ratio and blockiness) are taken into account. A series of random packing of non-cohesive, frictional monodisperse superellipsoids is conducted under gravitational forces in simulations. Fabric of a granular packing is quantified in terms of packing density, coordination number, distribution of particle orientations, anisotropy of three types of fabric vectors (i.e., particle orientation, contact normal and branch vector), and distribution of normalized contact forces. It is shown that the effects of particle shape on packing density and mean coordination number are in agreement with the reported in the literature. Moreover, ellipsoids show the lowest packing density in the family of superellipsoids. The distribution of particle orientations is much more sensitive to blockiness than aspect ratio. It is also found out that anisotropy of both particle orientations and contact normals shows a similar M-type relationship with aspect ratio, two times larger than that of branch vectors. Interestingly, particle shape has an insignificant effect on the probability distribution of normalized contact forces which shows a clear exponential distribution. Those findings would be useful for a better understanding of the initial fabric of granular packing, especially in granular mechanics and geomechanics.

Keywords: Discrete element method, random packing, superellipsoids, fabric, particle shape, anisotropy

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