NURBS-based DEM for non-spherical particles

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ABSTRACT

The discrete element method (DEM) is used to analyze complex practical granular systems; however, the representation of real shapes is an important consideration because behavior of non-spherical particles is unlike that of spherical particles both individually and collectively. In this study, we use non-uniform rational basis-splines (NURBS)[1] to describe the shapes of non-spherical particles (illustrated in Fig. 1) and introduce a contact detection scheme based on quadratic convergence. And a series of simulations for packing of elliptical particles with different aspect ratios are carried out to evaluate the performance of NURBS-based DEM (seen in Fig. 2). The resulted packing fraction (Fig. 3(a)) and average contact number (Fig. 3(b)) are compared with those in literatures[2] and based on polygons. In terms of the shape description and contact treatment, the high accuracy and efficiency of NURBS-based DEM are demonstrated.

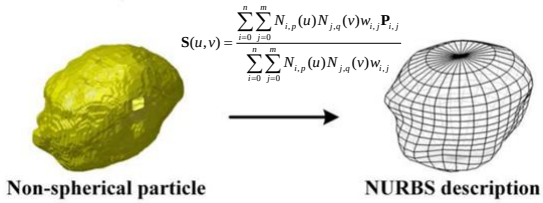


Fig. 1 NURBS description for non-spherical particle

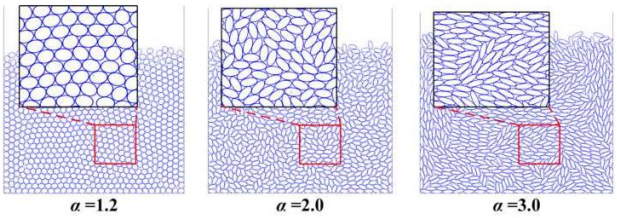
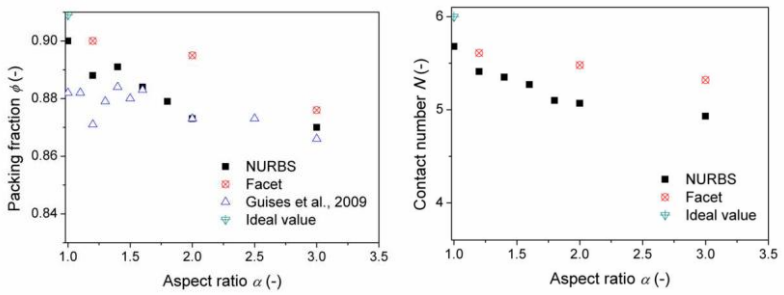


Fig. 2 snapshots of packing structures with different aspect ratios



(a) (b)

Fig. 3 (a) packing fraction with different aspect ratios; (b) average contact number with different aspect ratios

REFERENCES

[1] L. Piegl and W. Tiller. *The NURBS book. (2nd ed.)*, Springer, 1997.
[2] R. Guises, J. Xiang, J. Latham and A. Munjiza, "Granular packing: Numerical simulation and the characterisation of the effect of particle shape", *Granular Matter*, 11(5), 281-292 (2009).