DEM simulation of flat, flexible bodies using 2D triangulated meshes

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ABSTRACT

The Discrete Element Method is growing increasingly capable of modelling assemblies of complex shapes and materials. Arbitrary particle shapes can be represented using two major approaches. One is to combine spheres into composite structures that approximate the shape of a desired object. Alternatively, one can make use of more complex primitive shapes (e.g. ellipsoids, cylinders, triangles etc.) that are better suited to represent the given shape. Successful examples of advances in the latter technique are the modelling of bendable straw as a combination of cylinders [1] and the realisation of a generalized contact model for arbitrary polyhedra [2].

An additional challenge in the representation of complex shapes arises in the modelling of bendable objects with a large surface-to-thickness ratio. Again, these flexible flat objects can be modelled as a collection of spheres or as assemblies of tubes, elliptical cylinders, or similarly derived base objects. However, the large surface-to-thickness ratio complicates the applicability of these approaches. An intrinsically more suitable way to model these flat objects is as a deformable, 2-dimensional triangulated mesh. This 2D object is administered a finite thickness in its interactions with other particles.

The principal advantages of this approach include a more evident representation of the objects, and hence a better trade-off between the number of particles and accuracy of the model. Additionally, it offers a straightforward implementation of friction or adhesion, without the need for recalibrations. Finally, the use of meshed objects allows for the modelling of flat objects with arbitrary shape at any desired resolution.

REFERENCES

[1] T. Leblicq, B. Smeets, H. Ramon, & W. Saeys. A discrete element approach for modelling the compression of crop stems. Computers and Electronics in Agriculture, (2016).

[2] B. Smeets, T.Odenthal, S. Vanmaercke, & H. Ramon. Polygon-based contact description for modeling arbitrary polyhedra in the Discrete Element Method. Computer Methods in Applied Mechanics and Engineering, (2015).