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ENHANCED GEOMETRIC DESCRIPTION OF PARTICLES: METHODS AND APPLICATIONS

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ABSTRACT

The simplicity of a spherical representation of particles, whenever applicable, is highly advantageous, as it considerably facilitates contact detection, contact enforcement, and the simulation of particulate media. However, many applications require a more sophisticated geometric description of particle shapes in particle-based methods. In such cases, both contact detection and the enforcement of contact constraints become significantly more complex.

Particle shape descriptions using clumps of spheres, polyhedra, superquadrics, non-uniform rational B-splines (NURBS), among others can be useful when needing to represent complex interactions with multiple contact points. This strategy is commonly employed to introduce rolling resistance between particles without the need for an explicit rolling-friction law. Such an approach is particularly useful, and often necessary, for accurately capturing the packing density, realistic void ratios, compressibility, critical-state friction angle, and strength characteristics of granular media across different scales.

There are numerous ways to handle complex shapes of particles with pros/cons each. This session has the objective of providing a forum to discussion on these techniques, motivated by realistic applications, when there is a need for an enhanced description of particle shapes, including challenging cases of non-convex geometries. In such cases, it is generally necessary to employ more advanced contact detection techniques.

This session focuses on techniques for contact detection and enforcement as well as solution algorithms in such contexts. Topics of interest include soft-contact approaches, such as penalty-based formulations, barrier methods and their variants, level-set descriptions of particles, and the use of flexible particles based on, e.g., Finite Element or Virtual Element Method formulations, among other approaches.

We are also interested in discussions on practical applications involving enhanced particle shapes. Relevant topics include railway ballast simulations, geotechnical problems with particle-scale descriptions of soils, and multibody applications with complex geometries, where contact detection and enforcement are particularly challenging. Contributions on related applications are likewise welcome.