11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

A LEVEL SET-BASED GRANULAR ELEMENT METHOD

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Key words: *Discrete Element Method, Granular Element Method, Level Set Method.*

Motivated by recent advances in X-Ray computed tomography (XRCT) for analyzing grain-scale phenomena in geomaterials, we developed a level set-based granular element method (LS-GEM) for seamless integration between grain-scale characterization and modeling of real granular materials. The technology underlying LS-GEM is the level set method [1], which enables the direct use of the level set representation of grains, already obtained from the characterization stage [2], for performing efficient contact calculations. For the first time, the tomography-to-model translation process [3] is entirely bypassed, significantly reducing modeling time. More importantly, emergent properties such as shear strength can be captured entirely through particle geometry, without resorting to further artificial techniques for treating rolling resistance, and thus minimizing parameter calibration of classic DEM models. Through coarse-graining and homogenization techniques, LS-GEM would allow for the extraction of plastic internal variables such as dilatancy and friction directly from the granular microstructure. Independent of image data, LS-GEM can also be for used studying material behavior in what-if scenarios under loading conditions beyond the confines of experimental situations.

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