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Validation of DEM using macroscopic stress-strain behavior and microscopic particle motion in sheared granular assemblies

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Validation and/or calibration of distinct element method (DEM) models is usually performed by comparing element test simulation results with the corresponding stress-strain relationships observed in the laboratory [1]. However, such validation procedure performed at the macroscopic level does not ensure capturing the microscopic particle-level motion [2]. Thus, the reliability of DEM model may be limited to some stress paths and may not hold when the material response becomes non uniform for example when shear bands develop. In this study the validity of the DEM is assessed by comparing numerical result with experimental data considering both particle-scale behavior (including particle rotations) and macroscopic stress-strain characteristics observed in shearing tests on granular media. Biaxial shearing tests were conducted on bi-disperse granular assemblies composed of around 2700 circular particles under different confining pressures. Particle-level motions were detected by a novel image analysis technique. Particle rotations are observed to be a key mechanism of the deformation of granular materials. The results from this study suggest that to properly calibrate DEM models able to capture the mechanical behavior in a more realistic way particle scale motions observed in laboratory experiments along with macroscopic response are necessary.

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