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Concurrent multiscale modeling of 3D granular systems HOLGER MEIER, STEVEN MEIER, FUSHEN LIU, PETER GORDON, ExxonMobil Research and Engineering, TUAN TRAN, ExxonMobil Technical Computing — Large-scale granular mechanics simulations are often based on continuum approaches such as the finite element method (FEM). However, these approaches require continuum descriptions of the constitutive relationship between stresses and strains. As a result, grain-scale dynamics are not explicitly considered. Therefore, modeling of large-scale history dependent phenomena due to grain-scale rearrangement and strain localization remains a long-standing challenge. For small-scale studies, discrete element method (DEM) simulations model grain-scale interactions and thus capture history dependent phenomena. However, the application of this approach to large-scale systems is computationally expensive and impractical. We demonstrate a scalable multiscale approach where large-scale granular systems are discretized with the classical FEM simulation, while the necessary constitutive relation is calculated concurrently from DEM simulations of representative volume elements of grains subject to the loading and deformation prescribed by each finite element.

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