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Meso-scale modeling of granular material including grain fracture using grain morphology

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ABSTRACT

This study focuses on a meso-scale approach to numerical simulations of a granular material subjected to quasi-static loadings. The discrete grains used in this approach are comprised of finite elements that capture the microscale stress distribution within individual grains. In addition, the discrete grain topology is formed from the actual grain surface morphology, captured using X-ray tomography, which allows for more accurate characterization of the contact interaction between particles compared with idealized grain packing with simple shapes. The effects of selected finite element formulations and grain discretization approaches are investigated to maximize the ability to capture high-stress concentrations at contact points between grains, where fracture is likely to initiate, yet maintain computational efficiency. Simulations of uniaxial and triaxial compression quasi-static loadings of Ottawa sand specimens are performed with an FE/FD code, GEODYN-L. The influence of including granular in the numerical simulations is also examined.