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Finite element analyses of a granular assembly under projectile loading incorporating computed tomography imaging and damage mechanics[1] ANNE TURNER, AASHISH SHARMA, DAYAKAR PENUMADU, University of Tennessee, ERIC HERBOLD, Lawrence Livermore National Lab —

Granular materials can provide protection from projectile weapons, and understanding the physics behind penetrating these materials allows military artillery to successfully reach adversaries seeking sanctuary within deeply buried targets. The penetration depth of a projectile is determined by the strength and deformation behavior of the granular material, which is affected by fracture of individual grains within the granular assembly. Interparticle forces, leading to contact stresses and ultimately fracture initiation, are influenced by particle morphology. A numerical method incorporating both particle fracture and morphology can provide a more accurate model of projectile penetration. In this research, a numerical approach utilizing high resolution x-ray computed tomography (CT) to incorporate grain morphology and an explicit finite element code which includes damage mechanics for simulating grain fracture is used to analyze an assembly of Ottawa sand particles subjected to projectile penetration. A small granular assembly of CT imaged Ottawa sand particles is analyzed under projectile loading with and without incorporating damage mechanics to investigate the initiation of particle fracture and its effect on the projectile's depth. This approach can then be used to create multi-scale models of granular assemblies under projectile loading considering the effect of individual particle shape and fracture on the penetration response through well calibrated numerical simulations.

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