Large Deformation Plasticity in Reproducing Kernel Particle Method penetration into soil

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Key Words: *Large Deformation Plasticity, Reproducing Kernel Particle Method, Meshfree, Soil Plasticity.*

The penetration of projectiles into soils has multiple applications, both military and civilian. In this we research, we focus on the depth of penetration of projectile at formerly used munitions sites to aid in their remediation.

Purely continuum-based methods such as the standard finite element method general perform poorly in applications involving penetration as the physical processes involve extremely large deformation, separation and contact of particles. Here we use a semi-Lagrangrian Reproducing Kernel Particle Method (SLRKPM) [1] to model the deformation. By resetting the kernel at each step, the method handles large deformation and contact naturally.

The soil is handled with a large-deformation cap plasticity model extended from [1,2]. The model includes a unified nonlinear tension-shear surface, a compression cap, nonassociative dilation, and effects of the third stress invariant. The compression cap is updated to be related directly to the porosity and hardens as the porosity is reduced. This adjustment also sets up the model for future implementation in a poromechanical framework. A Duvaut-Lions viscoplastic overlay

The models are used to simulate lab experiments and field simulations to observe the behavior and final penetration depth.

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