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Multi-scale penetration mechanics of projectiles through granular media using neutrons and x-rays[1]

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The objective of the research is to use advanced non-destructive radiation based imaging techniques using neutrons and x-rays to address the fundamental science and engineering associated with the penetration mechanics of projectiles. Radiation based imaging is used to describe the initial state and after projectile penetration of a sand sample (three dimensional arrangement of solid particles and associated voids with and without water phases), evolution of its microstructure with applied stress, implementing one-dimensional and triaxial compression loading using controlled laboratory experiments to develop constitutive models to represent the mechanical behavior of a granular assemblage, obtain unique experimental data associated with penetrators impacted into such medium using suitable velocities while tracking the deceleration-time history of the projectile, visualizing the path it traverses using high speed X-ray flash images, and integrate the observations in a predictive and custom developed DEM-FEM formulation for modeling the boundary value problem(s). The work aims at developing a better understanding of the basic science and mechanics associated with increased penetration into granular materials and opaque composites.

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[2]Particulate, Porous, and Composite Materials Topical Area