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Granular flows in constrained geometries TEJAS MURTHY, Indian Institute of Science, Bangalore, KOUSHIK VISWANATHAN, Purdue University —
Confined geometries are widespread in granular processing applications. The deformation and flow fields in such a geometry, with non-trivial boundary conditions, determine the resultant mechanical properties of the material (local porosity, density, residual stresses etc.). We present experimental studies of deformation and plastic flow of a prototypical granular medium in different nontrivial geometries—flat-punch compression, Couette-shear flow and a rigid body sliding past a granular half-space. These geometries represent simplified scaled-down versions of common industrial configurations such as compaction and dredging. The corresponding granular flows show a rich variety of flow features, representing the entire gamut of material types, from elastic solids (beam buckling) to fluids (vortex-formation, boundary layers) and even plastically deforming metals (dead material zone, pile-up). The effect of changing particle-level properties (e.g., shape, size, density) on the observed flows is also explicitly demonstrated. Non-smooth contact dynamics particle simulations are shown to reproduce some of the observed flow features quantitatively. These results showcase some central challenges facing continuum-scale constitutive theories for dynamic granular flows.

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