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Simultaion of Dense Granular Flows in a Modified Couette Cell
JEREMY B. LECHMAN, GARY S. GREST, Sandia National Laboratories — Dense granular flows often exhibit thin, localized regions of particle motion, shear bands, separating largely solid-like regions. Recent experiments using a split-bottom Couette cell found that the width of the shear zone grew as the pack height increased and the azimuthal velocities when rescaled fall on a universal curve regardless of the particle properties. Here we present large-scale Discrete Element simulations of a similar system for packs of varying height up to 180,000 monodisperse spheres. We find a similar universal scaling relation for the azimuthal velocities both at the surface as well as in the bulk of the pack. However, we find the rescaled velocity profiles are asymmetric for smaller diameter systems. We observe a quasi-static inner core which changes shape with increasing pack height and undergoes a transition from a curved cylinder intersecting the surface of the pile to a closed surface within the bulk as predicted by theory. The mean-squared velocity fluctuations are found not to follow a simple scaling form with the shear rate as observed in traditional Couette cells and the velocity fluctuations in the cross-coordinate radial-azimuthal and azimuthal-vertical directions differ significantly from the other directions suggesting secondary flows.

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