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Complex Dynamics of a Floating Sheared Granular Layer[1]
QUENTIN SHERMAN, ZACHARY NEEDELL, Haverford College, DOUGLAS DURIAN, University of Pennsylvania, JERRY GOLLUB, Haverford College — We investigate the complex shear flow dynamics of a two-dimensional layer of cohesive particles floating on a magnetically driven fluid. Capillary forces provide cohesion, which can be adjusted using a surfactant. The layer shows a yield force that rises with packing fraction and cohesion. Using a Voronoi tessellation of the particle positions, we find that the distribution of the local free areas follows a Gamma distribution with an additional tail resulting from voids. The deformation gradient of the related Delaunay triangulation of the particle positions provides a useful way to characterize the dynamics. We focus especially on the rotation and stretching rates of these triangles, which are found to be only weakly correlated with the local free area. It appears that local structural quantities cannot reliably predict the evolving regions of large deformation. We note asymmetries of these fluctuations that correspond to elongated regions of high deformation (e.g.slip lines). Finally, we consider the mean square non-affine particle displacements, which appear to grow diffusively in time.

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