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Plastic Failure Events in 2D Sheared Granular Systems
TRUSHANT MAJMUDAR, ROBERT BEHRINGER, Physics Department, Duke University — We present experimental measurements of plastic failure events in a two dimensional granular system consisting of polymer photoelastic disks. The particles are confined in a rectangular geometry and placed horizontally. We visualize the formation and breaking up of force chains and measure the stress changes and displacements of particles during failure events. The stress changes are measured with photoleastic images and the displacements are measured by particle tracking. We find that certain regions of the sample remain rigid, but a band of particles undergo maximum irreversible deformation and reduction in stress signifying a shear band. We can extract quantitative information about the elastic as well as inelastic deformations. We compare our observations to the shear transformation zone (STZ) theory. We also report measurements of the normal and tangential forces at the grain scale for sheared systems and characterize the induced anisotropy in contact orientations and forces. We find that spatial correlations of forces serve as an additional distinguishing signature of induced anisotropy.

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