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3D imaging of particle-scale rotational motion in cyclically driven granular flows MATT HARRINGTON, University of Pennsylvania, DYLAN POWERS, University of Maryland, ERIC COOPER, Pomona College, WOLFGANG LOSERT, University of Maryland — Recent experimental advances have enabled three-dimensional (3D) imaging of motion, structure, and failure within granular systems. 3D imaging allows researchers to directly characterize bulk behaviors that arise from particle- and meso-scale features. For instance, segregation of a bidisperse system of spheres under cyclic shear can originate from microscopic irreversibilities and the development of convective secondary flows. Rotational motion and frictional rotational coupling, meanwhile, have been less explored in such experimental 3D systems, especially under cyclic forcing. In particular, relative amounts of sliding and/or rolling between pairs of contacting grains could influence the reversibility of both trajectories, in terms of both position and orientation. In this work, we apply the Refractive Index Matched Scanning technique to a granular system that is cyclically driven and measure both translational and rotational motion of individual grains. We relate measured rotational motion to resulting shear bands and convective flows, further indicating the degree to which pairs and neighborhoods of grains collectively rotate.

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