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Simulations of Granular Particles Under Cyclic Shear

JOHN ROYER, PAUL CHAIKIN, Center for Soft Matter Research, New York University — We perform molecular dynamics (MD) simulations of spherical grains subjected to cyclic, quasi-static shear in a 3D parallelepiped shear cell. This virtual shear cell is constructed out of rough, bumpy walls in order to minimize wall-induced ordering and has an open top surface to allow the packing to readily dilate or compact. Using a standard routine for MD simulations of frictional grains, we simulate over 1000 shear cycles, measuring grain displacements, the local packing density and changes in the contact network. Varying the shear amplitude and the friction coefficient between grains, we map out a phase diagram for the different types of behavior exhibited by these sheared grains. With low friction and high enough shear, the grains can spontaneously order into densely packed crystals. With low shear and increasing friction the packing remains disordered, yet the grains arrange themselves into configurations which exhibit limit cycles where all grains return to the same position after each full shear cycle. At higher shear and friction there is a transition to a diffusive state, where grains continue rearrange and move throughout the shear cell.

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