Time Dependence of Density Inversion in Granular Layers

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Granular hydrodynamics studies the flow, movement, and general behavior of grains, i.e. collections of roughly spherical macroscopic particles. The focus of my research has been the nature of density inversion: density inversion is observed when a very low density layer of grains is close to the plate of oscillation with a high density layer of grains above it. Where density inversion occurs, the energy imparted to the grains by the plate's motion can initiate something analogous to a phase-change with the bottom level behaving as a gas and the upper level behaving like a liquid and, in special cases, a solid. To model density inversion, I use a continuum simulation for three-dimensional, time-dependent forms of hydrodynamic conservation equations. I have computationally tested different frequencies and amplitudes of shaking in an attempt to identify a set of ideal circumstances for density inversion. These simulations have shown that the time-dependence of the density inversion is related to its shaking frequency. In our work, we have discovered that although density inversion does not occur as a steady state for lower shaking frequencies, it does occur in a periodic state.