Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Dynamics of an intruder pulled slowly from a granular material[1]

YUE ZHANG, Duke University, ABE CLARK, Yale University, ROBERT BEHRINGER, Duke University — What is the response of a granular material and an object buried in the material as the object is pulled out? To address this question, we use an experiment where the grains are 2D photoelastic disks to visualize the pull out dynamics for different circular intruders. We apply forces that are close to the minimum to initiate intruder motion. We observe the intruder motion, z(t), and the disk photoelastic response. We numerically differentiate z(t), to yield the intruder velocity, v(t), and acceleration, a(t). After transients, we find v(t)=c*exp(b*t), where coefficients c and b depend on the intruder, particularly, b decreases when increasing intruder size. Why does velocity depend exponentially on time, or equivalently why does acceleration linearly change with displacement? To answer this question, we compute the drag force caused by the granular disks from the acceleration of the intruder. The result shows that the drag force depends linearly on the thickness of disks above the intruder, which also changes linearly with the displacement of the intruder. However, the drag force is much bigger than the weight of particles above the intruder. Ongoing work focuses on illuminating the cause for the observed drag force.

[1]We would like to acknowledge grant agencies, NSD-DMR12065351 and NASA NNX15AD38G.

Yue Zhang
Duke Univ

Date submitted: 28 Jul 2015 Electronic form version 1.4