Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Collisional Model for Granular Impact Dynamics[1] ALEC PETERSEN, ABRAM CLARK, ROBERT BEHRINGER, Duke Univ — When an intruder collides with a granular material, the grains exert a stopping force which decelerates the intruder. A macroscopic force law, dominated by a v^2 drag term, is often used to characterize this decelerating force. However, a description which connects this drag force to grain-scale dynamics is still lacking, due in part to difficulty in obtaining sufficiently fast data at the grain scale. We present experiments using photoelastic particles and a high-speed camera, which capture the intruder dynamics and local granular force response at fast time scales. This allows us to analyze our experiments using both the macroscopic force law, and microscopically, where we observe large fluctuations at small space and time scales. Thus the intruder deceleration is not smooth and steady, but dominated by intermittent collisions with clusters of grains. Based on this, we present a model for the velocity-squared drag force in terms of these intermittent collisions we observe. We show that this model captures the shape-dependence of the v^2 drag force, as well as off-axis rotation. Therefore the microscopic assumptions of our model are confirmed, and may provide insight into other dense, driven granular flows.

[1]This work has been supported by the U.S. DTRA under Grant No. HDTRA1-10-0021.

Alec Petersen
Duke Univ

Date submitted: 14 Nov 2013 Electronic form version 1.4