Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Jamming aids jumping in granular media[1] JEFFREY AGUILAR, Georgia Tech School of Mechanical Engineering, ANDRAS KARSAI, DANIEL I. GOLDMAN, Georgia Tech School of Physics — Little is known about the impulsive force and flow fields generated during jumping on granular media. We use a simple robot jumping on poppy seeds to explore maneuvers that induce jammed (non-yielding) states, and find sensitive dependence of jumping performance to movement strategy. On loose packings (volume fraction $\phi = 0.57$), a preliminary hop followed by a delay ("delayed stutter jump") improves the height of a push-off maneuver ("single jump"). Constant speed intrusion force measurements suggest that reentry of the foot during the preliminary hop reintroduces high surface resistance. An optimal delay time ($t = 50$ ms) leads to maximal jump heights, while a short delay time ($t \approx 0$ ms) produces the lowest jumps. Velocimetry of grain flow reveals that non-delay stutters induce fluid-like granular states into which the robot sinks before jamming occurs, lowering jump heights. While simulations of single and delayed stutter jumps are well described using a frictional (depth dependent) plus drag (velocity dependent) penetration resistance, this model does not capture stutter jump performance at low ϕ. However, addition of an added mass term improves agreement, signaling the need for a more complex reactive force theory in impulsively forced granular media.

[1]This work is funded by NSF Physics of Living Systems CAREER, Burroughs Wellcome Fund, and ARO.

Jeffrey Aguilar
Georgia Tech

Date submitted: 13 Nov 2014 Electronic form version 1.4