

**2022 Granular Materials Committee
Student Competition Winner**

NOOR MILI

New Jersey Institute of Technology, Newark, NJ, USA



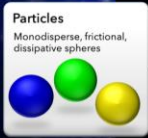
Title: *“Computational analysis of tapped density evolution in granular beds”*

Statement from judges:

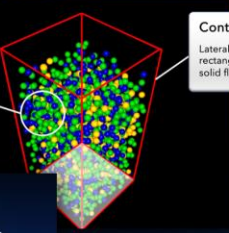
“The author conducted a comprehensive study of a granular bed that is periodically disrupted by regular vertical impulses of the bed's floor. These impulses produce rearrangements of the monodisperse spheres and a continual increase in density. Multiple realizations of the computational experiment revealed fascinating behaviors: periods during which thousands of impulses produce no change in density followed by sudden leaps in density; and realizations that remain near the relatively low random close packing density and other realizations that approach and remain near the Kepler maximum density. The author conducted a dimensionality reduction with Principal Component Analysis, mapping the post-tap particle positions to a two-dimensional space. This mapping revealed a clustering of the complex arrangements into a few crystallized and randomly packed states. The author is complemented for an insightful investigation of a seemingly complex system and of its underlying evolution and order.”

3 MODEL DEFINITION

Particles
Monodisperse, frictional, dissipative spheres

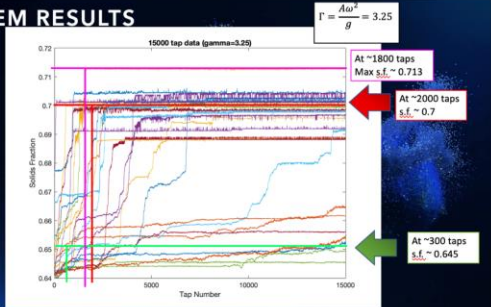


Container
Laterally periodic rectangular container with solid floor and open top



5 DEM RESULTS

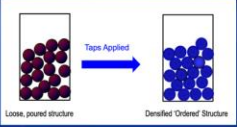
$\Gamma = \frac{A\omega^2}{g} = 3.25$




2 RESEARCH OBJECTIVE

Investigate the density relaxation process in bulk solids; that is, the changes in the bulk density of a granular system as it undergoes a series of discrete percussions.


Loose, poured structure



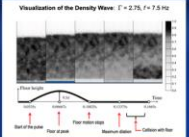
Tape Applied



Densified 'Ordered' Structure

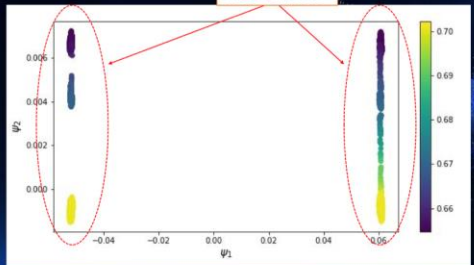



Visualization of the Density Wave: $\Gamma = 2.25, \Gamma = 7.50$



7 PCA RESULTS

2 data clusters





New Jersey Institute of Technology in Newark, NJ, USA

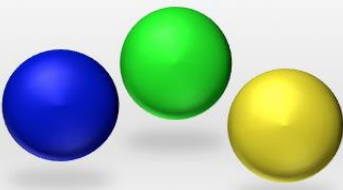
GRANULAR SCIENCE LABORATORY

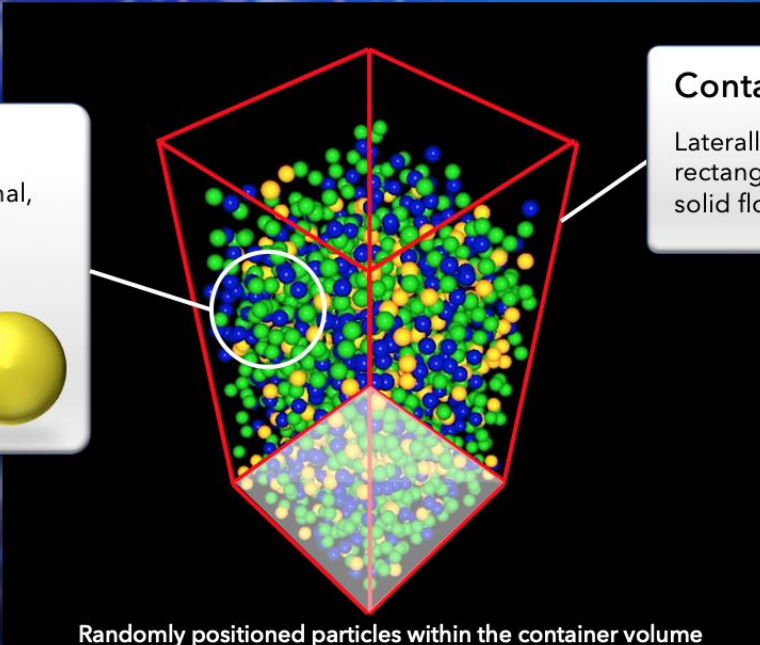
COMPUTATIONAL ANALYSIS OF TAPPED DENSITY EVOLUTION IN GRANULAR BEDS

DR. ANTHONY D. ROSATO • NOOR Z. MILI

3 MODEL DEFINITION

Particles
Monodisperse, frictional, dissipative spheres

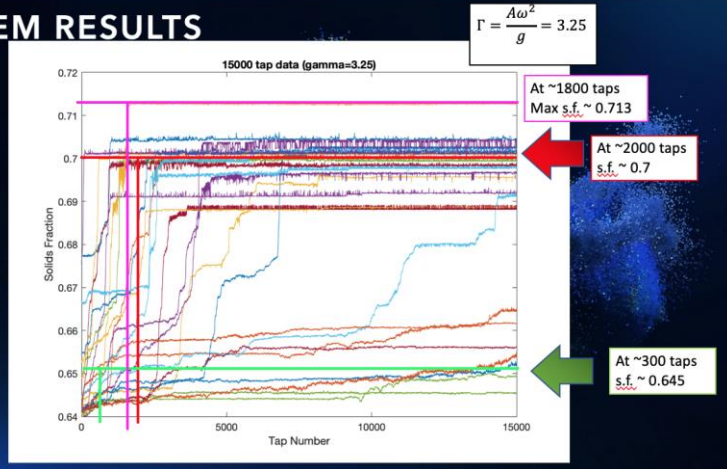




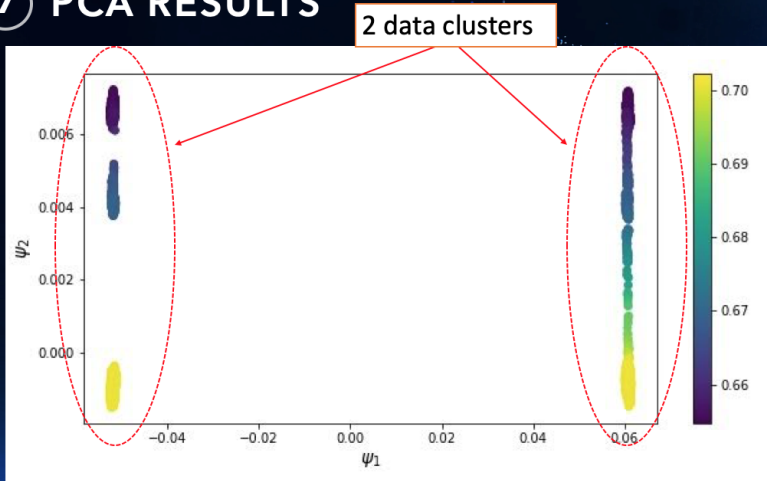
Randomly positioned particles within the container volume

Container
Laterally periodic rectangular container with solid floor and open top

5 DEM RESULTS



7 PCA RESULTS



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