Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Interaction of intruding objects within granular media using continuum modeling. HESAM ASKARI, KEN KAMRIN, Massachusetts Institute of Technology — The interaction of objects with granular media is very common in various aspects of our lives. Interestingly, such a broad problem is not easy to solve due to the complexity of the response of the granular materials to deformation and lack of understanding of the mechanics and physics of their deformation. Exclusively on the topic of the interaction with intruding objects, attempts have been made - mostly driven by experimental observation and validation - to describe this interaction using Resistive Force Theory (RFT), which works based on superposition rules. Understanding the origin of these empirical rules and delving deeper into the requirements on the validity of such hypotheses are crucial to understanding this theory. In an attempt to explain this theory, we hypothesize that the RFT is arising from the laws of continuum frictional plasticity. To demonstrate this we use the Finite Element Method to study the interaction of an intruder with a continuum granular media. We use a custom user-material definition in ABAQUS using a friction-based law for the flow rule as well as adjustments required to represent a discrete granular system in a continuum model. The findings of our model are in agreement with the experiments and numerical discrete element method results in the literature. These results are suggesting that the superposition rule can be obtained by the plasticity approach and the effects of the shape, size and depth of the object can be represented by a universal scaling law.

Hesam Askari
Massachusetts Institute of Technology

Date submitted: 14 Nov 2014 Electronic form version 1.4