ME Seminar

A Predictive Continuum Model for Coupled Size Segregation and Flow in Dense Granular Materials

Harkirat Singh, Brown University

ABSTRACT

Granular systems that consist of particles of disparate size segregate based on size during flow, resulting in complex, coupled segregation and flow fields. Predicting segregation in granular mixtures is important in the design of industrial processes and the understanding of geophysical phenomena. At the continuum level, the two primary driving mechanics of size segregation are pressure gradients and strain rate gradients. Discrete-element method (DEM) simulations are used to inform continuum-level constitutive equations for both the driving mechanics. Upon coupling the segregation constitutive equations with the nonlocal granular fluidity (NGF) model (a nonlocal continuum model for dense granular flow), the coupled model is able to quantitatively predict segregation and flow over a variety of flow configurations, including flow down a long vertical chute, flow down a rough inclined plane and planar shear with gravity flow. Besides this, it also captures the salient features of segregation dynamics in complex flow configuration, namely, annular shear flow with gravity and split bottom flow.

ABOUT THE SPEAKER

Harkirat is a PhD student in Solid Mechanics at Brown University. He received his BT-MT dual degree in Mechanical Engineering from IIT Kanpur in 2016, followed by joining Brown in fall 2017. His research work, under the supervision of Prof. David Henann, focuses on formulating continuum-level constitutive models for coupled flow and size segregation in granular materials.

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