VICI 10828: Bridging the gap between particulate systems and continuum theory

Progress report of Olukayode Imole, May 2014

Project description

This report briefly describes the ongoing activities related to the aforementioned project and provides a road map of the same for the users' committee. The project is mainly concerned with the *micro-macro transition* required to obtain the bulk properties of a system of granular particles directly from the particle properties. This requires a description of a discrete granular system (the positions and velocities of and forces acting on each particle) in terms of density, velocity, and stress. In particular, we focus on linking the macroscopic response of frictionless and frictional granular materials under different deformation conditions to the microscopic origin. This is important for a proper calibration, validation and predictive tests on constitutive models.

Publications in 2014:

1. Imole, O.I.; Wojtkowski M.; Magnanimo, V. and Luding, S. *Micro-Macro Correlations and Anisotropy in Granular Assemblies Under Uniaxial Deformation,* Physics Review E (2014).
2. Imole, O.I.; Wojtkowski M.; Magnanimo, V. and Luding, S. *Discrete Element Simulation and Experiments: Toward Applications for Cohesive Powders,* PhD Thesis, University of Twente (2014).

Presentations in 2014:

1. May 20, 2014, *Application of Discrete Particle Methods towards Cohesive Powder Simulation,* Nestle Product Technology Center, Orbe, Switzerland (Invited Talk)
2. March 14, 2014, *Discrete Element Simulation and Experiments: Toward Applications for Cohesive Powders* University of Twente, The Netherlands

Ongoing Efforts:

A) Stress Relaxation in Granular Materials

Currently, we are using discrete element simulations to investigate the microscopic origin of stress relaxation in granular materials – to complement our earlier experimental findings. Our approach is to perform numerical relaxation tests on packings of particles with different species of dissipation.

B) Dosing of Cohesive Powders in a Simplified canister geometry

The flow of sticky, cohesive powders is a challenge in industrial application. This project involves experimental and numerical studies on the dosing of cohesive powders in a simplified canister geometry. The effects of particle size coarse-graining, dosage time, coil pitch, rotation speed have been studied. At present, the effects of wall friction, rolling resistance and the origin of arching are being studied.

C) Uniaxial compression Contact Models

In this project, our goal is to match discrete element simulation to uniaxial compression element test experiments. The first goal is to calibrate the parameters of the contact model using the “simple” uniaxial test on maize samples. Finally, the predictive quality of the calibrated model will be tested on an independent application test, namely the maize harvesting process.