Level Set - Discrete Element Method to Study the Behaviour of a Load-Bearing Column built from designed granular material

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Roadmap of the Talk

- Motivation and Objective

- Discrete Element Method and Level Set - Discrete Element Method

- Methodologies

- Results and Discussions

- Future work
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Introduction and Motivation

Dierichs, K. and Menges, A., 2016

Figure: Sand (Alamy.com)

Figure: Snow Pile (kicdam.com)
To study the behaviour of a column made up of S-shape particles using Level Set Discrete Element Method (LS-DEM)
Discrete Element Method

YouTube - DEM Research Group
Level Set - Discrete Element Method

Wikipedia

www.itsnicethat.com
Level Set - Discrete Element Method

**Input**
- Surface points, mass, MOI
- Level Set values
- Properties of particle

**LS-DEM**
- Contact check (using Level Sets)
- Interparticle force update
- Velocity/position update

**Output**
- Kinetic energy
- Positions and rotations

**Kinetic Energy**
(kg. voxels$^2$ / s$^2$)
Simulations in 2 Dimensions

Figure: Level set grids and the particle
Calibration of the Input Parameters

- 1 mm = 2 voxels

- Density of acrylic = 1.475e-7 kg/voxels³

- Gravity (g) = 19600 voxels/sec²

- Time step (dt) - Criteria for static equilibrium in DEM (Tu and Andrade)
Pluviation with 10 S-Shaped Particles

Kinetic Energy
(kg. voxels$^2$ / s$^2$)
Pluviation with 10 S-Shaped Particles

Kinetic Energy
(kg. voxels$^2$ / s$^2$)
Pluviation with 200 S-Shape Particles
Pluviation with 200 S-shape particles
Simulations in 3 Dimensions

Figure: Original dimensions

Figure: Dimensions in simulation
Calibration of the Input Parameters

- 1 mm = 1.4 voxels

- Density of galvanised zinc = 3e-6 kg/voxels^3

- Gravity (g) = 14000 voxels/sec^2

- Time step (dt) - Criteria for static equilibrium in DEM (Tu and Andrade)
Calculation of Angle of Repose

Figure: Experimental setup

Figure: Simulation setup
Pluviation of S-Shaped Particles Through a Funnel
Future Work

- Calculation of angle of repose using LS-DEM (Image processing tools)

- Applying compression on the column made by S-shape particles and study its behaviour

- Validating the results obtained with simulations
Thank you!