School Code: CI-782

PhD in Civil Engineering Discrete Element Method modelling of non-spherical particles: application to geomaterials, process and mining engineering

Value of the award

100% of UK/EU tuition fees paid and annual living expenses of £14,296 (full award).

Start date and duration

9 January 2017 for 3 years. Funded by the Engineering and Physical Sciences Research Council

Application closing date

30th November 2016

Overview

Introduction

The Discrete Element Method originally developed to investigate the behaviour of geomaterials is now utilised in several industries, to name a few: process engineering, mining and packaging of pills. Most 3D DEM analyses are run with spherical particles, yet in reality particles are everything but spheres.

Recently, a new class of algorithms based on linear programming have been introduced for non spherical convex particles called 'potential particles' that are described by a combination of flat surfaces with either sharp or smooth edges together with the development of a novel computationally efficient contact detection algorithm (Boon et al., 2012; Boon et al., 2013). These algorithms have proved successful in a variety of rock mechanics problems where blocks tend to be rather 'sharp' polyhedra (Boon et al., 2014, Boon et al., 2015). The challenge still ahead is to employ these algorithms for geomaterials (such as ballast, sands and silts) and the irregular particles generated by mining and process engineering, so non spherical 'smooth' particles.

The PhD project

The student will develop a methodology to determine the mathematical description of the potential particle that best fit particle shapes from literature data and work out what is the fit required to replicate the main mechanical and hydraulic properties of the bulk assembly. To assess the bulk properties, he will run DEM numerical experiments on the reconstructed bulk assembly. Then, the methodology will be coupled to state of the art image recognition techniques currently utilised to scan particles to obtain a seamless tool from image recognition to DEM simulations.

School Code: CI-782

References

Boon CW., Houlsby GT., Utili S. (2015). Designing tunnel support in jointed rock masses via the DEM. *Rock mechanics and rock engineering,* **48**(2): 603-632.

Boon CW., Houlsby GT., Utili S. (2014). New insights in the 1963 Vajont slide using 2D and 3D Distinct Element Method analyses. *Geotechnique,* **64**(10): 800-816.

Boon CW., Houlsby GT, Utili S. (2013). A new contact detection algorithm for three dimensional non-spherical particles. *Powder Technology*, Special Issue on DEM, **248**: 94-102.

Boon CW., Houlsby GT., Utili S. (2012). A new algorithm for contact detection between convex polygonal and polyhedral particles in the discrete element method. *Computers and Geotechnics*, **44**: 73-82.

How to apply

Go to http://www.ncl.ac.uk/postgraduate/funding/sources/ukeustudents/ci782.html

Contact

For further details, please contact:

Prof. Stefano Utili

School of Civil Engineering and Geosciences

E-mail: stefano.utili@newcastle.ac.uk

Telephone: +44 (0) 191 208 6414