UNIVERSITY OF CAMBRIDGE
Department of Engineering

GEOTECHNICAL SOCIETY

# Large deformation modelling in geomechanics


## Dr. Krishna Kumar

Post-Doctoral Researcher, Dept. of Engineering, University of Cambridge


### Seminar overview:

Geophysical hazards usually involve multiphase flow of dense granular solids and water. Understanding the mechanics of granular flow is of particular importance in predicting the run-out behaviour of debris flows. The dynamics of a homogeneous granular flow involve three distinct scales: the microscopic scale, the meso-scale, and the macroscopic scale. Conventionally, granular flows are modelled as a continuum because they exhibit many collective phenomena. Recent studies, however, suggest that a continuum law may be unable to capture the effect of inhomogeneities at the grain scale level, such as orientation of force chains, which are micro-structural effects. Discrete element methods (DEM) are capable of simulating these micro-structural effects, however they are computationally expensive. In the present study, a multi-scale approach is adopted, using both DEM and continuum techniques, to understand the rheology of granular flows and the limitations of continuum models. For the continuum modelling, the Material Point Method (MPM) is used to simulate aerial and underwater landslides. The importance of modelling water entrainment along the base of the granular flow is investigated.

The initiation and propagation of submarine flows depend mainly on the slope, density, and quantity of the material destabilised. In order to describe the mechanism of submarine granular flows, it is important to consider both the dynamics of the solid phase and the role of the ambient fluid. In the present study, a two-dimensional coupled Lattice Boltzmann LBM – DEM technique is developed to understand the micro-scale rheology of granular flows in fluid. The effect of hydrodynamic forces on the run-out evolution is analysed by comparing the energy dissipation and flow evolution between dry and immersed conditions.

### Biography:

Krishna Kumar is a research associate at the Department of Engineering, University of Cambridge. Krishna will be starting at UT Austin in January 2019, as an Assistant Professor in the Civil, Architecture and Environmental Engineering gorroup. Krishna completed his PhD from University of Cambridge in January 2015 on multi-scale multiphase modelling of granular flows and was supervised by Professor Kenichi Soga. He is affiliated to the King’s College, Cambridge. Krishna's work involves developing massively parallel micro-/macro-scale numerical methods: Finite Element Method, Material Point Method, Lattice Boltzmann - Discrete Element coupling and Lattice Element method. Krishna also works on building large-scale graph-data systems for infrastructure sensing and traffic flow modelling.

## When and where:

**Wednesday, 24 Nov, 13:00**

**Teaching Room, JDB, Engineering Dept.**


**Queries:**

Chris Wilkes

cw646@cam.ac.uk