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COMBINED FINITE-DISCRETE ELEMENT METHODS FOR MULTI-BODY DYNAMICS AND FRACTURE MECHANICS - 1200

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ABSTRACT

This series of talks will cover the latest research developments and new methods in multi-body and fracture simulations with finite element methods (FEM) and discrete element methods (DEM), with a particular emphasis on combined finite-discrete element methods (FDEM), and with output from researchers from a variety of applied and multidisciplinary fields. It will be a chance to hear on the features of computational technologies developed by researchers around the world, and the latest research developments for multi-body systems and fracture simulations with FEM, DEM and FDEM. It will be a platform to bring together academics and industry specialists who are using and developing FDEM codes. It will also provide a great opportunity for people who have just started working with combined finite-discrete element methods to discuss with world experts in this field. The research areas that will be discussed include (but are not limited to):

- Numerical algorithms and optimisation techniques for combined finite-discrete element methods;
- Validation studies of multi-body and fracture simulations with experimental results;
- Coupling methods and applications for multi-physics (e.g. fluid and thermal) structural problems;
- Chemical and pharmaceutical applications (powder compaction, tableting, reactors, etc.);
- Civil and mechanical applications (track ballast, tunnelling, mechanical components, etc.);
- Rock mechanics, petroleum and mining applications (underground excavations, hydraulic fracturing, CO_2 sequestration, etc.).

Some of the discussion will focus on open problems and on the challenging aspects of FDEM in fracture simulations, such as the joint-element induced artificial compliance, element size constraints due to the discretisation of the process zone, dynamic effects induced by the application of boundary conditions (e.g. in-situ stresses), and so on. Algorithms for the combined finite-discrete element method (FDEM) started to be proposed from the 90s. Extensive developments and applications of the FDEM method have been carried out after the release of the open source Y-code in [1], and different versions have been released, including the code developed from the collaboration between Queen Mary University and Los

Alamos National Laboratory [2], the Y-Geo and Y-GUI software that have been developed by the Geomechanics Group at Toronto University [3], and VGeST (Virtual Geoscience Simulation Tools) released by the Applied Modelling and Computation Group (AMCG) at Imperial College London. Recently the AMCG has upgraded and renamed VGeST as 'Solidity'. A commercial FDEM code developed by Geomechanica (www.geomechanica.com), has also been released in Canada, although its application has been limited to modelling geomaterials. While the first Y-code employed finite strain elasticity coupled with a smeared crack model to capture deformation, rotation, contact interaction and fragmentation, the AMCG has greatly improved the code, implementing a range of constitutive models [4, 5], thermal coupling [6], parallelisation and a faster contact detection algorithm [7] with applications in different fields [8, 9].

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