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EDITORIAL

Special issue titled "combined finite discrete element method and virtual experimentation"

Esteban Rougier[1] · Earl E. Knight[1] · Antonio Munjiza[2]

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1 Preface

The work presented in this Special Issue is intended to showcase the strategic depth and continued growth of the Combined Finite Discrete Element Method (FDEM) and its virtual experimentation applications. Enclosed the reader will find articles written by seventeen Universities and three government organizations from eight different countries.

Arguably, twentieth-century computational mechanic's research fields were dominated by continuum-based assumptions to solve various problems in science and engineering. Science of continuum is based on differential equations governing the behaviour of infinitesimally small spatial and temporal domains to which are added initial and boundary conditions. It is worth noting that continuum as such does not exist and is only a theoretical construct.

Judging by recent developments in nanotechnology, biomedical sciences, material sciences, artificial intelligence, pharmaceutical manufacturing, and many other fast-growing research areas, it is becoming increasingly evident that twenty-first-century science, engineering, and technology needs are best characterized by discontinuum approaches. The basic idea of the discontinua is to model the physical world as an assembly of discrete entities such as atoms, molecules, particles, and solid bodies to describe the physical characteristics of these systems through interaction laws between their discrete entities.

Discontinua, however, cannot fully replace continuum methods; in actual fact the two complement each other and in many applications both continuum and discontinuum approaches are applied simultaneously. The result of this merging is hybrid methods, which can be thought of as a holistic adaptation of both continuum and discontinuum solutions. Much like discontinua, hybrid approaches such as FDEM provide a simulation platform for virtual experimentation.

Modern FDEM combines conventional continuum-based simulation solutions for both fluids and solids with state-of-the-art discontinuum methods, wherein material and interaction laws are supplied as separate libraries ranging from frictional to electromagnetic interactions, and even including aspects of molecular and atomistic dynamics. FDEM itself continues to see growth in its usage in research and industry and is being used across a wide spectrum of applications. Major research endeavours in the UK, Canada, China, Australia, Japan, and the USA continue to improve the method's multi-physics capabilities whilst capitalizing on modern day advances in computer architecture and design. One can clearly argue that, thanks to these advances, no more is the method's operational dexterity limited by a user's access to appropriate computational platforms.

This special issue aims to present the current state of the art in FDEM research: it showcases in one place fundamental developments, applications, validations, and simulation technologies that use platforms ranging from desktop computers to high-performance computers employing MPI libraries and/or GPGPU architectures. The researchers in this Special Issue wish to thank the Journal of Computational Particle Mechanics for this opportunity to disseminate FDEM's current state-of-the-art science and applications.

✉ Esteban Rougier
erougier@lanl.gov

1 Los Alamos National Laboratory, Los Alamos, USA

2 FGAG, University of Split, Split, Croatia