VANDERBILT
School *of* Engineering

DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

Seminar

Friday,

Sept. 15, 2023

12:10 pm

SC 5326

"SIMULATION OF LARGE DEFORMATION SOLID MECHANICS VIA THE MATERIAL POINT METHOD"

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ABSTRACT

Most engineering numerical analyses of solid mechanics problems are conducted using the Finite-Element Method (FEM). However, the FEM suffers from a key issue - the inability to handle large deformations without re-meshing and projection of history-dependent variables, making the simulation of large deformation problems numerically tiresome. The Material Point Method (MPM) is very similar to the FEM, with one key difference; the points that represent the physical material (known as material points or MPs) are allowed to move relative to the mesh, no longer being directly coupled to their parent element unlike conventional quadrature points in the FEM. This allows material to deform through the background grid and avoids mesh distortion and removes the need to re-mesh and makes the MPM seemingly ideal for the simulation of large deformation solid mechanics problems. However, several issues manifest when the points representing the physical material are decoupled from the computational mesh. This seminar will provide an overview of the MPM, explain some of the issues associated with the method, and ways that these issues have been overcome by researchers at Durham University. The numerical analyses presented during the seminar are based on AMPLE (A Material Point Learning Environment, https://wmcoombs.github.io/), which is a MATLAB-based implementation of the MPM developed by Professor Coombs that is ideally suited to people who want to understand the MPM and test out/develop new ideas within the method [1].
[1] Coombs, WM & Augarde, CE (2020). AMPLE: A Material Point Learning Environment. Advances in Engineering Software 139: 102748.

BIOGRAPHY

Will Coombs is a Professor in Computational Mechanics in the Department of Engineering at Durham University, UK. Will originally trained as a Civil Engineer before studying for a PhD in Computational Mechanics, focused on constitutive modelling of soils under large deformations, which he completed in 2011. In the same year he was appointed as a Lecturer at Durham University. Since that time, he has secured research funding exceeding £14M and published over 40 peer reviewed journal papers in areas such as: (i) constitutive modelling of soils, (ii) plasticity formulations, (iii) advanced finite element methods, (iv) imposition of boundary conditions, (v) meshless/meshfree methods, (vi) the material point method, (vii) topology optimization and (viii) computational fracture mechanics. He is also committed to making his research as accessible as possible, including publishing research codes in a way that is accessible to early career researchers.