The Hong Kong Polytechnic University
Department of Applied Mathematics

Colloquium

Single-Field Finite Element Simulations for Fluid-Structure Interactions

By

Prof. Peter Jimack
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Abstract

Numerical simulation of fluid–structure interaction (FSI) is a computational challenge because of its strong nonlinearity, especially when large deformation is considered. Three major questions arise when considering a finite element method (FEM) for the solution of an FSI problem: (1) What kind of meshes are used (interface fitted or unfitted)? (2) How to couple the fluid–structure interactions (fully-or loosely-coupled)? (3) what variables are solved (velocity and/or displacement)? In this talk I will provide a brief taxonomy of the most widely used combinations of these choices before describing two methods recently developed with co-authors at Leeds. These two techniques are based around fully-coupled solvers that directly compute only the material velocity in both the fluid and the solid regions (hence, "single-field"). The first approach is related to the Immersed Finite Element Method (IFEM) and the Fictitious Domain Method (FDM) since it solves on a single mesh covering the entire region, with modified flow equations in the region occupied by the solid (the fictitious fluid domain). The second approach is an Arbitrary Lagrangian-Eulerian (ALE) technique in which the interface between the fluid and the solid is tracked by a deforming finite element mesh: with equations for the velocity field in each region assembled into a single system. Having introduced the proposed numerical methods some stability results will be described and a range of numerical simulations will be provided for illustration. The talk will conclude with some reflections and a discussion of current and future research questions.

Date: 11 November 2021 (Thursday)
Time: 16:00-17:00 (Hong Kong Standard Time GMT +8)
Venue: Online Talk via Zoom (Meeting ID: 972 8795 6360)
Speaker: Prof. Peter Jimack, University of Leeds
Host: Prof. Zhonghua Qiao, The Hong Kong Polytechnic University
Click to join:
https://polyu.zoom.us/j/97287956360?pwd=S3NKWnVJci81Q1NIREZJR2kyRHgyZz09

Click to join (Zoom)

* * * ALL ARE WELCOME * * *

For enrolment, please send your name and email to wai-yan.moon@polyu.edu.hk on or before 10 November 2021