6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

An Immersed approach to Contact in Fluid Structure Interaction

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Keywords: *Multiphysics Problems, Contact problems, Fluid-structure interaction*

We present a completely parallel approach for contact between the elastic structures inside a fluid. Our approach exploits the mortar method for variational coupling of the contact surfaces between the solids [1], as well as the fictitious domain method for the fluid structure interaction (FSI).

The dynamic contact problem is treated with a contact-stabilized Newmark method which is proven to be dissipative hence does not allow energy blow-ups [3].

The FSI problem is modelled by embedding the solid in the background flow. The fluid is described in an Eulerian fashion (fixed mesh), while the solid in a Lagrangian one. The coupling between the fluid and the solid is constructed by means of L^2-projections for weakly enforcing the velocity vector constraint along the FSI-interface.

Note that meshes are in general non-matching on both the predicted area of contact and in the intersection between fluid and solid. Moreover, in parallel computing environments such meshes are arbitrarily distributed among processes. For handling this challenge we perform a scalable parallel assembly of the coupling operators by means of a tree-based search and load-balancing algorithm [2].

The presented methodologies are validated by means of 2D and 3D benchmarks.

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