Advances in unfitted mesh methods for the resolution of Computational Fluid Dynamics and Fluid-Structure interaction problems

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The fluid flow around deformable, and possibly moving, structures has been of particular interest for the industry during the last decades. Traditionally, the movements of the wet boundaries have been handled using Arbitrary Lagrangian-Eulerian (ALE) approaches. Although these family of methods has been proved to be an accurate and efficient alternative, they may lack robustness in those applications involving large displacements and moderate rotations of the analysed bodies. In this context the mesh motion problem is prone to yield extremely distorted, or even inverted elements, thus requiring the use of a re-meshing strategy.

Unfitted mesh methods aim at overcoming these limitations by using a non-conforming discretization of the analysed geometries. At the price of introducing the need of implicitly representing the wet bodies in the background mesh, this makes possible to completely decouple the structure boundaries from the computational mesh, thus allowing arbitrary movement of the analysed bodies. This gives rise to a wide variety of methods such as the Immersed Boundary Method (IBM), the Cut-Finite Element Method (Cut-FEM) or the Shifted Boundary Method (SBM).

The objective of this session is to present the most recent scientific advances as well as applications of this family of methods to Computational Fluid Dynamics (CFD) and Fluid-Structure Interaction (FSI) problems. Contributions from any engineering discipline are welcome.