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IMMERSED BOUNDARY METHODS FOR COUPLED PROBLEMS

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ABSTRACT

Immersed Boundary Methods (IBM) have been attracting strongly increased attention during the past ten to fifteen years. Their central principle is to extend a domain of computation to a larger one, typically with a simple shape, which is easy to mesh. On this extended domain a finite element type computation is performed, distinguishing between regions interior and exterior to the original domain. Under the denotation 'fictitious domain' or 'embedded domain methods' the central principle has been followed already since the 1960ies. The recent new interest results from innovative and efficient algorithmic developments, from mathematical analysis showing optimal convergence despite the presence of cut elements, the possibility to efficiently link these methods to various types of geometric models and from many new engineering applications. Many variants of Immersed Boundary Methods have been developed, like CutFEM, the Finite Cell Method, Unfitted Finite Elements, the Shifted Boundary Method, or Trimmed Isogeometric Analysis, just to name a few.

Although the principle of IBMs is generally suitable for many kinds of partial differential equations, several specific questions arise, when they are applied to coupled problems. In case of surface coupling, interfaces which do not fit to element boundaries need special care, the formulation of boundary conditions may have to be adopted, and for volume coupled problems non-matching grids of the individual field equations need to be addressed. This Invited Session will focus on IBMs for coupled problems dedicated, but not limited to problems in solid mechanics, including possible interactions with other physical fields (e.g. heat, fluid, etc.). The topics will range from the coupling of computation and geometric modelling, mathematical analysis, adaptivity and implementational issues to the efficient solution of complex coupled engineering problems. Of particular interest is the interaction with industry software developers who are exploring ways to integrate IBMs into legacy computer code.