Recent advances in immersed boundary, fictitious domain and unfitted discretization methods

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ABSTRACT

In scientific and industrial applications, a large part of the overall effort invested for a finite element analysis is very often devoted to geometric modelling and the transition from a computer-aided design to an analysis suitable model. To avoid the need for body-fitted mesh generation, fictitious domain methods were introduced already in the early 1960s. Since then many variants of these appealing approaches have been suggested, like embedded domain and immersed boundary methods or special implementations of the extended finite element method. Whereas in earlier years the focus was placed on the investigation of its mathematical aspects, more recently a lot of progress has been achieved in engineering sciences. An important reason for this success is an essential paradigm of fictitious domain and immersed boundary methods, which they share with Isogeometric Analysis: 'To support better design-through-analysis by closely coupling geometric modelling and numerical simulation'.

This mini-symposium will focus on fictitious domain methods dedicated, but not limited to problems in solid mechanics, including possible interactions with other physical fields (e.g. heat, fluid, etc.) or multi-phase applications. The topics of this mini-symposium will range from modelling aspects including the coupling of analysis and CAD, mathematical analysis, stabilization, pre-conditioning, integration of cut cells, adaptivity and implementational issues to the efficient solution of complex engineering problems. It will address low and higher order unfitted discretization approaches, CutFEM, the Finite Cell Method, the Shifted Boundary Method, as well as combinations with the Isogeometric Analysis including trimming of spline patches or recent approaches to shape and topology optimization.