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The finite element immersed boundary method for fluid structure interactions: A fictitious domain approach

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Abstract

The Immersed Boundary Method (IBM) has been introduced by Peskin in the 70's in order to model and approximate fluid-structure interaction problems related to the blood flow in the heart. The original scheme makes use of finite differences for the discretization of the Navier–Stokes equations. We introduced a finite element formulation which has the advantage of handling the presence of the solid (modeled via a Dirac delta function) in a more natural way. In this talk we review the finite element formulation of the IBM focusing, in particular, on the choice of the finite element spaces in order to guarantee a suitable mass conservation. Appropriate CFL conditions are discussed for the stability of the time marching scheme. A new implementation of the method shows a link with the *fictitious domain* method. It turns out that the new scheme enjoys more accurate mass conservation and more robust stability properties.

Key words: fluid-structure interactions, finite elements, immersed boundary method, fictitious domain, mass conservation

Mathematics subject classifications (1991): 65N30, 74F10, 65M85

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