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A NITSCHE-XFEM FICTITIOUS DOMAIN METHOD FOR AN IMMERSED THIN-WALLED STRUCTURE IN AN INCOMPRESSIBLE FLUID

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The use of fictitious domain or immersed boundary methods for the numerical modelisation of fluid-structure interaction problems was pioneered in the works [8, 12, 1, 6] and has recently seen a surge of interest in papers such as [11, 7, 3]. In this work we consider the extension of the Nitsche-XFEM method (see [9, 10, 2]) to fluid-structure interaction problems involving a thin-walled elastic structure immersed in an incompressible fluid. The solid mid-surface is meshed and hence fitted to the interface. The deformed solid mesh is then glued onto the fluid domain without respecting the fluid mesh. The fluid finite element space is enriched in order to allow velocity and pressure discontinuities across the interface. The kinematic/kinetic fluid-solid coupling is enforced weakly using Nitsches interface method. In order to guarantee robustness, with respect to arbitrary interface intersections, a ghost penalty stabilization is added to the fluid formulation (see, e.g., [5, 4]). For a simplified representative linear setting, an optimal a priori error estimate is derived for the space semi-discrete formulation following [4, 3]. Different strategies for the time discretization, either fully implicit or the loosely coupled schemes will be discussed. Several numerical simulations, with static and moving interfaces, illustrate the performance of the method.

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