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Adaptive Immersed Mesh Method for Fluid–Structure Interaction

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The need to simulate flexible, relatively thin structure is of growing interest with applications ranging from thin cylindrical sensors to membrane-like structures. These structures usually interact with their surroundings to accumulate data, or for a specific purpose. The inevitable interaction between the surrounding the fluid and the solid is solved using a novel Fluid–Structure Interaction (FSI) coupling scheme.

The proposed Adaptive Immersed Mesh Method (AIMM) is a hybrid method that combines the advantages of existing method in the literature. Note that all the involved equations for both fluid and solid mechanics are solved using Variational Multi-Scale (VMS) method [1-2].

First, an Eulerian resolution for both fluid-solid is proposed taking the best advantages from immersed methods such as solid implicit interfaces representations and anisotropic meshing for accuracy.

Second, the hyperplastic Lagrangian equations are solved on their solid mesh alone, taking advantages of the single solver non-linear resolution for efficiency and ability to deal with complex constitutive law, and R-adaption to easily handle the solid deformation.

Finally, the coupling and thus the interaction between both is covered by dynamic re-immersion, interpolation, and geometry information exchange. Various numerical problems and benchmarks are investigated to evaluate the accuracy, robustness, and capabilities of the proposed novel FSI framework.

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