# Immersed method with metric based anisotropic meh adaptation for Multiphase Flow and Fluid Solid Interaction

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**Key Words:** *Metric based mesh adaptation, Multiphase Flows, Fluid Solid Interaction.*

A wider use of numerical simulation is depending on meshing and adaptive meshing capabilities when complex geometry, multi-domain, moving interface and multiphase flow are involved. In order to overcome the lack of flexibility of the common body fitted method, the alternative we proposed, is based on an implicit representation of the interfaces by a local distance function and using a hyperbolic tangent filter. When it is combined with anisotropic mesh adaptation, it provides a unique mesh on which a monolithic formulation can be written for various multiphase applications including moving interfaces.

The geometries are interpolated and shown to contribute to the numerical error, and we propose a way to embed it in the a posteriori error estimator. This approach favours the full usage of anisotropic adaptive meshing techniques providing an optimal capture of moving interfaces within the volume mesh, whatever is the complexity of the geometries. The multiphase flow solver with unstructured meshes with possibly highly anisotropic elements (however solution aligned) enters in the framework of continuous stabilized finite element method (here a residual based stabilisation) that can afford with anisotropic meshing with high aspect ratio elements in a quasi-optimal way. Indeed, the stabilisation parameter is shown to be controlled by the minimal width of the element, which guarantee the lowest added diffusion. The interface condition transfer is enforced straightforward by the continuity of the mesh, the jump in stress is controlled implicitly by the high directionality of the elements.

Examples with industrial applications will be proposed in fluid structure interaction, liquid air solid interaction with surface tension (three phase capillarity and wettability) for a coating application (the drag-out problem) and the floating body problem (3 phases problem with gravity).

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