Fluid Structure Interaction in Fully Eulerian Coordinates

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Abstract: In this contribution we present a formulation for fluid-structure interaction problems which is given in Eulerian coordinates for both sub-problems, fluid and solid. By this setting it is possible to derive a novel monolithic formulation of the coupled problem.

This monolithic variational formulation is basis of a finite discretization. The discretized system of equations is solved by implicit solution schemes in a monolithically coupled way allowing e.g. for rigorous a posteriori error analysis.

In contract to the well-established *Arbitrary Lagrangian Eulerian* (ALE) coordinates - the usual basis for monolithic modeling of fluid-structure interactions - the Eulerian formulation goes without the introduction of an artificial coordinate system and artificial domain mappings. In ALE coordinate this mapping of the fluid domain gives rise to problems when dealing with large deformation, free movement of the structure or even contact of the structure with parts of the boundary (topology change).

The benefit of a fully Eulerian formulation is the possibility to model exactly such kind of problems without breaking the monolithic variational formulation.

For verifying this novel formulation we analyze benchmark-problems in comparison to classical approaches like the *Arbitrary Lagrangian Eulerian* coordinates. Then, by further numerical studies we highlight capabilities offered by this formulation which cannot be considered in classical monolithic approaches.

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