Fluid-Structure Interaction based on Monolithic Variational Formulations with Biharmonic Structure Extension

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In this talk, we present fluid-structure interactions in a monolithic setting. Typically, fluid and structure are given in different coordinate systems making a common solution approach challenging: Fluid flows are given in Eulerian coordinates whereas the structure is treated in a Lagrangian framework. The coupling of these subproblems makes the setup of a common variational framework difficult and leads to highly nonlinear behaviour of the system.

In the 'arbitrary Lagrangian-Eulerian' framework (ALE) the fluid problem is rewritten into artificial coordinates on some reference configuration. Here, the choice of appropriate fluid mesh movement is of great importance. This is achieved by solving an additional elasticity problem. We discuss different types of fluid mesh movement based on harmonic-, elastic-, and biharmonic structure extension.

It turns out that the biharmonic approach leads to the largest deformations. The performance is studied in numerical examples which are based on the benchmark proposals given by J. Hron and S. Turek.