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Numerical simulation of fluid structure interaction in a pump with hyperelastic components

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Many industrial applications deal with fluid-structure interaction, in which fluid flow and flexible deformations of solid structures are coupled. Examples are obstacles in fluid flow, the dynamics of fluid-filled structures or transport problems. Efficient numerical strategies are required to optimize such industrial applications. Topic of this paper is the numerical analysis of fluid flow in a pump with hyperelastic components.

For the simulation of fluid-structure interaction several numerical methods are existing, e.g. Coupled Euler Lagrange analysis, CEL, [1] or Smoothed Particle Hydrodynamics, SPH, [2]. In a former study [3] these two methods have been compared for the example of a fluid filled container colliding with a wall. The results have shown a significant higher numerical efficiency and robustness of the SPH analysis compared to the CEL analysis. For this sake, SPH is used for the numerical simulation of the pump.

The pump consists of two major parts: The metal housing modelled as linear elastic material and the hyperelastic impeller. The hyperelastic impeller is made from neoprene rubber. A main advantage of this material is the good sealing. Main goal in the industrial application of the considered pump is the optimization of the impeller with respect to operating parameters and lifetime. In this contribution, a suitable simulation model is presented, and the results and numerical effort are pointed out.

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