Fluid-Solid Interaction of Heartvalves

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Introduction
A still increasing number of 170,000 substitute heartvalves is replaced worldwide every year. To gain basic understanding of pathologies in heart valves, analysis is necessary on how geometry and material properties influence the movement of the artery and heartvalve, and the flow in the vicinity of the heartvalve. Numerical tools can be useful for such an analysis.

Objectives
- Develop an efficient and robust numerical tool for fluid-structure interaction in the cardiovascular system (emphasis on heartvalves)
- Analysis of the relation between patho-physiological mechanisms and fluid-structure interaction in heart valves

Methods
The numerical problem consists of a 3D fluid-filled solid tube of which the wall is coupled to the fluid using an ALE method. Three thin solid leaflets are attached to the wall and are able to move freely within the fluid.

Results
A simple 2D flow demonstrates the local mesh adaptation algorithm. A solid slab is attached to a rigid fluid domain. Movement of the slab is induced by a cyclic plug flow applied on the left side of the fluid domain.

Conclusions
The local mesh adaptation algorithm presented, makes it possible to compute shear stresses and pressures more accurately. Furthermore, it is now possible to position the Lagrange multipliers in the fluid nodes that lie on the solid surface, which improves the robustness of the problem. Therefore, a 3D extension of the meshing algorithm is currently being developed.

References:

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