Numerical approximation of the interaction between an incompressible fluid and an elastic curved arch

Cornel Murea
Laboratoire de Mathématiques, Informatique et Applications, Université de Haute-Alsace, 4, rue des Frères Lumière, 68093 MULHOUSE, France
e-mail: cornel.murea@uha.fr
web page: http://www.math.uha.fr/~edp/murea

ABSTRACT

The fluid fills the two-dimensional domain $\Omega^F_u$ bounded by the inflow section $\Sigma_1$, the rigid boundary $\Sigma_2$, the outflow section $\Sigma_3$ and the interface between the fluid and the structure $\Gamma_u$ (see Figure 1).

Figure 1: Geometrical model and notations for a fluid-structure interaction with curved interface

The boundary $\Gamma_u$ depends on the displacement $u$ of the elastic arch. The fluid flow is modeled by the steady Stokes equations and the arch verifies a particular case of the thin shell theory of Koiter.

For given pressure on the inflow and outflow sections, the problem is to find the displacement $u$ of the arch, the velocity $v$ and the pressure $p$ of the fluid.

This kind of fluid-structure interaction arises in the cardiovascular system, for example, the blood flow in large arteries with aneurysm (see [3] and [4]) or the blood flow in artificial lungs (see [1]).

We present an optimal control model for a fluid-arch interaction. The control is the normal force acting on the interface and the observation is the normal velocity of the fluid on the interface. This construction generalizes in the case of the curved interface that of [2].

Numerical results arising from blood flow in arteries are presented.

REFERENCES