A loosely-coupled scheme for the interaction between a fluid, elastic structure and poroelastic material

Martina Bukač *

Abstract The interaction between a fluid, elastic structure, and poroelastic material plays a fundamental role in many biomedical applications. An example of such application is the interaction between blood, arterial wall and blood clot. This multi-physics problem features three different types of coupling: fluid-elastic structure coupling, fluid-poroelastic material coupling, and elastic structure-poroelastic material coupling, resulting in a fully coupled, non-linear, moving boundary problem. As a consequence, numerical algorithms that split the fluid dynamics, structure mechanics, and poroelastic material dynamics are a natural choice. We propose a stable, partitioned method to solve the coupled problem. We present numerical tests where we investigate the effects of the material properties of the poroelastic medium on the fluid flow. Our findings indicate that the flow patterns highly depend on the storativity of the poroelastic material.

* University of Notre Dame, Department of Applied and Computational Mathematics and Statistics. Email: mbukac@nd.edu.