A partitioned numerical scheme for the interaction between fluid, an elastic structure and a poroelastic material

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ABSTRACT

The interaction between a fluid, elastic structure, and poroelastic structure plays a fundamental role in many biomedical applications. Examples of such applications are the interaction between the blood, blood vessel, and blood clot, as well as the blood flow through dissected artery, where the partially thrombosed false lumen can be modeled as a poroelastic material. This multi-physics problem features three different types of coupling: fluid-elastic structure coupling, fluid-poroelastic medium coupling, and elastic structure-poroelastic medium 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 structure dynamics are a natural choice. In this work, we propose a partitioned method to solve the coupled problem. We use this method to model the interaction between the blood, vessel wall, and thrombus under physiological conditions.