Positivity preserving schemes for the reactive flow of solutes from a viscous fluid to a poroelastic medium

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ABSTRACT

In this study, we consider a mathematical model for the reactive transport of chemical solutes from a viscous fluid to a poroelastic medium. The solutes are dissolved in an incompressible fluid and they are transported to the poroelastic medium through a moving interface due to fluid-structure interaction. In the poroelastic medium the solutes undergo chemical reactions where they are deposited to the solid material. The character of the fluid and the structure are not affected by the chemistry. We derive some positivity preserving numerical schemes for the flow with moving meshes using the ALE-FCT type of design. The schemes ensure mass conservation. We simulate the phenomena starting with flow in a fixed channel with a thick porous wall where the fluid flow via steady and time-dependent velocity profiles. We then consider flow in a moving domain where the fluid flow is defined by the Navier-Stokes equations and the structure is modeled by a Biot law. Consequences of these result are significant in the numerical simulation of nano-particle cancer drug delivery. Our results are an exploration of ways to enhance targeted adsorption of cancer drugs carried by nano-particles via the human vasculature.