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FINITE DIFFERENCE METHODS FOR COUPLED FLOW INTERACTION TRANSPORT MODELS

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Chemical transport in blood flow can modeled to determine if the chemical of interest is arriving at a certain place, and what the concentration is. The advection-diffusion equation is used to model the chemical transport process, which requires knowledge of the velocity of the blood flow. Since the blood flow determines how the chemical is transported, first the blood flow in the vessels and plasma flow in the vessel walls is modeled. Here the two-dimensional transient Navier-Stokes equation to model the blood flow in the vessel is coupled with Darcy's Law to model the plasma flow through the vessel wall. Then the advection-diffusion equation is coupled with the velocities from the flows in the vessel and wall to model the transport of the chemical. Using the additive Schwarz method to couple the discontious concentration across the boundary from the vessel to the wall is investigated. To avoid using a nonlinear solver for the Navier-Stokes equation, an explicit finite difference method for the blood flow is implemented, while an implicit finite differece method is used for the advection-diffusion equation. Development of the analytical, numerical methods and computer implementation are discussed for the advection-diffusion equation, and numerical results are included.

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