Existence of a weak solution to a fluid-elastic structure interaction problem with the Navier slip boundary condition

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Abstract

We study a nonlinear, moving boundary fluid-structure interaction (FSI) problem between an incompressible, viscous Newtonian fluid, modeled by the 2D Navier-Stokes equations, and an elastic structure modeled by the shell or plate equations. The fluid and structure are coupled via the *Navier slip boundary condition* and balance of contact forces at the fluid-structure interface. The slip boundary condition is more realistic than the classical no-slip boundary condition in situations, e.g., when the structure is "rough", and in modeling FSI dynamics near, or at a contact. Cardiovascular tissue and cell-seeded tissue constructs, which consist of grooves in tissue scaffolds that are lined with cells, are examples of "rough" elastic interfaces interacting with an incompressible, viscous fluid. The problem of heart valve closure is an example of a FSI problem with a contact involving elastic interfaces. We prove the existence of a weak solution to this class of problems by designing a constructive proof based on the time discretization via operator splitting.

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