

Semigroup Solutions for a Biot-Poroelastic Plate-Stokes System

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Abstract

In this talk, we discuss our recent work concerning a coupled system of partial differential equations which describe a multilayered filtration system. This PDE model describes the interaction of a viscous incompressible flow with bulk poroelasticity via a poroelastic interface. The geometry in which the PDE components evolve consists of two 3D toroidal subdomains connected via a plate interface, which permits elastic deformation and perfusive fluid dynamics. The governing dynamics comprise Stokes equations in the bulk fluid region, Biot's equations in the bulk poroelastic region, and the recent poroplate of Mikelić at the interface. Coupling occurs on the top and lower surfaces of the plate, and involves conservation of mass, stress balance, and a certain slip condition for the fluid free-flow. For this multilayered PDE system, we obtain strongly continuous semigroup generation, in large part via a resolvent analysis which employs a nonstandard mixed variational formulation that captures the complex, multiphysics coupling at the interface. Subsequently, we discuss how the availability of the Biot-poroelastic plate-Stokes semigroup straightforwardly admits structural (plate) nonlinearities into the dynamics, as well as allow for stability and regularity analyses. This is joint work with Galen Richard and Justin Webster.