Semilinear Degenerate Biot-Signorini System

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Abstract: Nonlinear extensions of the quasi-static Biot model of consolidation are studied with emphasis on boundary conditions, attainment of initial values, and parabolic regularizing effects. The local fluid content is monotone and possibly nonlinear or degenerate with respect to pressure, and the stress of the solid in the fully-saturated porous medium is strictly monotone in strain. In addition to boundary conditions of classical Dirichlet, Neumann, or Robin type, the medium may have a singular or degenerate semipermeable interface with the exterior fluid at a known pressure, and the monotone dependence of traction on boundary displacement includes unilateral constraints of Signorini type given by a variational inequality. The initial-boundary-value problem for this general system is formulated as a Cauchy problem in Hilbert space for a semilinear implicit evolution equation that is nonlinear in the time derivative, and it is shown to be well-posed with regularity of the solution dependent on the data. When the stress is the derivative of a convex strain energy function, the evolution equation is a gradient flow with corresponding *parabolic* regularizing effects on the solution.

References:

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