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A new stabilization of Biot's consolidation model

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Nonphysical oscillations might appear in the numerical solution of the fluid pressure for the quasi-static Biot's model for poroelasticity when standard finite difference or finite element discretizations are considered for the discretization of the model. In this work, we address the issue related to the presence of non-physical oscillations in the pressure approximation for low permeabilities and/or small time steps, by proposing a new stabilization based in adding a term in the flow equation. We consider different discretizations from finite element methods to isogeometric analysis and illustrate how such a stabilized scheme provides solutions free of spurious oscillations. Moreover, the proposed stabilized scheme is suitable for the application of the well-known fixed-stress split method for solving the poroelasticity problem. In this regard, a von Neumann analysis has been applied for proving the stability and convergence of the fixed-stress solver. Finally, numerical results are presented to illustrate the good behavior of both the stabilization and the fixed-stress solver with respect to physical and discretization parameters of the model.