

Stability and monotonicity in the low order discretizations of the Biot's model

C. Rodrigo*, F. J. Gaspar*, X. Hu[†] and L. T. Zikatanov^{‡§}

Abstract

We consider a finite element discretizations of the Biot's model in poroelasticity with lowest order (MINI and stabilized P1-P1) elements. We show convergence of discrete schemes which are implicit in time and use these types of elements in space. We deal with 1, 2 and 3 spatial dimensions in a unified fashion. We also address the issue related to the presence of non-physical oscillations in the pressure approximations for low permeabilities and/or small time steps. We show that even in 1D a Stokes-stable finite element pair does not provide a monotone discretization for low permeabilities. We then introduce a stabilization term which removes the oscillations. We present numerical results confirming the monotone behavior of the stabilized schemes.

*Department of Mathematics, University of Zaragoza, Spain

[†]Department of Mathematics, Tufts University, Boston, USA

[‡]Department of Mathematics, Penn State, University Park, USA

[§]Institute of Mathematics and Informatics, Bulg. Acad. Sci., Sofia, Bulgaria