A new stabilization based on the mass matrix for Biot's consolidation model

Álvaro Pé de la Riva[1], **Carmen Rodrigo**[2], **Francisco J. Gaspar**[3]

SUMMARY

A stabilization is usually required in order to avoid nonphysical oscillations in the numerical solution of the fluid pressure for the quasi-static Biot's model for poroelasticity [1]. For this purpose, we propose to add a mass term as stabilization such that the spurious oscillations are completely eliminated. In addition, this stabilization can be applied in a natural way together with the well-known fixed-stress method [2] for solving the poroelasticy problem. In this work, we will consider pairs of isogeometric elements for discretization. Specifically, we propose the pairs of isogeometric elements $Q1 - Q1$, $Q2 - Q1$ and $Q3 - Q2$ (with global $\mathcal{C}^1$ smoothness). By means of the standard von Neumann analysis, we prove the stability and convergence of these schemes. Finally some numerical results will be shown.

Keywords: Poroelasticity, Biot's model, stabilization, von Neumann analysis, isogeometric analysis

AMS Classification: 65F10, 65L20

References

[1] G. AGUILAR, F. GASPAR, F. LISBONA, C. RODRIGO. Numerical stabilization of biot's consolidation model by a perturbation on the flow equation. *International Journal for Numerical Methods in Engineering* **75**(11), 1282-1300, 2008.

[2] J. KIM AND H.A. TCHELEPI AND R. JUANES. Stability and convergence of sequential methods for coupled flow and geomechanics: Fixed-stress and fixed-strain splits. *Computer Methods in Applied Mechanics and Engineering* **200**(13), 1591-1606, 2011.

[1]IUMA, Department of Applied Mathematics
University of Zaragoza
email: `apedelariva@unizar.es`

[2]IUMA, Department of Applied Mathematics
University of Zaragoza
email: `carmenr@unizar.es`

[3]IUMA, Department of Applied Mathematics
University of Zaragoza
email: `fjgaspar@unizar.es`