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Modelling and simulation of the viscoelastic behavior of brain structures : preliminary results *

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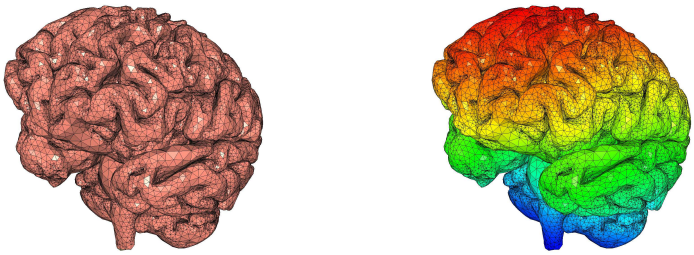
Abstract

We consider the problem of modelling the deformation of brain structures for which the nonlinear viscoelastic behavior has been established several years ago by [2]. Based on the thorough mathematical analysis of a model with internal variable suggested by [1], we focus here on its implementation in three dimensions. The problem associates a nonlinear PDE endowed with an incompressibility condition and an ODE describing the time evolution of the internal variable. The time discretization is based on an implicit Euler scheme and the spatial discretization involves P2 Lagrange finite elements. A linearized version of the resulting system is obtained by a Newton method and is solved by an Augmented Lagrangian technique. Computational results on complex domains will be provided to emphasize the adaptation on the geometric properties of the domain boundaries. Provided biophysical coefficients are available, these results aim to be confronted to experimental results in order to validate the underlying model. Furthermore, a coupling of this model with a plasticity model can be envisaged, possibly in other applications.



References

[1] Le Tallec P., *Numerical Analysis of viscoelastic problems*, Coll. Recherches en Mathmatiques Appliques, vol. 15, Masson, Paris (1990).

[2] Wittek A. et al., *Patient-specific model of brain deformation : Application to medical image registration*, Journal of Biomechanics, vol. 40, 4, p. 919-929, (2006).

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