Simulation of the nonlinear viscoelastic behavior of brain structures on complex domains

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In [1], we consider the problem of modelling the deformation of brain structures for which the nonlinear viscoelastic behavior has been established several years ago by [4]. Based on the thorough mathematical analysis by [3] of a model with internal variable suggested by [2], we focus here on the implementation in three dimensions of a generalized version. The problem associates a nonlinear PDE endowed with an incompressibility condition and two ODE describing the time evolution of the internal variables. The time discretization is based on an implicit Euler scheme and the spatial discretization involves $\mathbb{P}_2$ 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. These results are confronted to experimental results in order to validate the underlying model and determine the corresponding biophysical coefficients.

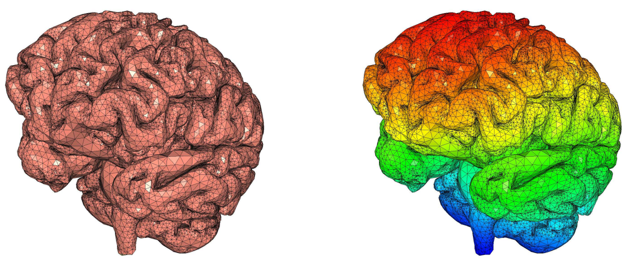

Figure 1: Computational mesh, Numerical result of an experiment

Références

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