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UNSOLVED ISSUES IN THE NUMERICAL MODELLING OF EXPERIMENTALLY-OBSERVED POROUS EFFECTS IN BRAIN TISSUE BEHAVIOUR

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We have implemented a nonlinear poroelastic formulation [1] using the open source finite element library deal.II [2] with the aim of characterizing human brain tissue behaviour [3]. The tissue is modelled as a biphasic material consisting in a fluid-saturated nonlinear porous solid. The governing equations are linearised using automatic differentiation and solved monolithically for the unknown solid displacements and fluid pore pressure values.

The implementation has been validated against numerical examples found in literature. Nevertheless, our attempts to reproduce the experimental results obtained from post-mortem human brain tissue under multiple loading conditions [3] have only been partially successful so far. Our model can capture the nonlinear response of the tissue, but the expected preconditioning and hysteresis due to porous effects are not observed.

In this talk we will present and discuss possible culprits in the problem outlined above. We believe that the poroelastic formulation adopted should intrinsically capture the hysteretic behaviour of brain tissue without the need of a viscous component in the solid constituent. Therefore, identifying adequate material parameters and setting appropriate boundary conditions seem to be the key to successfully reproduce the porous effects observed in the biomechanical tests.

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