INVESTIGATION OF THE MULTIPHYSICS FLOW DYNAMICS OF THE CEREBROSPINAL FLUID IN THE HUMAN BRAIN BY A POLYTOPAL METHOD

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In physiological conditions, the Cerebrospinal Fluid (CSF) plays a crucial role in washing out misfolded proteins from the brain, by filtrating through the cerebral tissues and flowing in its hollow cavities. Indeed, the impairment of this waste clearance mechanism is strongly associated with the onset and development of many neurodegenerative diseases. CSF filtration in the cerebral tissue is also in strict connection with blood perfusion of the brain and it can be modeled by Multiple-network Poro-Elasticity (MPE) equations, while its flow in the brain ventricles can be described by Stokes equations. The coupled Stokes-MPE model is discretized by a Polytopal Discontinuous Galerkin (PolyDG) method, which is particularly suitable to efficiently deal with the brain's complex geometry, and for which rigorous stability and convergence results are provided [1]. Its implementation in the PolyDG library lymph [2] (https://lymph.bitbucket.io/) allows for verification tests and simulations in realistic 2D geometries, while fully 3D computational models in patient-specific geometries are developed based on FEniCS (https://fenicsproject.org/).

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