Special Program in Applied Mathematics and Applied Mechanics

Computational modelling of brain transport phenomena: application of multicompartmental poroelasticity

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103, Mathematics Research Center Building (ori. New Math. Bldg.)

The implementation of a newly multicompartmental poroelasticity including glymphatic system and glial cells compartment for the purpose of studying is proposed, in detail, the transport of cerebrospinal fluid (CSF) within the cerebral environment. The advantage of using Multiple-Network Poroelastic Theory (MPET) representation is that it allows the investigation of fluid transport between CSF, brain parenchyma and cerebral blood. Currently, this model is demonstrated the impact of acute hydrocephalus and cerebral oedema. Moreover, developing a computational framework that will aid in the understanding of cerebral diseases arising from Dementia (such as Alzheimer\'s disease, vascular dementia and normal pressure hydrocephalus) is one of my current researches. We work within the VPH-DARE@IT project (FP7), which aims to deliver the first patient-specific predictive models for early differential diagnosis of dementias and their evolution. The foundations of the mathematical modelling that we work on lie in MPET, adapted to patient specific cases and simulated through a combination of Computational Fluid Dynamics (currently aided by High Performance Computing) and the Finite Element Method (or Finite Difference Method). We are developing a modelling platform that can handle, in an anatomically accurate and patient specific manner, the transport and interplay of blood and CSF with the parenchyma – the neuronal and astrocytic tissue that constitutes the functioning brain.