



Numerical Modelling of Wave Propagation in Brain MR Elastography

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Magnetic Resonance Elastography (MRE) is a non-invasive imaging modality for characterizing the mechanical properties of soft tissues by measuring their response to low-frequency mechanical excitation. In brain MRE, the viscoelastic behaviour of brain tissue and its interaction with cerebrospinal fluid (CSF) affect the propagation of mechanical waves and, consequently, the measured displacement fields. Experimental evidence indicates that CSF motion can affect these fields near fluid–solid interfaces, while its dynamics are often simplified or neglected in numerical models. In this talk, a computational framework for the numerical simulation of wave propagation in brain MRE will be presented. Brain tissue is described as a nearly incompressible viscoelastic solid, while CSF is represented as an incompressible Stokes fluid, leading to a coupled fluid–solid problem formulated in the frequency domain. A Variational Multiscale (VMS) formulation of the Finite Element Method (FEM) is employed to stabilize equal-order finite element approximations and enable efficient simulations on three-dimensional geometries. The numerical framework is examined through verification problems and subsequently applied to an anatomically realistic brain geometry to investigate the influence of CSF on viscoelastic wave propagation. The resulting model provides a physics-based description of the forward MRE problem and a computational basis for studying how fluid–solid interactions affect brain displacement fields.



Dimitrios C. Rodopoulos is a Research Scientist in the In Silico Modelling Group at the University of Cyprus. He received his Ph.D. in Mechanical Engineering and Aeronautics from the University of Patras in 2021 and was a Post-doctoral Associate at NYU Abu Dhabi from 2021 to 2025. He currently leads the BioMagnus project, an MSCA Seal of Excellence postdoctoral fellowship funded by the Cyprus Research and Innovation Foundation (RIF), developing computational methods for Magnetic Resonance Elastography. His research interests include computational mechanics and biomechanics, numerical methods for PDEs, solid mechanics and scientific machine learning.

The seminar is organized by the Solid and Structural Mechanics Group [D. Bigoni, F. Dal Corso, L. Deseri, D. Misseroni, M.F. Pantano, A. Piccolroaz, N. Pugno, R. Springhetti]