Numerical approximation of the viscoelastic Giesekus model in 2D

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In this talk, we study a numerical approximation of the viscoelastic Giesekus model in 2D. The model consists of the incompressible Navier--Stokes equations coupled with an additional stress tensor accounting for elastic effects. The elasticity is described by a viscoelastic evolution equation for the elastic deformation gradient that accounts for transport and relaxation effects.

Analytical results for related models are often restricted to weaker solution concepts or require a parabolic regularization to overcome the lack of compactness. In a recent work, Bulíček et al (Nonlinearity, 2022) studied the limit of vanishing regularizations and proved the existence of weak solutions in 2D.

Our main goal is to prove the convergence of our numerical method to a weak solution in 2D, thereby providing an alternative proof of the result by Bulíček et al.

This plays an important role for numerical experiments, since numerical schemes frequently suffer from accuracy and convergence issues, often due to missing existence results or inherent limitations of the discretization.

This talk is based on ongoing work with Endre Süli (University of Oxford).