24th IACM Computational Fluids Conference (CFC 2027)
March 12-15, 2027, Yokohama, Japan

NON-NEWTONIAN FLOWS IN GEODYNAMICS, BIOMEDICINE, AND INDUSTRIAL APPLICATIONS: MODELING, ANALYSIS, AND SCALABLE SOLVERS

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Key words: Non-Newtonian flows, viscoplasticity, viscoelasticity, learned rheology, finite element methods, adaptive methods, multiscale methods, nonlinear solvers, preconditioning

ABSTRACT

Many relevant flows, including geophysical suspensions and debris flows, biological fluids such as blood, and electromagnetorheological fluids, are described by non-Newtonian models with strongly nonlinear rheologies. The resulting nonlinear PDEs are highly parameter-sensitive and, in the presence of heterogeneous material properties and strongly varying rheological responses, often lead to ill-conditioned systems in which standard discretizations and off-the-shelf nonlinear solvers may lose robustness. These models frequently require locally high resolution, and the size of the resulting discrete systems demands tailored numerical methods, solvers, and preconditioners. The development of efficient, reliable, and scalable computational methods for such models therefore remains an active area of research.

This mini-symposium invites contributions on recent advances in the modeling and simulation of non-Newtonian fluids, including generalized Newtonian, viscoelastic, viscoplastic, and field-responsive models. It also welcomes work in nonlinear PDEs, numerical analysis, and scientific computing, including results on well-posedness, regularity, and stability, as well as advances in high-order and adaptive discretizations, multiscale methods, nonlinear iterative methods, space-time discretizations, and scalable parallel solvers and preconditioners. It further encompasses data-driven rheologies, together with solver and well-posedness challenges arising in data-driven rheology discovery.

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