A compact finite-difference scheme for two-dimensional fractional Oldroyd-B fluids

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An increasing attention has been devoted to the prediction of behaviour of viscoelastic non-Newtonian fluids in the recent years, due to their broad application in industry and biology (molten plastics, oils and greases, suspensions, emulsions, pulps, etc.). The generalized fractional Oldroyd-B constitutive model is frequently used for such viscoelastic fluids. It contains two Riemann-Liouville fractional time derivatives of orders α and $\beta \in (0, 1)$.

The two-dimensional Rayleigh-Stokes problem for a generalized Oldroyd-B fluid is considered in the present work. First and second order approximations of the fractional derivatives are implemented in the developed alternating direction implicit finite difference scheme. Fourth order compact approximation is used for the space derivatives. Extensive numerical experiments are performed in order to investigate the behaviour of the solutions for different values of the parameters α and β.

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