Abstract:
In this work we focus on developing a methodology for the free-to-use software OpenFOAM (R) to simulate non-isothermal viscoelastic flows, which is generally applicable to any mesh type and geometry. The methodology is validated by simulating non-isothermal viscoelastic flows in 4:1 axisymmetric contractions, in which the viscoelastic fluid is governed by the Oldroyd-B constitutive equation. The thermorheological modeling may vary between pure energy elasticity and entropy elasticity depending on a predetermined split coefficient. The temperature-dependent viscosity and relaxation time are modeled using the WLF (Williams-Landel-Ferry) relation. The governing equations are discretized in OpenFOAM (R) using a collocated finite volume method. The DEVSS technique is employed for stabilization of the numerical algorithm at high Deborah numbers. An extrapolation method is proposed for the viscoelastic stress on solid walls, which is subsequently being evaluated regarding accuracy and stability. Next, flows in axisymmetric 4:1 contractions with a temperature jump at the contraction are simulated, similar to the studies of Wachs and Clermont (2000) [24] The influence of the Deborah number and the temperature jump on the flow behavior, such as the vortex length, is examined. Furthermore, the asymptotic behavior at the singularity
is examined for different Deborah numbers. (C) 2012 Published by Elsevier B.V.

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