Smith, M. D.; **Armstrong, R. C.**; **Brown, R. A.**; **Sureshkumar, R.**

Finite element analysis of stability of two-dimensional viscoelastic flows to three-dimensional perturbations. (English) Zbl 0990.76047

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From the summary: We present numerical methods for the analysis of stability of two-dimensional steady viscoelastic flows to small-amplitude, two-dimensional and three-dimensional disturbances based on finite element calculations of the steady base flow and the perturbation. Direct time integration of linearized equations of motion and iterative calculation of the most dangerous components of eigenspectrum are tested. Finite element discretizations based on DEVSS-G finite element discretization together with Newton's method are used to compute steady-state solutions. Two different time integration schemes are tested for computing the time evolution of general random disturbances: a θ-method operator-splitting scheme, and a fourth-order Runge-Kutta method. For both time integrators, time stepping is decoupled into a solution of a modified Stokes problem and an evaluation of time-dependent constitutive equation. The overall efficiency of both methods is extremely high, as is the potential for implementation on parallel computers.

MSC:

76M10 Finite element methods applied to problems in fluid mechanics
76E99 Hydrodynamic stability
76A10 Viscoelastic fluids

Keywords:

theta-method operator-splitting scheme; stability; two-dimensional steady viscoelastic flows; linearized equations of motion; eigenspectrum; DEVSS-G finite element discretization; Newton's method; different time integration schemes; fourth-order Runge-Kutta method; modified Stokes problem; time-dependent constitutive equation

Software:

ARPACK

Full Text: DOI