Time discretization in visco-elastodynamics at large displacements and strains in the Eulerian frame

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The fully-implicit time discretization (i.e. the backward Euler formula) is applied to compressible nonlinear dynamical models of viscoelastic media in the Eulerian description, i.e. in the actual deforming configuration. The Kelvin-Voigt rheology or also, in the deviatoric part, the Jeffreys (also called anti-Zener) rheology are considered. Both a linearized convective model at large displacements with a convex stored energy and the fully nonlinear large strain variant with a (possibly generalized) polyconvex stored energy are considered. The time-discrete suitably regularized schemes are devised for both cases. The numerical stability and, considering the multipolar 2nd-grade viscosity, also convergence towards weak solutions are proved, exploiting the convexity of the kinetic energy when written in terms of linear momentum instead of velocity. In the fully nonlinear case, the examples of neo-Hookean and Mooney-Rivlin materials are presented. A comparison with models of viscoelastic barotropic fluids is also made.

For reference see the arXive preprint no. 2407.18799
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