6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

Approaches to viscoelasticity at large deformations

Ralf Landgraf*, Jörn Ihlemann

Chair of Solid Mechanics, Chemnitz University of Technology, Reichenhainer Straße 70, 09126 Chemnitz, Germany, ralf.landgraf@mb.tu-chemnitz.de, www.tu-chemnitz.de/mb/FestKoerpMech

Keywords: *Viscoelasticity, Large deformation, Phenomenological behaviour, Numerics*

In non-linear solid mechanics, a variety of modelling approaches for the simulation of viscoelastic material behaviour at large deformations exists. Thereby, complex viscoelastic behaviour over a wide range of frequency or relaxation spectra can be simulated by models consisting of numerous parameters. One special case of viscoelastic models is the so called Maxwell fluid, which, from a point of view of rheological elements, is the series connection of an elastic spring and a viscous dashpot. All modelling approaches at large deformation are able to reproduce the basic phenomenological behaviour of the Maxwell fluid, e.g. relaxation to zero stress within a relaxation test, among others. However, the specific stress response differs between the different modelling approaches, especially in the case of large strain loading.

In this contribution, some of the modelling approaches to viscoelasticity at large deformations are seized. In particular, specific models representing the phenomenological behaviour of the Maxwell fluid are analysed in view of their phenomenological behaviour, the efficiency of numerical time integration algorithms and the feasibility of model extensions, like the application of hyperelastic relations with pronounces non-linear behaviour. The analyses are conducted on approaches provided within commercial finite element codes as well as on approaches widely applied in scientific literature. This, for example, includes an approach based on the multiplicative decomposition of the deformation gradient [1] as well as an approach of physically linear viscoelasticity at large deformations [2, 3, 4].

REFERENCES

[1] A. V. Shutov, R. Landgraf and J. Ihlemann, An explicit solution for implicit time stepping in multiplicative nite strain viscoelasticity. *Comput. Methods Appl. Mech. Eng.*, Vol. **265**, pp. 213-225, 2013.

[2] J. G. Oldroyd, On the formulation of rheological equations of state. *Proc. Royal Soc. A*, Vol. **200** No. 1063, pp. 523-541, 1950.

[3] B. D. Coleman and W. Noll, Foundations of linear viscoelasticity. *Rev. Mod. Phys.*, Vol. **33** No. 2, pp. 239-249, 1961.

[4] P. Haupt and A. Lion, On nite linear viscoelasticity of incompressible isotropic materials. *Acta Mech.*, Vol. **159** No. 1, pp. 87-124, 2002.