

On the isogeometric approach for coupled thermomechanical problems at large strain

L. Zhang¹, S. Lejeunes¹, D. Eyheramendy¹

¹LMA, Ecole Centrale Marseille, Aix Marseille Université, CNRS, France, lejeunes@lma.cnrs-mrs.fr, dominique.eyheramendy@centrale-marseille.fr

In this contribution, we investigate isogeometric models for the simulation of dissipative elastomers under coupled thermomechanical loadings. We first study the question of convergence of an isogeometric temperature/displacement formulation in the case of thermoelasticity at small and large strains. In the context of nearly-incompressible behavior we adopt a mixed displacement/pressure/temperature formulation (e.g. [1]). We show that at least in the adiabatic and isothermal case we obtain a stable and convergent formulation that can be compared with other strategies (see for instance [2]). For the thermomechanical case, we discuss about the straight-forward link between perturbed lagrangian variational principles and a thermodynamic approach based on the hybrid free energy. As shown in [3], this approach allows both for a better understanding and fitting of material parameters (isobaric heat capacity for instance) and is able to correctly describe free thermal expansion solution in the context of nearly incompressible behavior. From simple examples, we show that we can simply take into account entropic elasticity, thermal dilatation, viscous damping and self-heating phenomena in a mixed formulation and that we can qualitatively reproduce experimentally observed phenomena (see for instance figure 1).

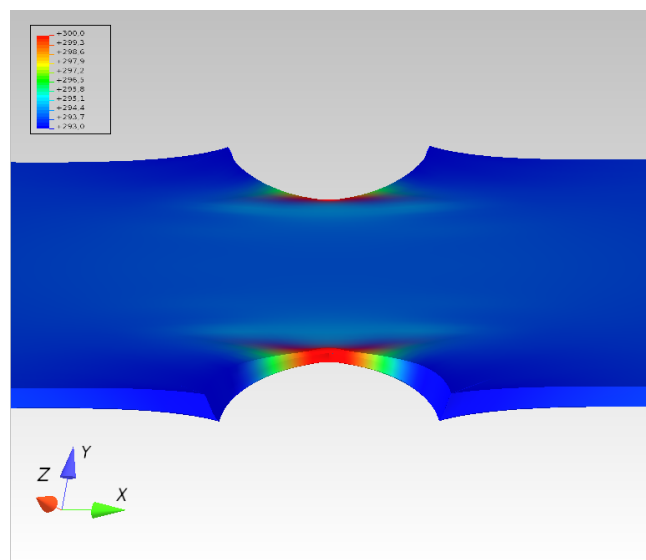


Figure 1 - Temperature field for a notched specimen submitted to cyclic tension

Références

- [1] Zhang, L. ; **On an isogeometric approach for multi-fields coupled problems at finite strain** ; PhD Thesis ; (2016)
- [2] Kadapa, C. and Dettmer, W. G. and Perić, D.; **Subdivision based mixed methods for isogeometric** ; *Comput. Methods Appl. Mech. Eng.*, vol. 305, pp. 241–270, (2016)
- [3] Lion, A., and Dippel, B. and Liebl, C. ; **Thermomechanical material modelling based on a hybrid free energy density depending on pressure, isochoric deformation and temperature.** *International Journal of Solids and Structures* 51 (34), 729 – 73, (2014)