A posteriori control of modelling and discretization errors in thermoelasticity

André Große-Wöhrmann[1] Heribert Blum[2] Marcus Stiemer[3]

The concept of adaptive error control for finite element Galerkin discretizations has more recently been extended from the pure treatment of the discretization errors [1], [2] also to the control of modelling errors [4], [5]. These techniques can be employed for a rigorous justification of the local choice of the model out of a given hierarchy with increasing complexity. In the present talk the concept is exemplified by a hierarchy of models arising out of the scope of thermoelasticity [6]. Significant reduction of the computational complexity can be achieved by a proper choice of the model in different subdomains, automatically chosen by the error estimators. Several error indicators are investigated in the context of goal oriented error estimation. Their efficiency is compared by means of finite element simulations [3].

This project is supported by the Deutsche Forschungsgemeinschaft (DFG) under grant SFB-TR 73 "Sheet-Bulk Metal Forming" (`https://www.tr-73.de`).

References:

[1] M. Ainsworth, J. T. Oden: A Posteriori Error Estimation in Finite Element Analysis, Wiley 2000.
[2] R. Becker, R. Rannacher: An optimal control approach to a posteriori error estimation in finite element methods, Acta Numerica, Vol. 10, pp. 1-102, edited by A. Iserles, Ed., Cambridge Univ. Press, 2002.
[3] W. Bangerth, R. Hartmann and G. Kanschat: deal.II Differential Equations Analysis Library, Technical Reference: `http://www.dealii.org`.
[4] M. Braack, A. Ern: A posteriori control of modeling errors and discretization errors, Multiscale Model. Simul. Vol. 1, No. 2, pp 221-238, 2003.
[5] J.T. Oden, S. Prudhomme: Estimation of Modeling error in computational mechanics, J. Comp. Phys. 182, 496-515 (2002).
[6] P. G. Ciarlet and J.L. Lions (Editors): Handbook of Numerical Analysis (Volume VI): J.C. SIMO: Numerical Analysis and Simulation of Plasticity, North Holland 1998.

[1] Fac. Mathematics, Chair of Scientific Computing, Dortmund University of Technology, Vogelpothsweg 87, 44227 Dortmund, Germany,
`andre.grosse-woehrmann@tu-dortmund.de`

[2] Fac. Mathematics, Chair of Scientific Computing, Dortmund University of Technology,
`heribert.blum@mathematik.tu-dortmund.de`

[3] Hochschule Hamm-Lippstadt, Hamm, Germany,
`Marcus.Stiemer@hshl.de`