A posteriori control of modeling and discretization errors in finite elastoplasticity

Andre Große-Wöhrmann[1]   Heribert Blum[2]

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], [4] also to the control of modeling errors [6]. 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 paper the concept is exemplified by a hierarchy of elastoplasticity models [2], [3], [7]. 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. The method is applied to finite element simulations [5] of metal forming.

References:

[1] M. Ainsworth, J. T. Oden: A Posteriori Error Estimation in Finite Element Analysis, Wiley 2000.

[2] F. Armero: Energy-dissipative momentum-conserving time-stepping algorithms for finite strain multiplicative plasticity, Comput. Methods Appl. Mech. Engrg. 195 (2006) 4862-4889.

[3] F. Armero, C. Zambrana-Rojas: Volume-preserving energy-momentum schemes for isochoric multiplicative plasticity, Comput. Methods Appl. Mech. Engrg. 196 (2007) 4130-4159.

[4] 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.

[5] W. Bangerth, R. Hartmann and G. Kanschat: deal.II Differential Equations Analysis Library, Technical Reference: http://www.dealii.org.

[6] M. Braack, A. Ern: A posteriori control of modeling errors and discretization errors, Multiscale Model. Simul. Vol. 1, No. 2, pp 221-238, 2003.

[7] 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] Dortmund University of Technology, Faculty of Mathematics, Chair of Scientific Computing, Dortmund, Germany,
andre.grosse-woehrmann@tu-dortmund.de

[2] heribert.blum@mathematik.tu-dortmund.de