Increasing Numerical Efficiency in Coupled Eulerian-Lagrangain Metal Forming Simulations

Franz Hammelmüller[*] and Christian Zehetner[*]

[*] Linz Center of Mechatronics (LCM)
Altenbergerstrasse 69, 4040 Linz, Austria
e-mail: christian.zehetner@lcm.at, web page: http://www.lcm.at

ABSTRACT

The Coupled Eulerian-Lagrangain formulation is an efficient tool to model and simulate metal forming processes with large plastic deformations. Frequently, the forming process of cold or hot work pieces is controlled by linear elastic tools. In order to control and optimize such processes with respect to cycle time, life time of the tools and quality of the product, detailed numerical simulation models are necessary. However, in such complex processes simulation time and the numerical effort is very high.

In this paper, several strategies to reduce the simulation time are investigated for the example of a hot cylinder which is pressed into a die by a moving stamp. For this process a three-dimensional Finite Element model is implemented in the software package Abaqus. The linear elastic tools (stamp and die) are represented by Lagrangain three-dimensional continum elements, and the work piece by three-dimensional Eulerian elements. Contact is implemented between tools and work-piece and an explicit dynamic coupled thermo-mechanic simulation is performed.

Implementing the simulation model with all the relevant physical parameters yields a very long computation time. In commercial software tools, e.g. Abaqus, strategies like mass scaling are implemented in order to reduce simulation times. In this paper further strategies have been investigated for reducing the computation time: Besides mass scaling, also time scaling and scaling of thermal properties (e.g. conductivity) has been applied.

Based on the implemented metal forming process, these approaches are compared, and it is shown that by an appropriate scaling of the physical parameters, the simulation time can be reduced by several orders of magnitude without loss of accuracy of the results.

REFERENCES

[1] D.J. Benson, “Computational Methods in Lagrangian and Eulerian Hydrocodes,” *Computer Methods in Applied Mechanics and Engineering*, **99**, 235–394 (1992).

[2] L. Stanier, Q. Yang, M. Ortiz, "On the variational formulation of nonlinear coupled thermomechanical constitutive equations and updates", Proceedings of VIII International Conference on Computational Plasticity (COMPLAS VIII), E. Onate and D.R.J. Owen (Eds), Barcelona (2005).