Electromagnetic Forming of Metallic Sheets

Dieter Weise[1], Dalibor Lukáš[2]

[1]) Fraunhofer IWU, Chemnitz
dieter.weise@iwu.fraunhofer.de
[2]) VŠB-Technical University of Ostrava
dalibor.lukas@vsb.cz

We present a collaborative project between the Faculty of Electrical Engineering and Computer Science of the VŠB-Technical University of Ostrava and the Fraunhofer Institute for Machine Tool and Forming Technologies (IWU). Since the establishment of the IWU in Chemnitz, research on the theoretical basis of innovative sheet metal forming methods and the transfer to operational practice is one of the core competences of the Institute. In the field of incremental forming the IWU is one of the worlds leading institutes. Concerning the expansion of forming limits, tool development and control especially for large sheet metal parts the IWU has a leading position in the forming community.

The smart application of electromagnetic forming (EMF) enables the realization of complex sheet metal parts. It is particularly suitable for aluminium alloys, because of their good electrical conductivity. However, EMF is currently limited to small components and component sections, since the required energy and thus the load on all machine and tool components increases with larger part dimensions, making the development of durable machines and tools increasingly complex and ultimately impossible. This is where the principles of conventional incremental sheet metal forming come into play, especially with regard to individualized components. The Sequentiel ELectromagnetic Forming (SELF) project combines the advantages of both processes in order to extend the respective limits of the individual processes. As its results, suitable settings and procedures for future incremental electromagnetic forming processes, basic machine concepts and verified design and simulation strategies have been developed with which it is possible to optimally form large-area components and thus make use of the already known process advantages of electromagnetic forming for a new spectrum of components.

The mathematical part of the project includes simulations of transient eddy current problems by means of a symmetric coupling of finite and boundary element methods. This is an essential step in modelling of electromagnetic forming of metallic sheets. The finite element method is employed in the conducting region. The boundary element method relies on the Stratton-Chu representation formula and it models the electromagnetic field in the air including its decay at infinity. We impose external currents by the Biot-Savart law. The eddy current simulations are postprocessed with finite element transient heat simulations and elastodynamics of the metallic sheet.

Acknowledgement. The IGF project 173 EBR SELF of the Research Association Forschungsgemeinschaft Werkzeuge und Werkstoffe e.V. - FGW, Papenbergerstrae 49, 42859 Remscheid has been founded by the AiF under the industrial Community Research (IGF) program from the Federal Ministry of Economics and Energy on the basis of a decision of the German Bundestag.