6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 – 15 June 2018, Glasgow, UK

NUMERICAL DESIGN FOR PRIMARY SHAPING MANUFACTURING PROCESSES

S. Elgeti[1], M. Frings[1] and F. Zwicke[1]

[1] Chair for Computational Analysis of Technical Systems (CATS), CCES, RWTH Aachen University
52062 Aachen, Germany, elgeti@cats.rwth-aachen.de, http://www.cats.rwth-aachen.de

Key Words: *Injection Molding, High-Pressure Die Casting, Shape Optimization, CFD.*

Using a mold or die, primary shaping manufacturing processes form material from an initially unshaped state (usually melt) into a desired shape. All of these processes have in common that the exact design of the mold cannot be determined directly and intuitively from the product shape. This is due to the non-linear behavior of the material regarding the flow and solidification processes. Consequently, shape optimization as a means of numerical design can be a useful tool in mold development.
The core of our optimization tool [1] is the in-house flow solver XNS, which is based on the finite element method with GLS stabilization. It is able to exploit the common communication interfaces for distributed-memory systems. XNS has been coupled with the optimization framework NLOPT [2]. Furthermore, a geometry kernel has been developed, which internally describes the geometry of the mold in a CAD-based fashion.
The optimization tool has been applied to three melt-based manufacturing processes: plastics profile extrusion, injection molding and high-pressure die casting.
Topics discussed will be our approach to shape optimization as well as methods for simulating the flow through, in and behind the mold/die [3]. Recent examples in 2D and 3D will compare different design objectives, material models, and geometry descriptions, giving insight into the influence of these factors on the optimization result.

REFERENCES

[1] S. Elgeti, M. Probst, C. Windeck, M. Behr, W. Michaeli, and Ch. Hopmann, “Numerical shape optimization as an approach to extrusion die design”, *Finite Elements in Analysis and Design*, Vol. **48**, pp. 35-43, (2012).

[2] S. G. Johnson, The NLopt nonlinear-optimization package, http://ab-initio.mit.edu/nlopt.

[3] R. Siegbert, N. Yesildag, M. Frings, F. Schmidt, S. Elgeti, H. Sauerland, M. Behr, C. Windeck, Ch. Hopmann, Y. Queudeville, U. Vroomen, and A. Bührig-Polaczek, “Individualized Production in Die-Based Manufacturing Processes Using Numerical Optimization”, *Journal of Advanced Manufacturing*, doi:http://dx.doi.org/10.1007/s00170-015-7003-8, (2015).