Coupling FEM and CFD solvers for continuous casting process simulation using preCICE

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ABSTRACT

Modern metal production processes vary significantly from overhauled process routines by a vast amount of improvements and small details. Current production efficiency, quality and quantity targets can only be achieved by ongoing, continuous process improvement. Nowadays, these developments can be supported by means of numerical simulations and research promoting virtualisation. Therefore, it is necessary to have and use validated simulation routines.

The numerical investigation of metal casting processes requires more than just one simulation technique, as e.g. the continuous casting process. In there, liquid metal is continuously poured into a mould while the starting head is slowly moved downwards and a growing metal ingot results. Though, the ingot's outer surface is solidified after the mould, its inside core is still a mixture of liquid, mushy and solid materials.

The mixture of the different physical states of the material demands for different simulation routines. While CFD solvers are capable of representing the material flow and resulting temperature field, FEM simulations are ideally suited to describe resulting deformation in the solid part, internal plastic strains hence final, internal residual stresses in the billet. As a consequence, it is logical to combine a CFD solver with a FEM solver for an ideal numerical representation of the continuous casting process. The coupling of two different solvers – in the present work CFX and LS-DYNA – communicating in two different programming languages, is not an easy task. However, preCICE [1] enables the coupling of the different solvers with a minimum of intrusive functions.

The present work deals with the challenges of developing the adapter for commercial solvers. Hereby, the motivation for coupling of two simulation techniques will be further addressed and shown. Furthermore, the current status of the coupling will be presented. Finally, the outlook will be discussed together with the resulting perspectives on the continuous casting process simulation.

REFERENCES

[1] Hans-Joachim Bungartz, Bernhard Gatzhammer, Florian Lindner, Miriam Mehl, Klaudius Scheufele, Alexander Shukaev, Benjamin Uekermann, "preCICE -- A Fully Parallel Library for Multi-Physics Surface Coupling", *In Computers and Fluids,* Volume 141 (2016), p. 250—258. Elsevier.