"*Adaptive Mesh Refinement in Filling Simulations Based on Level Set*"

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**Abstract**

Mould filling is an important stage of die-casting and injection moulding, which are the most commonly used manufacturing processes for producing metal, polymeric and ceramic components. It plays a part in determining the quality of these produced components, due to the fact that many defects of them occur during the filling stage. As a consequence, the numerical simulation of this process based on computational fluid dynamics is of great significance for the production engineering [1]. However, modeling of the mould filling is a tremendously demanding process, because many complex physical phenomena, such as the two-phase flow, the propagation of an interface, the surface tension etc., should be taken into account.

The governing equations for the two-phase flow during the filling stage are the transient, incompressible Navier-Stokes equations, since we assume that the fluids of our interest are incompressible and Newtonian. We use a stabilized finite element method in combination with space-time meshes in order to discretize them. For the description of the moving front, an interface capturing method based on the Eulerian formulation, such as the Level-Set method, is used, because of its inherent ability to account for topological changes of the interface [2]. The interface is described implicitly by the Level-Set field on a fixed mesh.

Our goal is the temporal refinement in the region of the evolving interface, in the context of a space-time finite element discretization. 4D simplex-based space-time grids will be used within the framework of this adaptive refinement. The method for generating this type of meshes has been already described in [3]. This adaptive mesh refinement gives us the flexibility to use variable time step for our simulations. The numerical examples, used for validating this refinement scheme, involve the benchmark cases of a static drop inside a square domain, a rising bubble in a rectangular domain and the filling of mould cavities.

This is a joint work with Markus Frings, Loic Wendling and Stefanie Elgeti under the supervision of Prof. Marek Behr at RWTH Aachen University, CATS.

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