Numerical Modelling and Optimization of High Pressure Die Casting Processes using OpenFOAM with RISE

Introduction:

High-pressure die casting (HPDC) is a process in which molten metal is forced under pressure into a metal mold cavity, where it remains in place within the mold until the metal cools and solidifies. The demand is driven by an increased use of aluminium in car bodies, electric drivetrains, and battery boxes with the common desire to reduce the weight of the components. HPDC is a critical manufacturing process known for its complex fluid flow and heat transfer dynamics. This master's thesis project aims to employ the open-source computational fluid dynamics (CFD) software, OpenFOAM, to develop a comprehensive numerical model of HPDC. The focus will be on simulating and optimizing the fluid flow, heat transfer, and solidification aspects of the process to improve casting quality and production efficiency.

Research Goals:

The goal of this research project is to

- Utilize and further develop a detailed numerical model of the entire HPDC process, encompassing the filling, solidification, and cooling phases using OpenFOAM framework to simulate the fluid flow, heat transfer, and phase change phenomena.
- Process Parameter Optimization: Investigate the influence of various process parameters (e.g., injection speed, die temperature, pressure profile) on the final casting quality.
- Employ optimization techniques to determine the optimal set of parameters that minimize defects and maximize part quality.

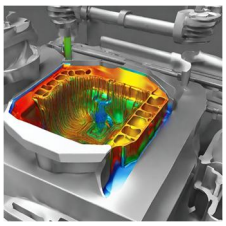
Methodology:

The proposed research project will use the OpenFOAM framework to simulate the fluid flow, heat transfer, and phase change phenomena in HPDC. Herein, various optimization techniques will be evaluated for improvement of the simulation process.

Prerequisites & Suitable background:

• Students in the final year of their M.Sc. program in Mechanical Engineering, Engineering Physics, Mathematics or similar.
• Skilled in fluid dynamics and numerical analysis.
• Accustomed with CFD/OpenFoam.

Contact: Erdzan.hodzic@ri.se & Rixin.yu@energy.lth.se



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