

Proposal for the Master's Thesis/Project Work

CFD simulation of conjugate heat transfer during the cooling stage of the Aluminothermic welding process

CFD Simulation des konjugierten Wärmeübertragung während der Abkühlphase beim Aluminothermischen Schweißverfahren

Aluminothermic (AT) rail welding presents a particular challenge in numerical modelling as it involves numerous physical phenomena that occur simultaneously and are strongly coupled. The cooling phase, in particular, is crucial for the quality of the weld joint, as it significantly influences solidification process, micro-structure formation, and ultimately the mechanical properties of the weld. The aim of this project is to numerically predict this cooling stage using the open-source CFD code OpenFOAM® in combination with the multi-physics coupling library preCICE. By coupling suitable OpenFOAM® solvers, the conjugate heat transfer (CHT) between the molten metal, the mould, the rail, and the surrounding regions shall be investigated. This project contributes to the advancement of coupled simulation methods providing a deeper understanding of the thermal conditions involved during the AT welding process.

The main objectives of this project work are as follows:

- Literature review on CHT coupling und preCICE
- Familiarisation with OpenFOAM® und preCICE
- Selection and preparation of reference cases for validation
- CAD model creation and grid generation
- Simulation, Implementation and Validation of the Heat transfer models and coupling methods (intern, preCICE)
- Simulation of the cooling phase
- Documentation and evaluation of the results

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