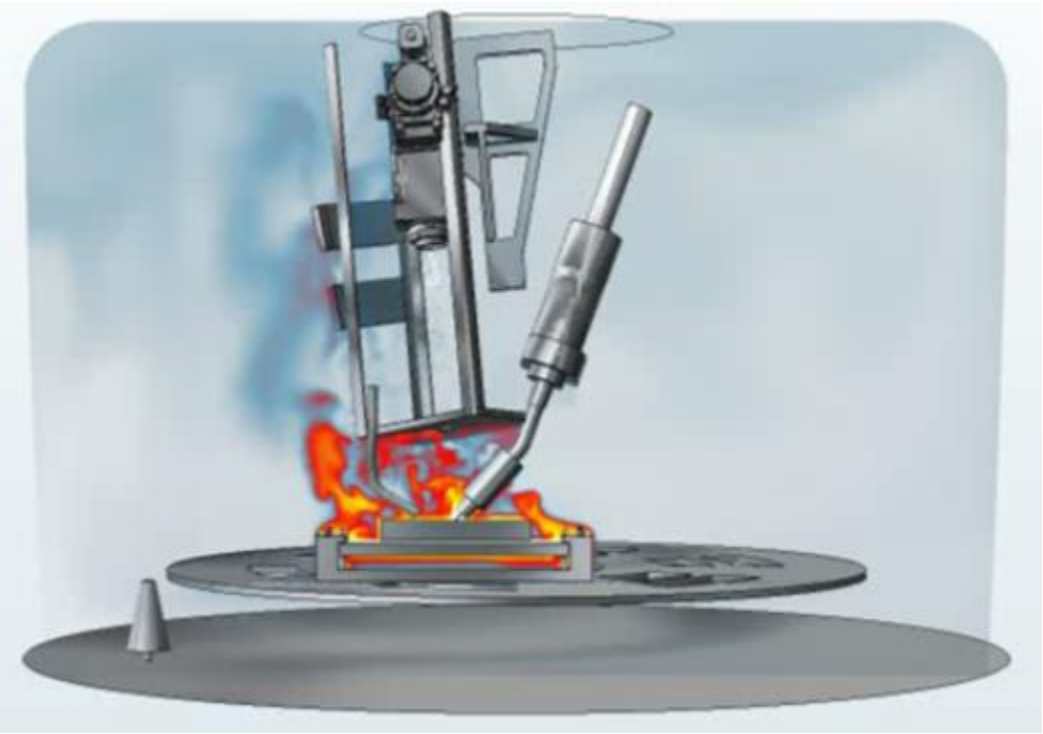
Master Thesis - “Aero-thermo Analysis of Laser Metal Deposition – Wire (LMD-w)”

(30 credits/20 weeks – x1 student)

About us

GKN Aerospace is the world’s leading multi-technology tier 1 aerospace supplier. With 55 manufacturing locations in 15 countries, we serve over 90% of the world’s aircraft and engine manufacturers. We design and manufacture innovative smart aerospace systems and components. Our technologies are used in aircraft ranging from the most used civil aircraft to the world’s advanced 5th generation fighter aircraft and the Ariane orbital rockets used by ESA.



Project Background

3D printing or additive manufacturing has been developing for several decades, however when faced with high-grade material such as Ni- and Ti-based superalloys there is still work to be done. This is valid for process parameters such as; speed, layer height, power, temperature etc., material decomposition and machine design as well. There are several additive manufacturing processes, including powder bed fusion (PBF, L-PBF – binderjet technology) and laser metal deposition (LMD, LMD-w – direct energy deposition technology). This thesis will look into the LMD-w process and particularly focus on analysing the condition in the machine while in operation - to ensure mechanical properties of the build and speed of operation (cost).

Assignment Description

Commercial CFD software will be used to access the built condition. Flow-field, temperature and specie composition will be calculated, analysed and compared with set values for process operations. To reduce the complexity, the simulations will. initially, be steady-state with the built fixed in space for a given geometry. Process operating prarameters such as; power of the laser, flow of the shielding gas (argon), and operating conditions (V, p, T of protective cover) etc. will be maintained, however as the work progress we will perform sensitivity analysis (DoE) possibly using OptiSLang. If the project advances quickly, transient condition will be added to simulate the movable laser/built. The purpose of the thesis is to understand the conditions prevailing in the build-zone,

and based on that recommend changes in process parameters, design of the machine; laser head, shielding gas injection etc. to enhance material properties, increase manufacturing roboustness and reduce cost.

- Content
    - Literature survey including studying previously performed simulations
    - Gathering operating data, CAD-model, measured data etcs
    - Simulating the weld-zone condition using simplestic boundary condition and fluid properties
    - Improve the simulation accuracy by adding radiation (in addition to convection and conduction), including species, varying fluid properties, temperature dependent heat source etc.
    - Compare measured data with simulated data
    - Evaluate whether steady-state is valid/accurate enough
    - Perform transient simulation on a sub-model
    - Document the findings in a thesis report
- Project milestones and delivables
    - Literature survey
    - Mid-term review/presentation (after initial simulations are performed)
    - Final presentation (at GKN and UNI)
    - Thesis report

The thesis is set to start as soon as possible in the new year (2025) and finish by summer 2025, for a duration of 20 weeks.

Qualifications

- Bachelors degree
- Courses with aerothermodynamics content including numerics and computational. Preferable a course with commercial CFD software

Apply by

Send your resume and cover letter to Jonas.Bredberg@gknaerospace.com (supervisor) or Richard.Avellan@gknaerospace.com (manager GTC)

Last date for application: 2024-12-30