Master Thesis (1 year): Multi-physics modelling of the Laser Powder Bed Fusion Process on a meso scale

Background & Research question

To date the research and development in metal LPBF have been to a large extent driven by experimental technologies. For geometry independent studies, easy-to-be-printed specimens are often used as test samples. In this case the risk in build failure and area fraction of defects are usually low, and experimental investigation normally suffices. But for temperature driven phenomena, which are geometry dependent, combined efforts in simulation and modelling over several lengths scales to interpret empirical data and to correlate to field experience and the experimental results available. The physics complexity of the LPBF process demands multiscale modelling strategies framed in a comprehensive validation framework. The modelling concepts on micro, meso, and macro scale are described in [1].

Objective & Work description

The objective of the thesis is to develop a *FEA* p*rocess- melting and solidification model* on the meso scale, i.e. scan pattern level. Furthermore, verified the simulation results and validate the methodology using a combination of novel in-situ monitoring data analysis and post manufacturing experiments. The meso scale model is to be integrated in a multiscale simulation methodology.

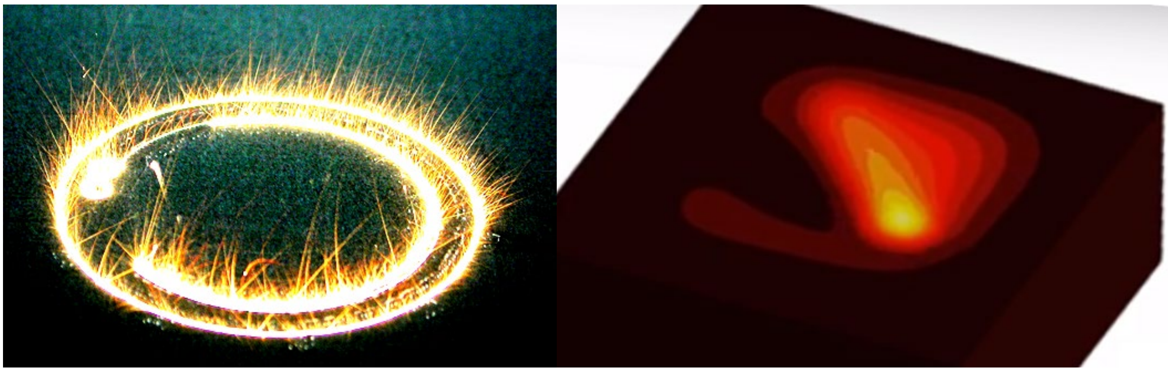

Figure 1 Left: Picture of Laser scanning. Right: temperature response from a meso scale model.

Qualifications

Computational continuum mechanics and programming. Knowledge in Python programming language, metallurgy and material mechanics is meritorious.

Start of the thesis work: Based on agreement
Time frame: The thesis covers 60 credits / 40 weeks
Contact:

Prof. Ragnar Larsson (ragnar.larsson@chalmers.se)
David Ohlsson (david.ohlsson@ri.se)

[1] M. Bayat, W. Dong, J. Thorborg, A. C. To, and J. H. Hattel, “A review of multi-scale and multi-physics simulations of metal additive manufacturing processes with focus on modeling strategies,” *Additive Manufacturing*, vol. 47, Nov. 2021, doi: 10.1016/j.addma.2021.102278.