

Professorship of Laser-based Additive Manufacturing

Digital Twin in Metal Additive Manufacturing: Synchronization and Automation in Process Monitoring

Initial situation

The Professorship for Laser-based Additive Manufacturing is researching innovative concepts in Laser-based Powder Bed Fusion of Metals (PBF-LB/M), an Additive Manufacturing process that creates components by successively melting metal powders in layers with a laser.

The EU research project InShaPe, within the framework of which this work is being carried out, focuses on establishing a "first-time-right PBF-LB/M" process that will make Additive Manufacturing with metals significantly faster, cheaper, and more sustainable. This is achieved through two innovations: an AI-based beam shaping module that enables the adjustment of the intensity distribution of the laser beam, and a multispectral camera for process monitoring.

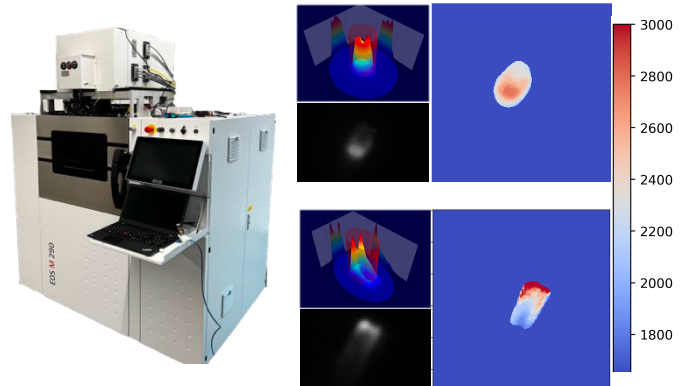
Aim and content of the work

The main objective of this thesis is to synchronize multispectral imaging (MSI) data with process information, automate the monitoring system, and develop a digital twin—a comprehensive 3D representation of the process incorporating temperature data. The work will involve devising a conceptual framework and implementing programming solutions to link melt pool images accurately to the process, utilizing advanced temperature calculation algorithms.

As part of this thesis, you will collaborate with a highly motivated team on a unique and innovative system concept with strong industrial relevance and diverse challenges.

Thesis Work Packages (WP):

WP1: Literature review of AM process monitoring and process automation.



WP2: Refine the current synchronization framework.

WP3: Implement and validate the synchronization of MSI data with the PBF-LB/M process

WP4: Develop an automated software package for process monitoring

WP5: Develop a digital twin to visualize synchronized process data, incorporating 3D information and temperature mapping.

WP6: Discussion and documentation.



Requirements / Application documents

- Programming skills and data management.
- Communication and problem solving abilities.
- A keen inclination towards experimental design and an analytical approach to research.
- A willingness to spearhead AM experiments.

Please send your application with your **CV**, a brief **motivation letter** and a **current transcript of grades** to:

Contact

Ruihang Dai, M.Sc.
ruihang.dai@tum.de