

Research Internship / Bachelor Thesis / Master Thesis

# In-Situ Stand-Off Distance Estimation and 3D Geometry Reconstruction for Plasma-Based DED

## Background

In plasma-based Directed Energy Deposition (DED), the stand-off distance between the deposition head and the current layer surface strongly influences powder catchment, energy input, layer geometry and process stability. Previous work at the chair has investigated image segmentation from horizontal and vertical camera views to extract geometry-related process information. A next step is to develop a more robust and cost-efficient approach for estimating stand-off distance and reconstructing the evolving layer geometry during the process.

## Aim

The aim of this thesis is to investigate methods for in-situ stand-off distance estimation and/or 3D geometry reconstruction during plasma-based DED. A central question is whether reliable distance or geometry information can be obtained without relying on expensive camera systems, for example through low-cost optical sensors, camera-based image processing, structured-light concepts or sensor fusion. Depending on the thesis level, the focus can be placed either on method evaluation and proof-of-concept implementation or on a more advanced reconstruction and control-oriented framework.

## Tasks

- Literature review on stand-off distance monitoring, geometry reconstruction and process monitoring in DED
- Review of previous segmentation work using horizontal and vertical process images
- Definition of suitable sensor concepts for distance or geometry estimation
- Evaluation of possible low-cost alternatives to high-end camera systems
- Implementation of an image- or sensor-based distance estimation pipeline
- Calibration and validation using reference geometry or controlled experiments
- Reconstruction of layer height / surface geometry from in-situ data
- Assessment of accuracy, robustness and suitability for future process control
- Discussion of limitations and recommendations for implementation in plasma-based DED

## Your profile

- Interest in additive manufacturing, process monitoring and automation
- Programming skills in Python or MATLAB
- Knowledge/experience of image processing, computer vision or sensor data analysis
- Experience with OpenCV, 3D reconstruction, calibration or machine learning is beneficial
- Basic understanding of robotics, manufacturing processes or control systems is a plus
- Independent and structured working style

## Contact

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