Laser Powder Bed Fusion manufacturing of ferromagnetic materials

Master (PDM) project or internship, Fall 2022

Collaboration CSEM – EPFL (Neuchâtel)

Laser Powder Bed Fusion (LPBF) is a fast evolving metal Additive Manufacturing (AM) process used in industries such as aerospace, automotive, biomedical and energy. One of the biggest advantages of the LPBF process is the ability to build high density parts with extremely complex geometries (lattice structures, conformal cooling channels, small features, etc).

In this project we will investigate the possibility to apply LPBF for the production of ferromagnetic parts with complex geometries in order to achieve the long-standing goal of miniaturized magnetics as well as to integrate additional novel functionalities (e.g. cooling channels for hard magnets).

LPBF is a complex manufacturing process. A successful ferromagnetic fabrication requires optimization of a wide variety of parameters such as laser power, scanning speed, layer thickness, laser pass overlap but it is also influenced by other factors such as quality of the powder and the deposited powder bed. In order to produce high density parts, a definition of the processing window must be made and it requires a thorough study of the process <-> microstructure <-> property relationship.
The main objective of this project is to better understand the LPBF processing of ferromagnetic materials and the effect of the processing parameters on the magnetic properties of the printed parts.

During the project the student will be involved in:
1- Preliminary literature search and design of experiment for LPBF fabrication
2- Getting familiar with the LPBF machines available at CSEM and EPFL
3- Investigation of magnetic properties of manufactured parts
4- Density analysis
4- Microstructural study using classical metallography and Scanning Electron Microscopy (SEM)
5- Phase analysis using X-Ray Diffraction
6- Mechanical properties characterization

With the knowledge acquired during this project, as the final objective, we will manufacture a high performance miniaturized magnetic demonstrator (probe) with tailored magnetic properties.

Project type: (paid) master project /internship

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