Implementation of a Model for the Simulation of the Microstructure in Additive Manufacturing (3D Printing)

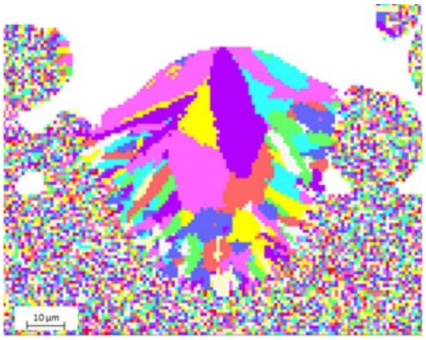
Initial Situation

The process of additive manufacturing – also known as "3D printing" – and in particular laser beam melting (LBM) have proven in recent years to be competitive manufacturing methods for producing customer-specific components with a high complexity.

The LBM process is characterized in particular by the fact that manufactured components have a unique microstructure. The latter significantly influences the mechanical behavior in the later use. In order to be able to estimate the mechanical properties of the components before the manufacturing process, the simulation of the microstructure has proven its worth.

Objective

The aim of the project is therefore to implement a suitable model for simulating the microstructure evolution during the LBM process within an existing simulation tool. For this purpose, the finite element method (FEM) shall be used. As programming languages, the focus shall be on C and Fortran. However, individual implementations in Python may also be necessary.



Microstructure Simulation during the LBM process

Project Schedule

First, the students will be familiarized with the principles of additive manufacturing in general and with the LBM process in particular. In the course of this, the project participants are familiarized with the existing FEM simulation tool.

The next step will be to familiarize them with an existing approach for the simulative representation of the microstructure. The students will be given an overview of the procedure for such an implementation. A suitable model type is the so-called Cellular Automaton (CA) model.

Subsequently, the identified microstructure model will be implemented. For this purpose, the previously learned knowledge will be applied and extended.

The project concludes with the documentation of the results in the form of a joint final report and a presentation on the project contents.

Requirements

- intrigued by additive manufacturing
- interested in FEM and CA modeling
- ideally programming experience in C, Fortran, and Python

Contact

Hannes Panzer, hannes.panzer@iwb.tum.de, Tel.: +49 89 289 15558