

SLM Metal 3D print of AlSi10Mg optimization combining part orientation, support pattern, support placement and residual stress analysis.

Every manufacturer wants to print accurately, in sufficient quality and economically in a first run to eliminate wasted energy, time and material. It currently exists papers working on printed part orientation optimization, which leads to material and time savings. Some of them also include stress analysis. But nobody up to date was considering influence of support structure pattern and positioning to residual stress and part quality.

The goal of this project is to explore influence of support structure parameters to microstructure, macrostructure, and residual stress/distortion in printed part after supports removal. Novelty of this project is in combining part orientation, support pattern and support placement and stress analysis simulation into one optimization process.

Project consist of these steps:

1. Part orientation – 3 weeks

- ~~1. Importing step into MATLAB~~
- ~~2. Parametrically Rotating with object in 2 axes~~
- ~~3. Meshing (cubic)~~
4. Identifying faces and edges which need to be supported.
5. Calculate support volume needed for part orientation.
6. Minimizing support structure volume by altering part rotation.

2. Support structure placement –3 weeks

1. Create database of different support structure types with association to different problems (flat faces, round shapes, long shapes, small shapes...)
2. Make first iteration of rules, which would say which support use in which situation.

3. Stress analysis simulation – 3 weeks

1. Simulation of designed part orientation and supports using ANSYS Additive - simulation of printing process.
2. Output will show residual stress and distortion of designed part orientation and support structure placement.
3. Result should evaluate previous two steps.
4. Iterative process of part reorienting, optimizing support structure placement and simulation should provide optimal solution for part printing process.

4. Testing – 3 weeks

1. Output of previous will be tested on real print process and results of optimized parameters will be compared to unoptimized.
2. Validation of previous steps process.
3. Measure material properties (microhardness, microstructure and macrostructure) at the support placement to determine optimal support pattern and positioning.