

Bachelor's Thesis, Term Paper, Master's Thesis

Smart Tooling: Closing the Design Loop for Self-Heating 3D-Printed Curing Molds

At our chair, we print curing molds for carbon fiber reinforced composites from electrically conductive thermoplastics. When a current is applied, the mold heats itself through Joule heating, with no oven or autoclave needed. How evenly it heats depends on how the material was deposited, because the toolpath defines the local, direction-dependent material properties. We are therefore building an automated design loop of three steps: simulation, assessment and adaptation. The simulation already exists: it reads the G-code, derives a tensor field of the local material properties, projects it onto the simulation mesh and computes the electrothermal behavior. The loop itself, however, does not exist yet.

Your thesis takes the next steps toward closing it. The first focus is making the **existing simulation more robust**, by testing it on varying geometries and toolpaths as well as **validating its results** against thermography measurements on printed samples. On this basis, you will develop a **quality assessment system** as a new module of the automation loop. It defines metrics for heating performance, such as temperature homogeneity, hot spots and deviation from a target temperature field, and rates every simulation result automatically. Together, we will then turn to **geometry adaptation**, the final step of the loop: deriving a concept for how the assessment feeds back into the design, and implementing first approaches where you can bring in your own ideas.

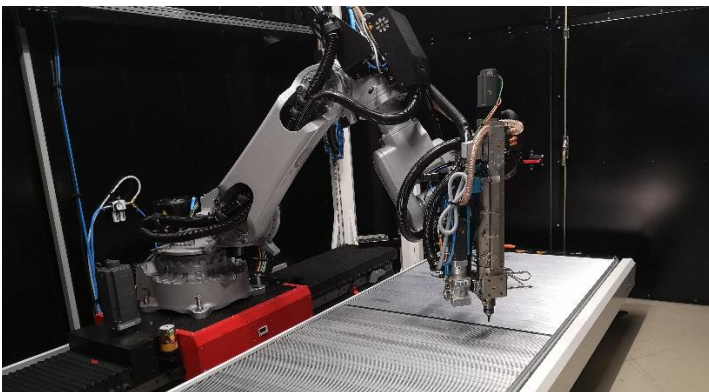


Figure 1: Large Formate Additive Manufacturing System

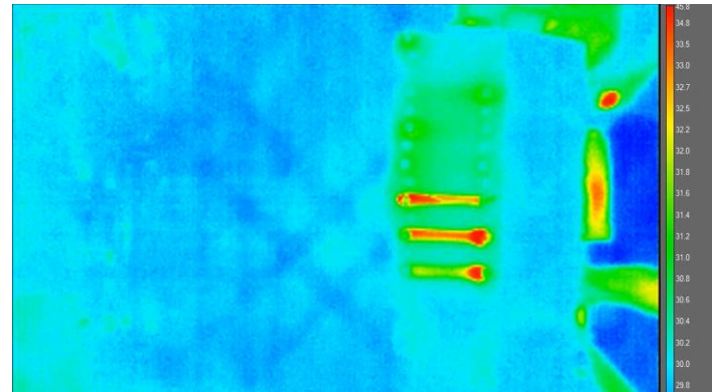


Figure 2: Exemplary Thermal Analysis of self-heating samples

Research focus of the thesis

- Ansys: Thermoelectric simulation and Python interface
- Automated CAD (Grasshopper)
- Research, Documentation and Evaluation

Requirements

- Solid Python skills and experience with FEM
- Understanding of Additive Manufacturing, its influence on material behaviour and g-code
- Self-organized, proactive and reliable way of working

Starting date: immediately

For more details please contact:

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