Chair of Carbon Composites
TUM Department of Aerospace and Geodesy
Technical University of Munich

Bachelor's Thesis / Semester Project / Master's Thesis

Development and testing of carbon fiber reinforced parts printed with robot-based 3D printer

Additive manufacturing provides high flexibility for manufacturing parts with complex geometries. However, manufacturing complex parts using the conventional planar 3D printing method could result in poor surface smoothness (see Fig. 1) and reduce the strength and stiffness of the printed parts [Alsharhan et al.]. Therefore, printing with a 6-DOF robotic arm (see Fig. 2) can be the solution of such limitations by allowing materials to deposit in a 3D free space with desired tool orientation.

The aim of this work is to develop methods to print nonplanar carbon fiber reinforced parts using robot-based 3D printing. This work provides the opportunity to learn about the automation and control of robotic 3D printing. The print speed, extrusion rate, collision-avoidance of trajectory with the printing surface, etc., will be tested for a successful nonplanar 3D printing. Moreover, printing carbon fiber using the conventional planar 3D printing often leads to undesirable fiber orientation and reduced mechanical properties in several directions. The idea of nonplanar 3D printing can then be expanded to position carbon fibers along the desired 3D curvatures for optimized carbon fiber reinforced parts.

Figure 1: Difference in surface smoothness with planar 3D printing (left) and non-planar 3D printing (right) [Ahlers et al.]

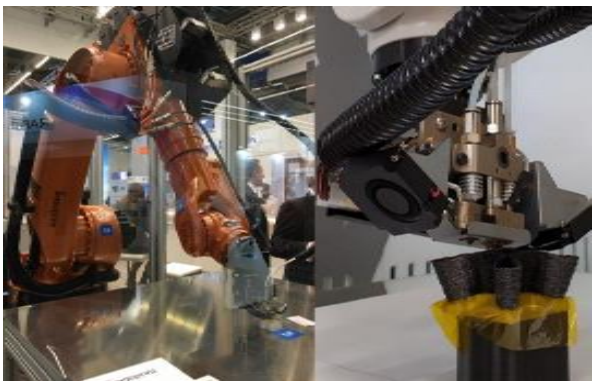

Figure 2: Extrusion-based 3D printing KUKA robot

Research focus of the thesis

- Familiarization with the extrusion-based 3D printing KUKA robot
- Literature review of methods for printing nonplanar carbon fiber reinforced parts
- Testing of parts printed with robot-based 3D printer.
- Documentation of the results

Requirements

- Willingness to do practical works
- Strong interest in additive manufacturing and carbon fiber composites
- Structured and independent way of working

Starting date: Now, flexible

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