PRESS RELEASE

Aachen, October 28, 2021

Real-Time Control of 3D Printing Processes

WZL Research Project Investigates the Use of Sensors and Artificial Intelligence for Model-Based Control in 3D Printing

Additive manufacturing (AM) processes are characterized by their flexibility and possibilities for individual production. By reducing the batch size, thanks to demand-driven manufacturing and the character of additive manufacturing, resources in the form of material, energy and time can be saved along the entire product life cycle, making a significant contribution to sustainability in production. For these reasons, AM is used particularly in lightweight construction and custom manufacturing. However, AM technologies are not yet ready for series production on a broad scale, which is due to the fact that the technologies often do not yet allow reproducible and controllable production of high-quality components and thus require a high level of effort for the qualification of the produced components.

Against this background, the DFG-funded research project "SmoPa3D - Sensor-supported model-based parameterization of 3D printing processes", the second phase of which will start in November 2021, is investigating how the quality of the print can be recorded in the process by integrating laser light-section sensors and how this knowledge can be used for real-time model-predictive control. This will enable the printing processes to guarantee quality despite sudden faults or unsuitable parameterization and to avoid print aborts.

The project, which is being carried out at the Chair of Production Metrology and Quality Management, headed by Prof. Robert Schmitt, follows on from the first phase of the project, in which automatic defect detection was implemented using laser light-section sensors. This measurement system records the individual component layers with a resolution of 50 µm and forms a digital model of the component's condition. By comparing this model with the target model, deviations can be detected which may lead to a reduced quality of the component. Using machine learning methods, the project team was able to show that it is possible to predict quality-relevant characteristics of the final component.

Based on these findings, a real-time capable process control system is to be developed and implemented in the coming funding period. To this end, any deviations that occur will not only be detected, but also categorized according to quality and type. Subsequently, quality-relevant characteristics of subsequent layers will be estimated on the basis of this data and the control parameters of the printer, in order to be able to predict serious defects that lead to reduced component quality or print failure. This knowledge is to be used for the implementation of a process control, which provides for a dynamic correction of the ma

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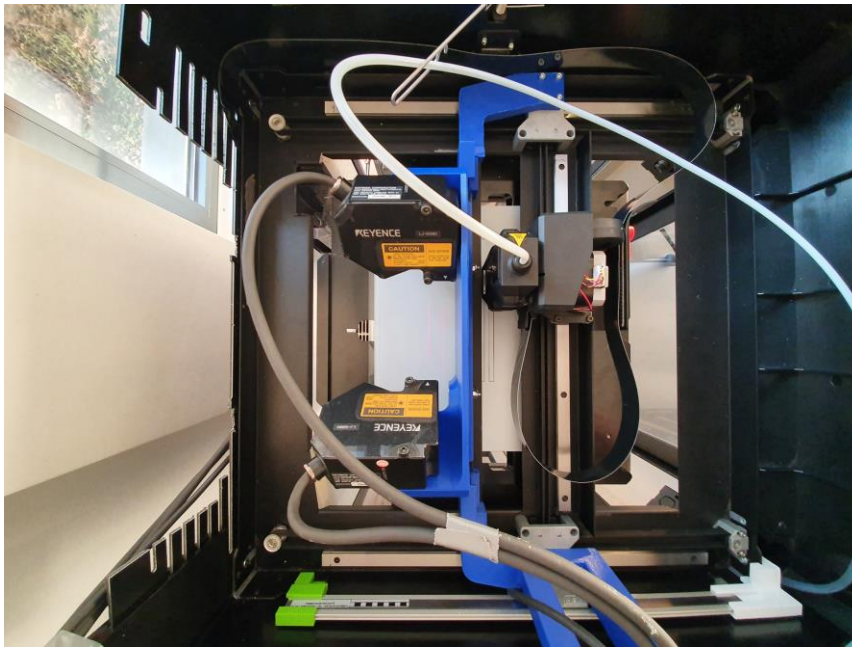
chine code or the control parameters. This will enable automatic optimization of the printer during printing.

"Through data-driven control of 3D printing processes, we hope to achieve greater acceptance for the industrial use of these technologies and thus more resource-efficient production through material savings and avoidance of overproduction," says Jonas Großeheide, research associate at the Chair of Production Metrology and Quality Management at the Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University, about the project vision. Over the next two years of the project, the two-person team, consisting of Hanna Brings and Jonas Großeheide, expects to successfully implement a real-time capable control system on an FDM printer.



FDM printer with implemented laser light section sensors for in-process monitoring (© WZL)

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The Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University enhances the innovative strength and competitiveness of the industry with trend-setting basic research, applied re-search and the associated consulting and implementation projects in the field of production technology. In the research fields of manufacturing technology, machine tools, production engineering, gear technology as well as production metrology and quality management, practical solutions for rationalizing production are developed with industrial partners from a broad range of branches.