



## QUALITY ASSURANCE IN ADDITIVE MANUFACTURING BY MEANS OF DIGITAL IMAGE PROCESSING

### Task

The properties of components made with laser powder bed fusion (LPBF) are unknown while they are being manufactured. In particular, internal defects as well as the actual part geometry can only be determined afterwards by taking additional steps in external quality control. At the same time, the cyclic character of the LPBF process could be used for layer-by-layer process monitoring. Existing approaches to this are already focused on observing thermal emissions.

### Method

Fraunhofer ILT has developed a process monitoring system with a line sensor, which uses the inherent movement of the powder application unit to record images of the cooled process zone layer by layer and line by line. The institute has also developed application-specific image processing algorithms and tested them to identify process deviations and possible defects from the image data.

### Results

Thanks to the detailed resolution of the system, the institute can identify individual solidified melt paths as well as estimate their textures that are closely linked to the resulting component quality. A material-specific “fingerprint” can be extracted from the sensor data; the deviation from the nominal value can be used to infer critical process conditions. By means of machine learning, certain process deviations (e.g. the “balling effect”) can also be detected directly from the image data. The detection of the actual component geometry is made possible by a specially developed approach to image segmentation. In principle, a large number of process deviations can be detected, both inside the part and in the contour area.

### Applications

LPBF is currently used primarily for the production of complex and heavy-duty components, e.g. in medical technology and aviation. Initially, the in-process recording of the process behavior can reduce costly downstream quality controls. In the future, the system could also be used as a basis for the in-situ adjustment of process parameters in order to sustainably increase component quality and to repair or prevent potential defects while the process is still in progress.

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- 2 *Slice image acquired with the system.*  
3 *Line scan camera system integrated in laboratory plant.*