



## PROCESS CHAINS FOR MANUFACTURING AND REPAIR

### Task

Laser-based processes such as Selective Laser Melting (SLM) or Laser Metal Deposition (LMD) are already being used in industry for the additive manufacture and repair of turbomachinery components. Depending on the application, SLM or LMD may require conventional processes such as milling, grinding and polishing for initial or final machining of the components. To link the various process steps, the processes should be combined by setting up a joint platform – the CAx Framework – to create a single process chain. As part of Fraunhofer's »TurPro« Innovation Cluster, end-to-end process chains have been developed for three different components in collaboration with Fraunhofer IPT.

### Method

To implement an end-to-end process chain, interfaces have been created in order to transfer CAD data from process to process without any losses. To this end, a clamping system for the various technologies is used in order to minimize the work involved in calibrating the component in the machine coordinate system. The offline planning of the tool paths and implementation of the process strategy are conducted for each technology by means of a separate CAx module. Commercial CAD/CAM programs for data processing and path planning can be used for the SLM process. Separate CAx modules have been developed in cooperation with Fraunhofer IPT for offline path planning of the additive manufacturing of new components and for repairing components using LMD. In the case of

additive manufacturing, tool paths are generated on the basis of the target CAD model. In the case of repair, the prepared component is scanned using a laser scanner, an actual CAD model generated and compared with the target CAD model. Tool paths for the LMD are then generated by using a best fit of the CAD models.

### Result

The process chains have been implemented for the additive manufacturing of a micro gas turbine using the SLM process, for the additive manufacturing of a compressor blade using a BLISK design, and for the tip repair of a gas turbine blade using the LMD process.

### Applications

The process chains developed within »TurPro« are primarily aimed at turbomachinery components in the energy and aerospace industries. The method can, however, be applied to components and applications in other industries.

### Contact

Dr. Andres Gasser  
Phone +49 241 8906-209  
andres.gasser@ilt.fraunhofer.de

2 Left: compressor blades additively manufactured using LMD in various finishing states. Right: tip of a gas turbine blade repaired using LMD before and after final processing. Front: micro gas turbine components additively manufactured using SLM.