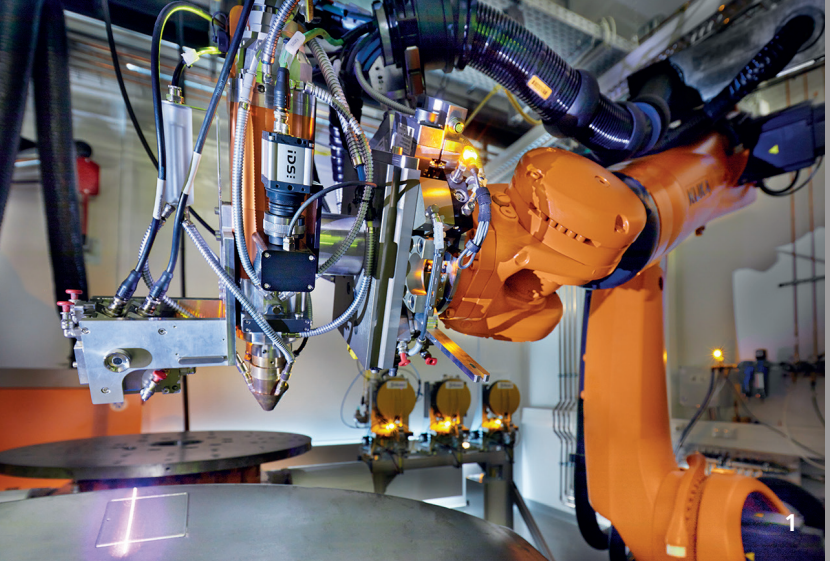

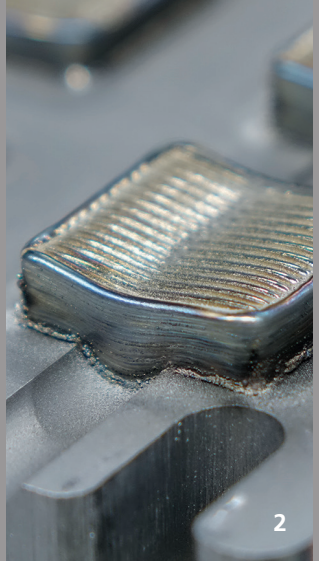

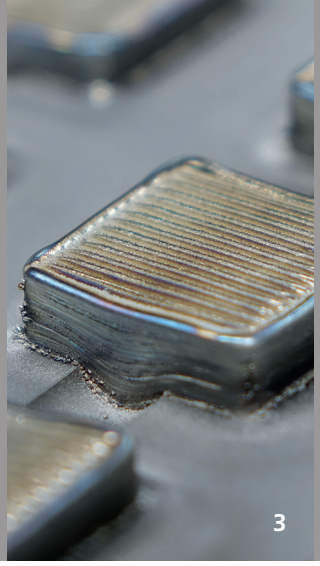

LASER MATERIAL DEPOSITON WITH SELF-ADAPTING TOOL PATH PLANNING

Task

To produce high-quality metal solid bodies, Laser Material Deposition (LMD) has to be operated within a qualified process window. When the ideal distance between the processing head and the substrate deviates, geometric inaccuracies occur in the material volume applied, material quality suffers and the process becomes instable. Often, such differences result from deviations of the real substrate surface from that of the CAD model, the latter of which guides tool path planning. A particular challenge is posed by small deviations in the build-up height of individual tracks, inaccuracies that accumulate in multilayer welds.

Method

By integrating a laser line scanner (LLS) into the LMD system, Fraunhofer ILT is able to digitize the surface topology of the substrate directly in the machine. Based on the 3D scan, tool paths can then be planned using automated algorithms.
To counteract small deviations in track height, geometry is recorded between the build-up of the individual layers and, based on this, the path planning is adapted to the real build-up height. In addition, special path planning algorithms allow local geometric deviations to be counteracted by adjustments to the process parameters.

Results

Fraunhofer ILT has implemented this approach in a software solution that combines machine-integrated geometry acquisition, automated web planning and program generation. The open-machine solution can be used on different industrial machine concepts.

Applications

The software solution developed here, the path generation and the process adaptation could be successfully tested for LMD on freeform surfaces within the ProLMD project (funding code: 02P15B115). In addition, it was successfully demonstrated for repair applications in both the aerospace as well as tool making sectors. In the EVEREST project (funding code: EFRE-0800732), the approach was also qualified for Extreme High-Speed Laser Material Deposition (EHLA) on rotationally symmetric components.

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1 Robot system during geometric acquisition of a welding layer.
2 Machining result with uncontrolled setup.
3 Machining result with controlled setup.