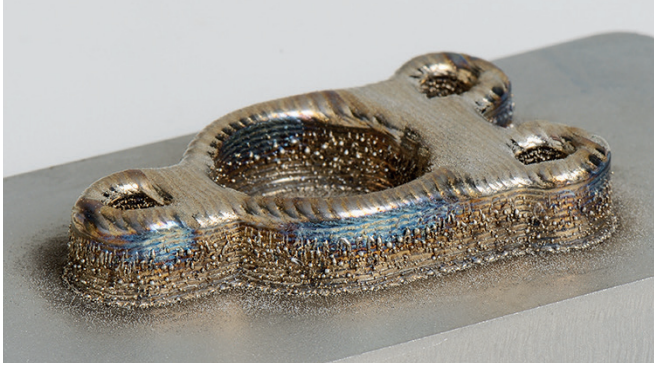
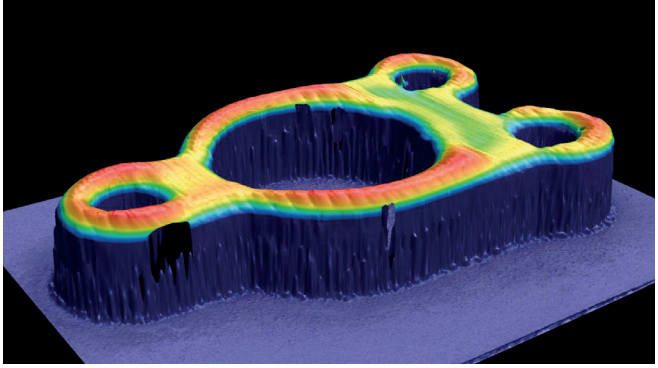
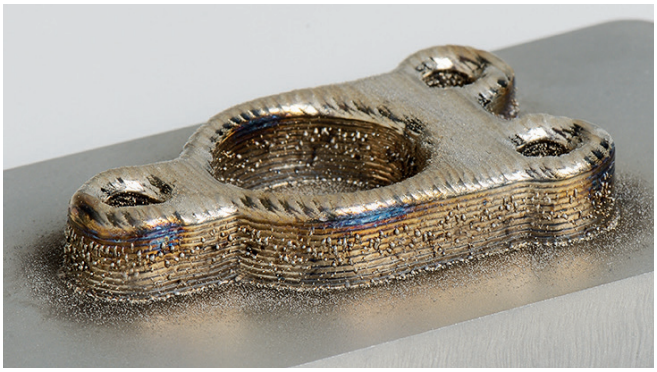
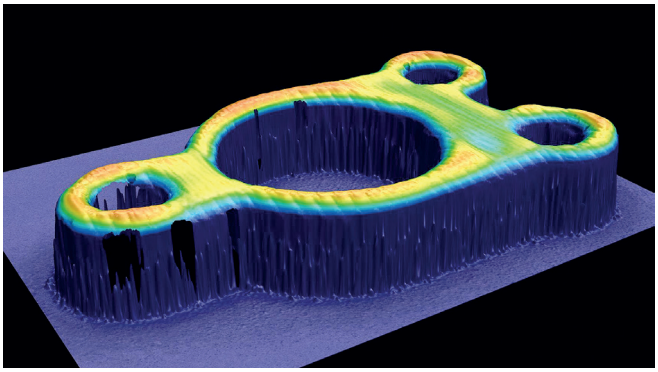

Additive LMD setup without (top) and with (bottom) AI prediction.

AI-based process design in laser material deposition

When components are additively manufactured with powder-based laser material deposition (LMD), the heat in the volume decisively influences process stability and contour accuracy. When process parameters are kept constant, this intrinsic heating leads to thickness deviations in the deposited layers during the process since the melt pool volume changes. If all process parameters no longer interact within the optimum process window, contour deviations in the component can occur, and the process may even stop. Particularly in the case of complex geometries, time-consuming process development is required to adapt the process parameters and build-up strategies.

Step 1: Data acquisition in the process

The melt pool volume in LMD indicates how stable the process is. As a measured variable, the melt pool area can be recorded with a camera integrated into the beam path. In a first approach, the variations in the melt pool area should be reduced by adjusting the laser power in the process. For this purpose, an AI model will first be trained using data from an LMD process with constant process parameters while building a geometrical shape.

Trained AI for greater process stability

The AI model learns correlations between laser power, geometry and other component-dependent influencing factors. The trained AI model can then be used to predict the laser power required for a stable process. This eliminates the need for extensive experiments and evaluations to set suitable process parameters when, for example, the geometry of a component changes. The AI model can significantly reduce process development in LMD by predicting a stable process a priori and is continuously being improved as the amount of data increases. In the future, this model will also be extended to predict other process parameters, such as feed rate. The concept can be used for additive manufacturing, repair processes or coatings.

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