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INFLUENCE OF THE GALVANOMETER SCANNER ON LASER POWDER BED FUSION PROCESS TIME

Task

In laser powder bed fusion (LPBF), highly complex components are produced layer-by-layer by melting the starting material, which is in powder form. The laser radiation is typically positioned over two movable mirrors of a galvanometer scanner in the xy plane to selectively melt the powder. It is known that the non-productive times of the scanner (including jump times and drag delay of the mirrors) have an influence on the process time. As part of a series of tests, Fraunhofer ILT is investigating various types of galvanometer scanners and their influence on the LPBF process time and component quality.

Method

In the examinations, the institute uses three different scanners with different apertures (one 30 mm, two 14 mm) - and thus different sizes and inertia of the mirrors – as well as various control technologies (constant control parameters, dynamic adjustment of the control parameters in the process). With each scanner, identical test components of varying complexity are manufactured with the same process parameters from stainless steel 1.4404 by means of LPBF. The components were examined quantitatively with regard to the resulting process times and qualitatively with regard to the detail resolution of the manufactured components.

Results

As component complexity increases, the processing times between the scanners differ significantly. While the process time from the 30 mm to 14 mm aperture (constant control parameter) is reduced by approx. 5 percent for simple cube geometries, this reduction increases to 28 percent in a complex lattice structure typical of LPBF. With 14 mm aperture scanner and dynamic adjustment of the control parameters, the process time can be reduced by a further 20 percent from a 14 mm aperture scanner with constant control parameters. The manufactured specimens have no visible differences among each other with regard to detail resolution or surface roughness.

Applications

The findings can be used in the design of the optical systems for LPBF systems and make it possible to optimize the control parameters of existing optical systems. In both cases, there is great potential for increasing efficiency, especially when complex components are manufactured.

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3 Galvanometer scanner »excelliSCAN 14« with dynamic control, source: Scanlab GmbH.

4 Test specimens made with different scanners.

Subject to alterations in specifications and other technical information. 06/2019.