



TEMPORAL AND SPATIAL LASER BEAM MODULATION FOR LASER POWDER BED FUSION (LPBF)

Task

The additive manufacturing process laser powder bed fusion (LPBF) makes it possible to produce functional components with almost unlimited geometric complexity. However, its comparatively low productivity inhibits broad industrial use in production. In particular, the use of small laser beam diameters with simultaneous use of large laser powers of up to 1000 W leads to large maximum intensities in LPBF and, thus, to a greater risk of component defects and process instabilities. For this reason, the industry often resorts to using multiple laser scanner systems to increase the productivity of LPBF machines. This, however, is prohibitively expensive. In order to overcome the resulting restrictions of LPBF, Fraunhofer ILT is developing alternative approaches to temporal and spatial laser beam modulation in collaboration with research and industry partners as part of the Digital Photonic Production (DPP) Research Campus.

Method

One possible solution is using a dual fiber laser array in LPBF. In contrast to conventional LPBF, the dual fiber approach uses two individually addressable single-mode fiber lasers, which are deflected via a single galvanometer scanner. With the multi-beam optical system developed at Fraunhofer ILT, the relative orientation of the laser spots can be adjusted flexibly and dynamically. This results in additional degrees of freedom that can be used to increase process productivity in LPBF.

Results

Fraunhofer ILT demonstrated the basic feasibility and potential of LPBF using a dual fiber laser array for processing AISI 316L stainless steel and analyzed it using high-speed images of the LPBF process. Relative component densities above 99.9 percent could be achieved. At the same time, this array was able to double the build-up rate compared to LPBF with a single laser beam source.

Applications

In the framework of the DPP Research Campus, Fraunhofer ILT is researching this approach to improve LPBF together with industrial partners from mechanical and plant engineering as well as users from turbo mechanical engineering.

The work is being supported by the Digital Photonic Production DPP Research Campus as part of the "Research Campus Public-Private Partnership for Innovation" research funding initiative of the German Federal Ministry of Education and Research BMBF.

Contact

Tim Lantzsch M. Sc., Ext: -193
tim.lantzsch@ilt.fraunhofer.de

Jasmin Saewe M. Sc., Ext: -135
jasmin.saewe@ilt.fraunhofer.de

3 Multi-beam optical system for LPBF using dual fiber laser array.