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MEASUREMENT AND CHARACTERISATION OF MULTI-BEAM OPTICS

Task

Micro material processing with ultra-short pulsed (USP) lasers enables a multitude of innovative manufacturing processes based on short interaction times. The small spatial extent of the laser focus of some microns, however, contradicts high productivity. One approach to increase production rate is by using diffractive optical elements to split the laser beam into a multitude of beams. The achievement of required beam properties, though, is a prerequisite for successful manufacturing with high reproducibility at requested quality. Current beam analysis tools are only capable of analysing single beams with high accuracy.

Method

To process materials with USP laser radiation and spot geometries below $10\ \mu\text{m}$ in multi spot configuration, the researchers at the Fraunhofer ILT have implemented an analysis system capable of determining the absolute position of each beam as well as the geometry of the beams themselves. A flat panel sensor with $2\ \mu\text{m}$ pixels is positioned under the focusing optics and measures process-relevant properties of each beam. Image and signal processing algorithms especially developed for the analysis of multiple laser foci extract relevant information about the laser beams from the measurement signals.

Result

The visualisation of the processed measurement data allows a direct inference on positioning errors in the plane and on deviations in intensity distribution in the field. This information enables an efficient and precise adjustment of optical components in the beam path and aids in achieving increased performance of the overall system.

Applications

The multi spot measurement system enables users to determine properties of multiple beams in manufacturing systems for micro material processing. Its use for adjustment and inspection of the optical system facilitates fast set up of manufacturing systems and regular examination of boundary conditions in the manufacturing environment.

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2 Visualisation of multiple beams.

3 Sensor system with attenuator.