Beam Analysis in the scan-field of powder bed laser additive manufacturing systems

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With the rapid development of additive manufacturing to an established industrial manufacturing process, arises an increasing demand for process control. Especially industrial sectors with stringent safety regulations like aerospace, automotive or medicine, require a high level of quality monitoring. The limited space and the variety of possible beam incidence angle and position configurations inherent to laser scanning systems, constitute special framework conditions, only inadequately provided by state of the art beam diagnostic devices.
To meet these requirements we developed a novel and compact measuring instrument capable of addressing scanner specific measurement tasks, including quantities so far inaccessible to conventional beam diagnostics. These involve for example the examination of the field flatness, pincushion distortion, position dependent focal shift, or accuracy of position and marking speed. Even more sophisticated issues like the accurate stitching of two overlapping exposure schemes are feasible.
The working principle is based on a pattern of scattering defects within a glass plate. When scanned across the pattern, a small fraction of the laser beam is scattered and the light collected by means of a photo-diode, allowing the reconstruction of the light path and derivation of the beam width. All above mentioned quantities can be measured with high resolution and reproducibility. We demonstrate measurements at several different scanning field positions. The current state of the experiments is presented, and the prospects of this novel measuring technology for scanner system diagnostics discussed.