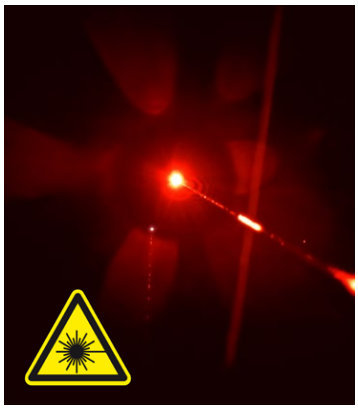
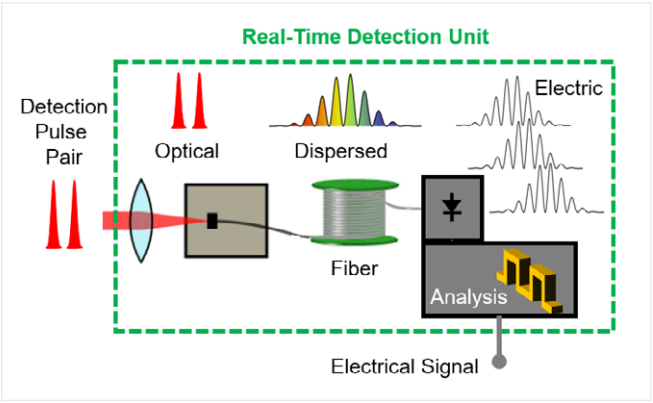
Laser pulse distance measurement in real time (>100 MHz)

Reference No: B78038





CHALLENGE

Fast and precise control of processing depths between the laser head and the workpiece limits the process speed of a variety of potential micro-laser processing operations for ablation, cutting or structuring. This reduces efficiency.

Current measurement methods, based on white-light interferometry or optical coherence tomography, achieve scan rates in the hertz up to kilohertz range - characteristically after machining has been completed or in time-average. However, to accurately modulate or interrupt exposure, many applications require a shot-to-shot monitoring in real time. Wherever irregular inhomogeneous materials (e.g., organic structures or fiber-reinforced components) are processed with high precision, compromises between accuracy and operating speed limit process efficiency. Particularly high demands arise especially in medical eye treatment and skin ablation, but also in battery or solar cell production, where electrical insulation must be ablated in a defined manner.

INNOVATION

The present invention is based entirely on optics and analog electronics. The process achieves real-time process control with extraordinary measurement rates up to over 100 MHz. It is based on spectral interferometry and compares the differences in path lengths in reference and sample paths. The Dispersive Fourier Transform processes the analog signals at unmatched speed. The electrical measurement signal can be directly fed back to change the processing exposure between successive laser shots. The robust technology is based on standardized and cost-effective components.

COMMERCIAL OPPORTUNITIES

The invention enables unprecedented precision and speed in laser processing and microsurgery. Single-shot inspection with real-time feedback enables new processing schemes. The technology allows the use of time-efficient, highly repetitive laser sources, which increases the economic efficiency in the process. Areas of application are in the processing of complex and brittle materials with structural inhomogeneity. These include non-contact surface straightening and free-forming (individual surface height variability), selective ablation, safety-critical applications in electronics (electrical insulation of batteries or organic electronics) or laser eye treatment. Even moving or vibrating workpieces can be precisely processed.

DEVELOPMENT STATUS

A demonstrator for a laser micromachining application with real-time feedback, based on single-shot processing, is currently being implemented. The measurement principle has been successfully proven.

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Technology from
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IP rights:
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