

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

This invention is based 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 low cost components.



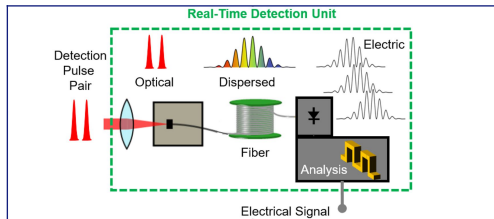
Moving or vibrating workpieces can be precisely processed

Areas of application are in the processing of complex and brittle materials with structural inhomogeneity. These include non-contact surface straightening and free-forming, selective ablation, safety-critical applications in electronics or laser eye treatment.

REFERENCES:

 View Patent Application

- 01 Enables unprecedented precision and speed in laser processing and microsurgery
- 02 Single-shot inspection with real-time feedback enables new processing
- 03 Time-efficient, highly repetitive laser sources increase the economic use
- 04 The Dispersive Fourier Transform processes the analog signals at unmatched speed



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.

IP RIGHTS

EP granted
(DE/FR/GB)
US, CN
pending

2019

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.

INNOVATION

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.

TRL 08

TRL 07

TRL 06

TRL 05

TRL 04

TRL 03

TRL 02

TRL 01

Technology Readiness Level (TRL)

01 Basic principles observed · 02 Technology concept formulated · 03 Experimental proof of concept · 04 Technology validated in lab · 05 Technology validated in relevant environment · 06 Technology demonstrated in relevant environment · 07 System prototype demonstrated in operational environment · 08 System complete and qualified



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