

# Time intervals of laser pulses adjustable for each single pulse - USP lasers included / "pulse on demand"

## Background

Today's pulsed lasers, especially ultra-short pulse (USP) lasers, allow for highly efficient processing (e.g. cutting, micro-drilling, surface texturing, etc.) of a wide variety of materials (e.g. metals, dielectrics, semi-conductors, etc.). Micromachining work can also be carried out at a high level of precision and high processing speeds, even when using sensitive material composites such as carbon fiber reinforced polymers.

However, pulsed lasers are also used for many other applications, e.g. in the field of metrology or in scientific fields.

## Problem

If the relative speed between the laser and the workpiece changes during material processing (e.g. due to directional changes of the beam), the spatial distance between the individual laser pulses on the workpiece will change. This leads to quality inconsistency of machined components and products. To avoid these undesired effects, the laser can be switched off or the laser beam is "dumped" for a short period of time. However, this in turn partly leads to undesired changes in the pulse characteristics. So far, actual approaches have led to reduced quality of the processed parts. The approach developed at the Institut für Strahlwerkzeuge of the University of Stuttgart and presented here now allows users to make a quantum leap in terms of productivity and quality.

## Solution

With the new method, the laser pulses are completely or partially fed into a separate delay unit. By decoupling pulses from the latter at the desired time and overlaying them on the actual beam path composed of one or more pulses, the temporal sequence of the laser pulses can be exactly adapted to the relative speed of the machining station. Conversely, the machining pattern can also be varied in a targeted manner while maintaining the same relative speed.

In addition, it is possible to implement a "pulse on demand" function or a "pulse burst mode".

The system thus opens up a wide range of new design options when using USP lasers in material processing, while maintaining consistent processing quality.

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## Development Status

Concept / TRL2

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## Patent Situation

EP 2544317 B1 granted  
DE, FR, GB validated

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## Service

TLB GmbH manages inventions until they are marketable and offers companies opportunities for license and collaboration agreements.

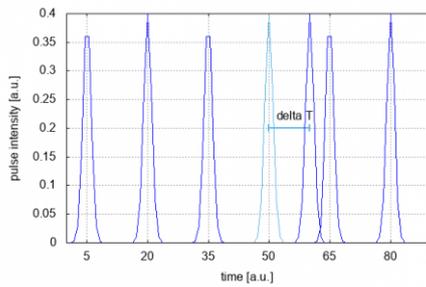


Figure: Schematic example of a shifted laser pulse and thus adjusted time intervals. [Image: University of Stuttgart, IFSW]

### Advantages

- Laser pulse intervals adjustable for each single pulse
- “Pulse on demand“ and “pulse burst mode“
- Lasers can be retrofitted
- Stable pulse energy with high variability of the repetition rate
- Enormous potential to increase efficiency and productivity
- Improved machining quality

### Application

- laser machining
- measurement technology