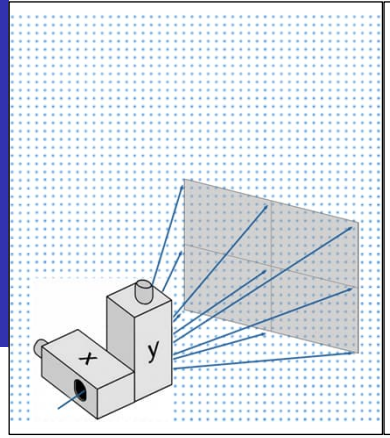
EquaLazer

Real-time control and intensity equalization of two-dimensional laser beam patterns with thousands of laser beams



STATUS QUO

In many applications, laser beam control for spatiotemporal pattern generation relies on acousto-optical components. However, control bandwidth and flexibility for intensity-controlled and multi-beam applications are severely restricted by nonlinearities as well as by interactions in case of controlling multiple beams and multiple dimensions. Current techniques employ pre-calibration and closed-loop control methods, which impede highly dynamic pattern generation.

OUR TECHNOLOGY

EquaLazer implements an innovative open-loop system for programmable acousto-optical laser patterns based on 2D multi-beam trajectories and intensity profiles with microsecond latency. Applying a novel physical model of the acousto-optic response, frequency and intensity of the control signal are updated with nanosecond temporal resolution. Our method eliminates the need for a closed feedback loop and overcomes limitations induced by predefined pattern sets, thereby achieving significant improvements in pattern size, flexibility, bandwidth, and latency.

BENEFITS

- ▶ Parallelization through pattern generation with thousands of simultaneously controlled beams
- ▶ Real-time laser intensity control with high bandwidth for arbitrary spatiotemporal pattern sequences

APPLICATION POSSIBILITIES

Real-time spatial control of multiple parallelized laser beams with low latency for, e.g., optical tweezers and high-resolution imaging techniques in microcopy applications, beam steering in laser material processing, additive manufacturing, and quantum technology.

COMMERCIALIZATION OPPORTUNITIES

There are various possibilities for cooperation between the industrial partner and TU Darmstadt: from an exchange with the know-how carriers of the technology up to a close cooperation in case of further development needs. The technology is protected by intellectual property rights and can be used by the industry partner after a sale or licensing agreement.

CURRENT STAGE OF DEVELOPMENT TECHNOLOGY READINESS LEVEL (TRL)

9	Product ready to launch
8	
7	Prototype
6	
5	
4	Proof of Concept
3	
2	
1	Idea

The technology development is at Level 3-4:

Application in laboratory environment to generate dynamic two-dimensional laser beam patterns with up to 2500 laser beams (50×50)

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