SELF-OPTIMIZING LASER CUTTING MACHINE

Task

As part of the Integrative Production Technology for High-Wage Countries cluster of excellence at RWTH Aachen University, Fraunhofer ILT is involved in the Integration of Self-Optimizing Setup, Monitoring and Control Systems in Production Processes project. The aim of the project is to develop a process-independent methodology that provides a better understanding of the laser machining processes used and to pave the way technologically for the self-optimization of production systems.

Method

The basis for the developments is provided by a detailed process analysis, a definition of the most sensitive process parameters and the identification of a suitable concept for the process sensor system. In self-optimization the metamodel is the central, methodically integrative tool for storing and processing available theoretical and experimental knowledge and for issuing optimized parameters to the process control system. The focus position, which is one of the most relevant process parameters, is subject to thermal changes in the optical elements. Despite the challenge posed by a stationary setting, the focus position opens up the possibility of exerting strong influence on the cutting quality, process robustness and cutting efficiency. A high-speed camera integrated coaxially to the laser beam provides the necessary process data for this.

Result

Various stages of self-optimization were developed on a TRUMPF TruLaser 5030 laser cutting machine as a function of the complexity of the closed-loop control system. In the first stage, external control of the focus position was implemented, enabling the position to be changed without affecting the functionality of the system. To achieve automated referencing of the focus position a concept for a set-up assistance function was developed and largely implemented. Using a high-speed camera the reference value belonging to the position of the minimal gap width is determined from numerous cuts at different focus positions.

Applications

The methodology developed in this project for laser cutting can be applied to a broad range of production processes, for example, injection molding, welding, weaving and milling.

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1 TruLaser 5030 laser cutting machine.
2 Close-up of a cut edge in stainless steel t = 6 mm.