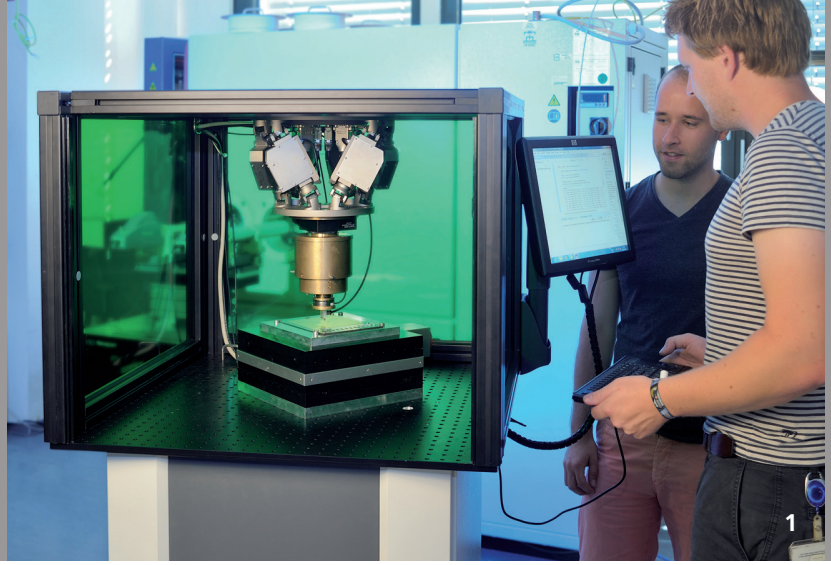

FUNCTIONAL ASSEMBLY OF OPTICAL SYSTEMS

Task

Optical systems in laser technology are mainly adjusted and assembled manually, which causes up to 80 percent of the costs in the value-added chain. In this context, therefore, many are searching for a semi- or fully automated solution. In particular, the tolerances of the optical elements and the joining process have prevented a time and cost-effective, fully automated assembly of optical elements so far.

Method

By means of a tolerance analysis and model-based calculations, Fraunhofer ILT has developed an optimized assembly sequence for the optical components so that the error in the assembly is minimized throughout the entire process. During the adjustment and assembly of the individual optical elements, misalignments are identified thanks to the integration of ray-tracing models in the control of the assembly cell; this can correct such misalignments in the process. For this purpose, appropriate measurement techniques and algorithms are used to detect the direct influence of the optical elements on the desired optical functionality (e.g. beam parameter product). In order to ensure that the system remains flexible, the individual components of the mounting system are interconnected via a multi-agent system. The definition of standard interfaces within this system allows fast and easy changes to the assembly system.

Result

In the early development stages of the mounting system, robotics were successfully coupled to the optical model of a beam shaping system via standardized interfaces so that changes to the optical model directly were implemented in the assembly system. Also, a measurement strategy was developed to record the functionality and influence of optical elements in the system.

Applications

The results can be used in the assembly of laser systems for small quantities with the aim achieving full automation. The developed algorithms can be modified and adapted to other alignment applications.

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1 Assembly cell for laser systems.

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