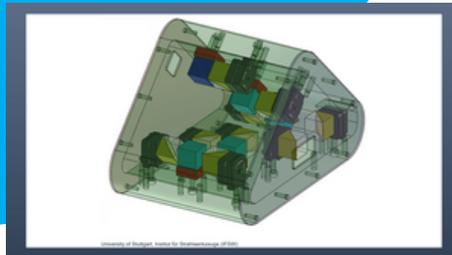


# Polarization goniometer for the detection of 3D structures

Novel, high resolution polarization measuring device for the measurement of 3D geometries, based on the use of thermal radiation from the machining process.

- Very high temporal (up to 75 kHz) and spatial resolutions (about 20 to 50  $\mu\text{m}$ )
- Temperatures > 600 °C can be recorded
- A pyrometer can be integrated



## Fields of application

- Geometry measuring instruments (optical)
- Quality control, e.g., cutting edge evaluation during laser cutting
- Wafer manufacturing
- Laser cladding
- Weld seam inspection

## Background

High resolution viewing of infrared emitting surfaces is required in many fields, e.g., for the quality control of metalworking processes. In addition, if the processing speed is high, optical processes with high frame rates are needed.

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## Development Status

TRL 8 - System complete and qualified

## Patent Situation

DE 50 2010 013 086.1 granted

## Reference ID

10/064TLB

## Service

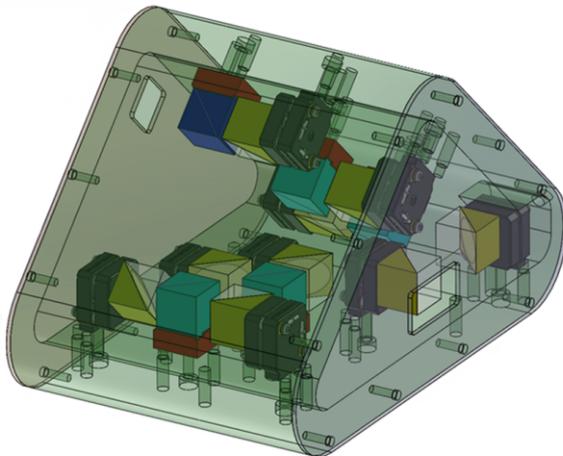
Technologie-Lizenz-Büro GmbH has been entrusted with exploiting this technology and assisting companies in obtaining licenses.

## Problem

In laser processing, especially laser cutting, the cut quality correlates with the thickness of the sheet to be processed. The quality of the cutting edge is mainly affected by the absorbed intensity and the melt flow. To improve the process, knowledge of the very rapidly changing surface geometry is essential.

## Solution

For this purpose, a polarization goniometer was developed at the Institut für Strahlwerkzeuge (IFSW), one of the leading laser research centers worldwide, at the University of Stuttgart. It scans and reconstructs the three-dimensional geometry of the surface of the workpiece based on the polarization of the thermal radiation. The measuring device consists of a specially developed optical system combined with a high-speed camera. To be able to assume a complex refractive index for the measurement, a bandpass filter adapted to the material properties is integrated. This allows cutting fronts to be evaluated at up to 75,000 fps. The polarization goniometer is suitable for all applications where the workpiece emits thermal radiation and which require high resolutions



University of Stuttgart, Institut für Strahlwerkzeuge (IFSW)

Figure 1: Polarization optics of the goniometer [M.Sawannia, IFSW, University of Stuttgart]

## Publications and links

Michael Sawannia, Peter Berger, Michael Jarwitz, Rudolf Weber, and Thomas Graf, "Thermal emission-based geometry determination of hot surfaces generated during laser material processing", ICALEO 2018, 603 (2018)  
<https://doi.org/10.2351/7.0004014>

M. Sawannia, P. Berger, M. Jarwitz, R. Weber, und T. Graf, „Determination of the 3D-Geometry of Cutting Fronts with High Temporal Resolution“, gehalten auf der LiM, Lasers in Manufacturing, München, Bayern, Deutschland, 2019

Michael Sawannia et al 2021 IOP Conf. Ser.: Mater. Sci. Eng. 1135 012013,  
"Determination of the geometry of laser-cutting fronts with high spatial and  
temporal resolution"