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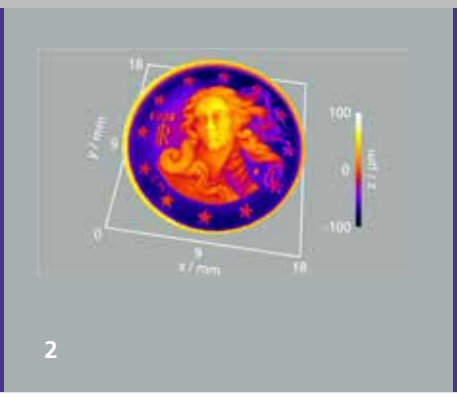
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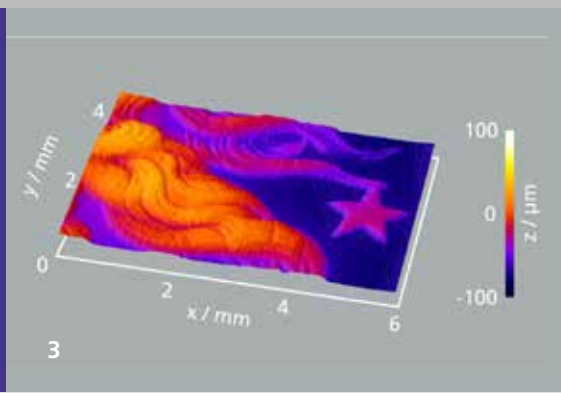

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1 *HoloTop detects the topography of surfaces quickly and reliably enough for inline inspections.*
2 / 3 *Topography of a coin recorded by HoloTop. The image demonstrates the system's potential for high-resolution surface measurements.*

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HOLOTOP

3D INLINE MEASURING TECHNOLOGY

Precision and safety demands on machines and components are increasing steadily. This is especially true for high-tech industries, such as aerospace and medical technology and for mass-produced parts in the automotive industry. They may serve as examples for quality standards which require precise measurement of each critical component during production in order to avoid unnecessary waste or recalls of entire high-value systems.

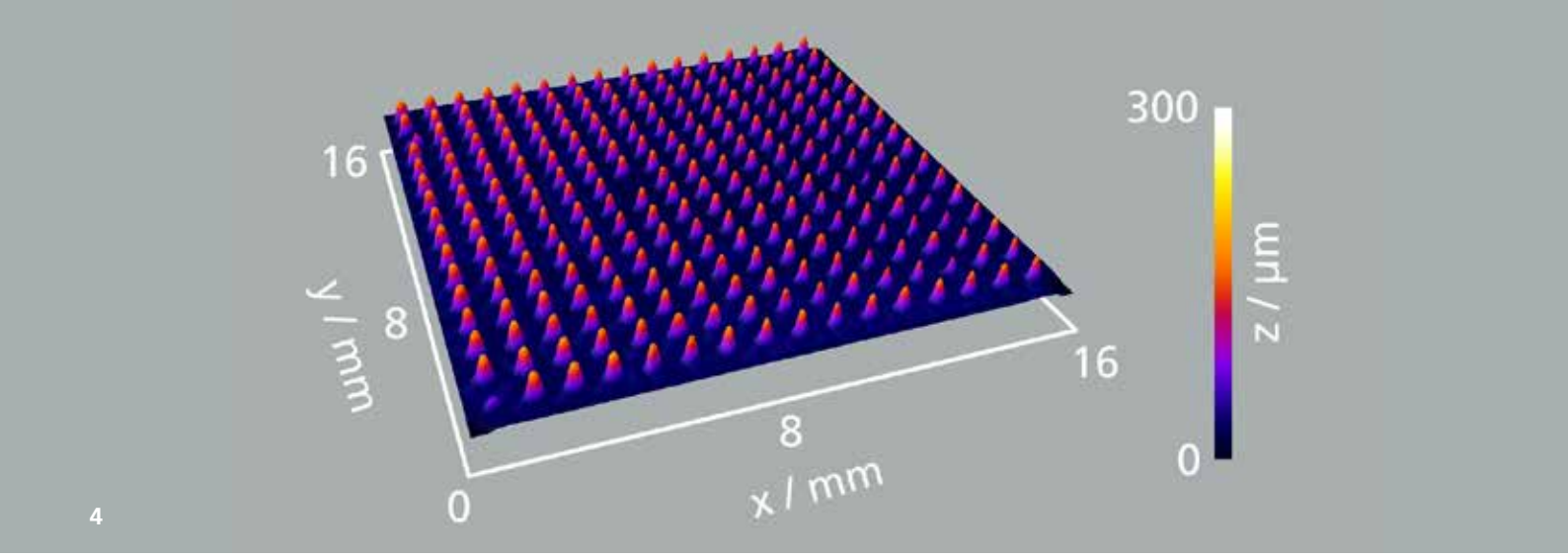
Precise surface measurement and defect recognition

Complete inspection, measurement and documentation of all crucial components will soon be standard practice. In many cases, the precise shape of components is essential for their function. In current mass production, a 100% quality control of many important parameters is only feasible qualitatively. Precise, quantitative measurements are possible only for a small random sample. This is no longer sufficient for the comprehensive demands of modern quality control.

With HoloTop, Fraunhofer IPM offers an optical system for 3D inline measurement of surfaces based on digital holographic microscopy. HoloTop makes contactless, highly precise measurements of component surfaces. It records the topography of rough object surfaces with interferometric precision. The measuring system is so fast and robust that it can be used for inline inspections. This is possible thanks to the use of multi-wavelength holography.

Macroscopic topography measured with microscopic precision

Through the use of narrowband lasers various synthetic wavelengths are generated. Thanks to these different measure-



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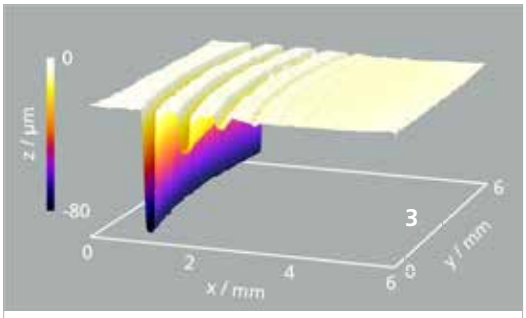
ment wavelengths HoloTop exploits a broad measurement spectrum from the (sub)micrometer to the millimeter range, depending on roughness. The measurement resolution and reproducibility depend on the distances between the individual wavelengths used and the surface properties of the object and can be adapted to the specific application.

Other interferometric methods for surface inspection often fail to measure complex structures such as steep slopes, deep grooves, high edges and holes. If the object has steep edges, the height relief can no longer be clearly analyzed, because the phase jumps lie too close together.

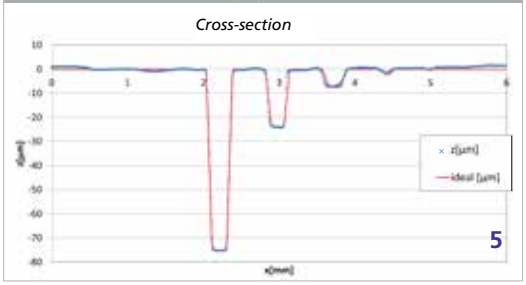
Measuring with digital multi-wavelength holography

Digital multi-wavelength holography solves this problem: a coarse virtual signal of several millimeter length, adapted to the object geometry, is generated from the slight differences between the selected laser wavelengths. Combining the virtual signal with the laser wavelengths guarantees unambiguous measurements with high resolution.

Speed is another advantage: The camera-based measurement takes just a fraction of a second, measuring the entire object surface in a single step without scanning. Short measurement time and precision on a micrometer scale make the system suitable for use in industrial production.



Cross-section



4 *Topography of a ball grid array. The inline measuring system inspects ball grid arrays with 9 megapixel resolution and 10 Hz imaging rate.*

5 *Image of a calibration standard. The diagram compares the measured data along the dotted line with the reference shape of the standard. Measurement precision is better than 1 µm.*

Advantages

- Unambiguous measurement of macroscopic topography with a depth of about 5 mm and micrometer precision
- Complete quality control
- Lower testing costs due to automatic inspection
- Inline measurement in industrial production due to short measuring time
- Measurement of heterogeneous surfaces of one and the same object

Applications

- 3D surface measurement of components in the production process
- Quality control of high-tech products, such as in aerospace and medical technology, or in automotive production

Technical Specifications

Resolution	3072 × 3072 measurement points
Measuring field	15 × 15 mm² up to 30 × 30 mm² (scalable)
Reproducibility	axial < 1 µm (1 σ)
Measuring time	< 100 ms (+ 150 ms data analysis) at 9 megapixel
Working distance	up to 300 mm