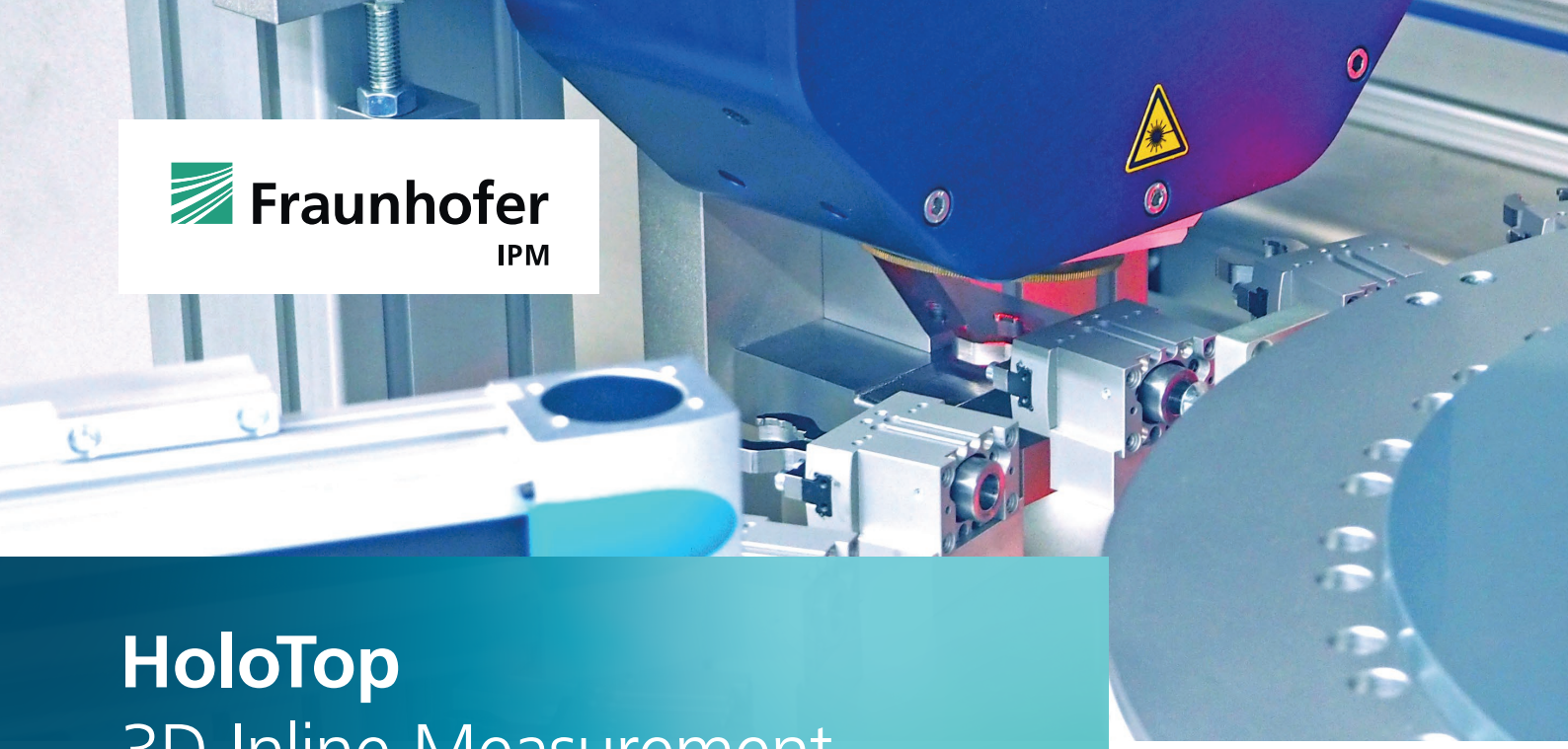
Fraunhofer IPM



HoloTop
3D Inline Measurement

HoloTop measures the topography of surfaces so quickly and reliably that it can be used in inline quality control.

100 percent quality control using digital multi-wavelength holography

Precision demands for components and machines are continually increasing. This is especially true for high-tech industries, such as aerospace, medical technology, electronics or the automotive industry. In these industries, it is important that each and every essential component is measured accurately as early as during production in order to avoid waste or recalls of entire high-value systems.

Precise surface measurement and defect recognition

Complete inspection, measurement and documentation of functional surfaces is already required in many places; typically, however, in mass production the most important parameters are only checked qualitatively or using random samples. This no longer meets the growing demands for a 100 percent quality control.

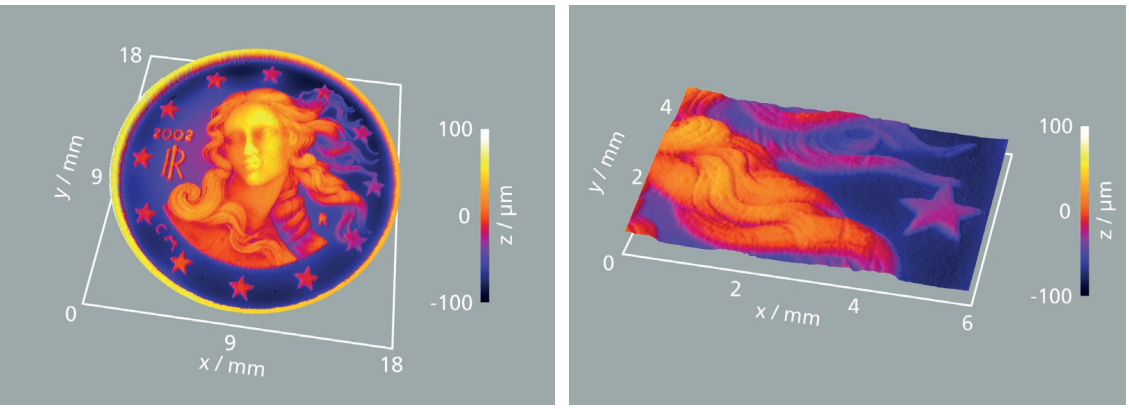
With HoloTop, Fraunhofer IPM offers an optical system for 3D inline measurements based on digital multi-wavelength holography. HoloTop sensors provide contactless, precise and quick component measurement, while also recording the topography of rough surfaces with interferometric precision. The measuring systems are so fast and robust that they can be directly integrated into production facilities and machines. The compact and wireless HoloTop NX sensor head was developed for use in machine tools.

Macroscopic topography measured with microscopic accuracy

Digital multi-wavelength holography is based on the principle of interferometry, in which the light of a laser is split into a measuring beam and a reference beam. While the measuring beam strikes the surface of the sample object, the reference beam is run through a precisely defined optical path within the sensor. Using a camera, the measuring beam

HoloTop at a glance
Technical data

- **Lateral resolution**
  3–30 µm (depending on the camera and measurement field)
- **Measurement field**
  15 × 15 mm² to 190 × 150 mm² (scalable)
- **Accuracy of height measurements**
  Axial < 0,2 µm (3 σ)
- **Measurement time**
  < 100 ms at 9 megapixel, < 200 ms at 65 megapixel
- **Working distance**
  Flexible up to approx. 300 mm (no need for mechanical focusing)



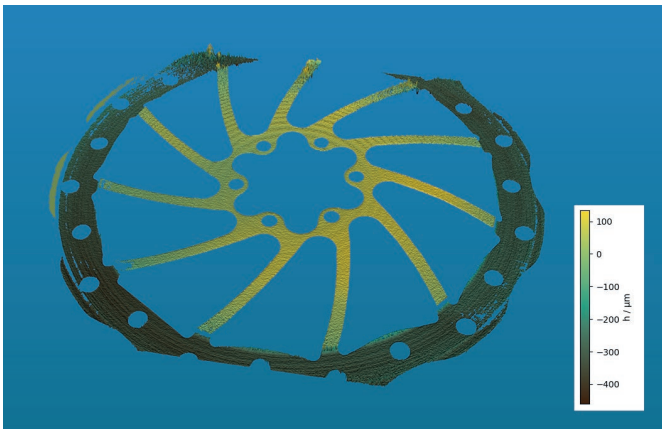
3D measurement data of a coin recorded by HoloTop. The image demonstrates the system's potential for high-resolution surface measurements.

and the reference beam are then superimposed. The emerging interference pattern contains information on the topography of the sample object. With the appropriate numerical methods, the shape of the technical surface can be calculated using the interference pattern in just a fraction of a second. Not only that: Since digital holography captures both the intensity as well as the phase of the measuring beam accurately and comprehensively, it is also possible to numerically calculate its spatial propagation. In this way, the object surface can be measured, even if it is not displayed in high resolution on the camera chip.

By using multiple lasers with various wavelengths, HoloTop is able to carry out unambiguous measurements down to the centimeter as well as down to the submicrometer. LED lighting can also be integrated as an additional option. Bright and dark field illumunitation can be used to detect and analyze even the smallest defects using conventional image processing methods, with just one single optical sensor.

A variety of applications thanks to flexible system design

The most important elements of the HoloTop sensor technology – in addition to the various laser sources used to illuminate the object – include an area scan camera and a high-quality lens. By adjusting the components, the sensor technology can be adapted to a variety of measurement fields, pixel resolutions, measurement speeds and surface and environment conditions. This allows for a wide range of applications: from accurately milled metal surfaces for diesel fuel injectors and the finest microbumps to contacting computer chips and measuring large surface areas of electric switchboard for high-current applications. HoloTop offers just the right sensor for each of these applications.



Using a HoloTop sensor optimized for large surface areas it is possible to determine the degree of wear on a bike disc brake measuring 160 mm in diameter.

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