Fraunhofer IPM

Press release

Optical coordinate measuring technology

Digital holographic sensor integrated into a coordinate measuring machine for the first time ever

Coordinate measurement technology is evolving from purely tactile devices to multisensor systems. For the first time worldwide, researchers at Fraunhofer IPM have fully integrated a high-precision digital holographic sensor into a coordinate measuring machine. Combining the flexibility of tactile measurements with the high speed and precision of digital holography promises new possibilities for inspecting the quality of precision components.

Digital multi-wavelength holography is a powerful technology that enables fast, highly accurate, large-area measurement of surface topographies. At Fraunhofer IPM, this optical method has been continuously refined over the years. The sensors in the HoloTop system family quickly measure surface topographies with accuracies down to the submicrometer range. As inline systems, they are widely used in industrial applications for 100-percent quality control. The latest version of the HoloTop NX digital holographic sensor can measure the entire technical surface of coin-sized objects in about one-tenth of a second, generating up to nine million 3D points in the process. The sensor is barely larger than a can and has been integrated and tested for the first time in Hexagon's PMM-C series Leitz Infinity 12.10.7 3D coordinate measuring machine.

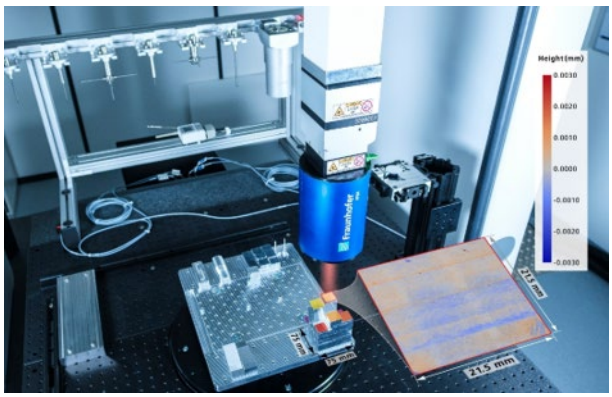
A fully wireless integration into the coordinate measuring machine (CMM) was achieved using the SENMATION interface from Hexagon, which is a universal system for fully automated sensor change. The ability to switch between optical and tactile measurements allows for highly accurate fusion of the measurement data. The zero-point clamping system, installed at Fraunhofer IPM, enables the easy transfer of components between carrier systems, as needed—for example, for post-processing in a machine tool.

Selectively measuring the surface area of components' critical areas

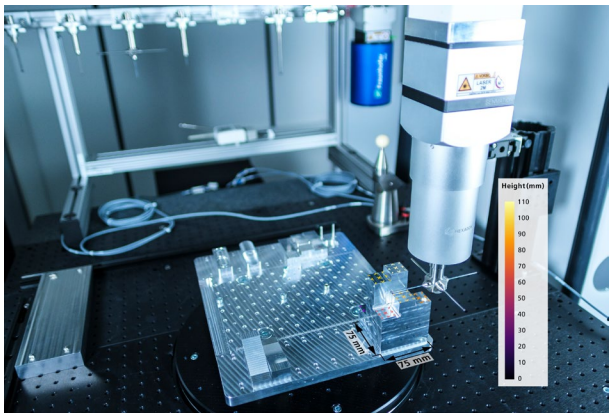
In a comparative measurement of a 75 × 75 mm² test object, the HoloTop NX generates over 700 million 3D measurement points in under two minutes. The CMM records 729 measurement points with maximum accuracy using tactile measurement in approximately four minutes. Rather than providing a single-point representation with coarse lateral resolution, the holographic measurement result displays the surface profile of the test specimen with a comparable accuracy of less than 1 µm. The sensor's working distance is comparatively high

at 120 mm. Digital holography also enables measurements outside the focal plane over a range of several centimeters. In principle, this makes it possible to integrate "optical probes" or mirror optics that allow the sensor to measure the test specimen from various angles and distances thanks to the large working range. This allows measurements to be taken in different directions, similar to a star stylus.

Fraunhofer IPM is seeking industry partners to test the capabilities of digital holographic measurement technology in a CMM through feasibility studies on precision components to further develop this technology.



The HoloTop NX is integrated into the Leitz Infinity coordinate measuring machine from Hexagon at Fraunhofer IPM. With the addition of an optical sensor, high-resolution, full-surface quality inspections of critical components can be performed cost-effectively. © Fraunhofer IPM



Tactile measurement of the same test part: The CMM's tactile sensor system generates 729 measurement points in about four minutes, whereas the digital holographic sensor integrated into the device records 700 million measurement points in just two minutes. © Fraunhofer IPM

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