Precision components must be produced with an accuracy of a few micrometers. This requires a level of accuracy during manufacture that even cutting-edge processing machines are often unable to reliably deliver. Unfavorable trajectories or even minor wear to tools can lead to component geometries which do not conform to the specifications. Quality control thus involves precise measurement of the components. Typically, coordinate measuring machines in special measuring rooms outside of the machine tool are used for this purpose. The process is slow and complicated, and only random samples are possible.

The optical sensor HoloTop NX measures the topography of component surfaces directly in the machine tool. It detects the surface and depth of milling paths over a large area. Due to its compact design, comparable to typical milling tools, it can be integrated into many machine tools.

HoloTop NX captures an area of 12.5 × 12.5 mm² with micrometer accuracy within 500 ms. Even deviations of a few micrometers can thus be reworked directly in the machine tool without the need to first reposition the workpiece. The acquired images are processed particularly quickly, while data preprocessing guarantees good robustness to vibrations.

The sensor uses multiwavelength digital holography for inline 3D measurement. Similar to all HoloTop systems, it maps the topography even of rough object surfaces with interferometric accuracy. HoloTop NX provides contactless, highly accurate measurements of component surfaces and operates so quickly and robustly that it can be integrated directly into the machine tool. It is thus possible to detect rejects at an early stage. In addition, process errors can be identified and corrected directly in the manufac-
Sealing surface measurement of a reworked casting material. The machine tools’ axes allow several measuring fields to be combined to form an overall measurement (center). In this way, milling paths and flatness (right) as well as local defects (left) in the micrometer range can be reliably detected over a large area.

HoloTop NX maps the component surface in the fraction of a second with micrometer accuracy directly in the machine tool (as in the example of a heat sink for laser assembly). Alongside the geometry, relevant surface parameters such as microdefects and microstructures as well as the height, parallelism and inclination of surfaces can be measured simultaneously.

Applications
- Comprehensive 3D measurement of component surfaces in the manufacturing process
- Quality control for precision and safety-related parts e.g. in aerospace engineering, medical technology or automotive engineering

Advantages
- Measurement of macroscopic topographies with accuracies into the sub-micrometer range
- Axial measurement range of a few millimeters
- Complete quality control in the workpiece holder – no need for new set-up
- Lower costs thanks to automatic inspection in the machine tool
- Inline measurements in an industrial setting thanks to short measurement time
- Roughness measurements even in hard-to-reach functional areas

Measuring macroscopic topography with microscopic accuracy

The tactile measurements or optical probes, which are currently commonplace, are severely limited by the number of measuring points and the significant measuring time that this entails. Furthermore, these methods have a very limited capacity to measure complex structures such as gradients, deep grooves, high edges or holes. Optical alternatives generally require an expensive separate measurement system, meaning that workpieces must be repeatedly set up after inspection. HoloTop NX sets new standards here – the sensor is fully integrable and boasts a very large working distance, a large measuring range and high measuring accuracy.

Technical data
- Dimensions: Ø 125 mm x 180 mm (D x H)
- Resolution: 3008 x 3008 measurement points
- Detection area: 12.5 x 12.5 mm²
- Reproducibility: axial < 1 µm (1σ)
- Measuring time/processing time: < 500 ms
- Working distance: up to 300 mm