Perfect optical inline 3D measurements

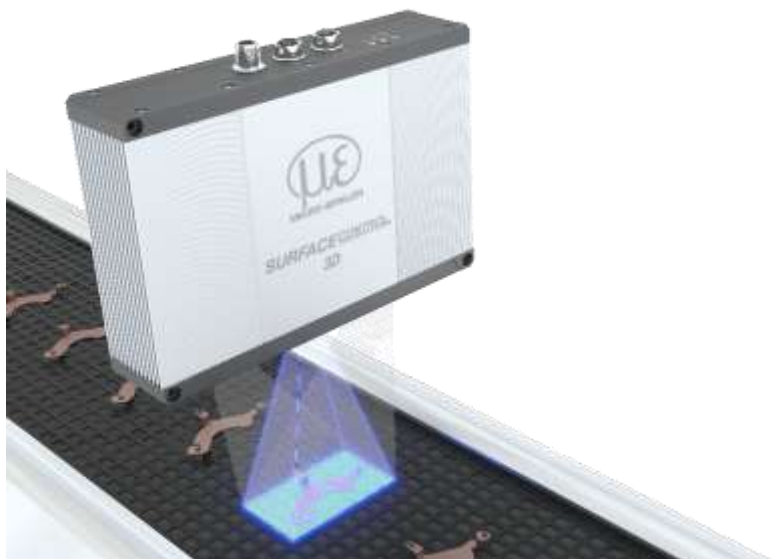## High precision inspection of geometry, shapes and surfaces

The method of triangulation, in which distances between two points are determined by trigonometric calculations in a triangle, is ideally suited to precise shape and surface measurements. The new 3D snapshot sensor from Micro-Epsilon sets new standards in terms of precision.

Geometric triangulation has its origin as a method in geodesy. As early as the Middle Ages, land surveyors covered entire states with triangular nets to determine areas and distances. High-precision distance measurement with optical triangulation is based on a similar principle: a point of light is projected onto a surface and simultaneously received by a sensor line at a defined angular offset. With the fixed distance between projector and sensor line as well as the position of the point on the sensor line, the distance between sensor and surface can be determined very precisely by simple trigonometry.

Extension of the measuring principle into the third dimension

The measuring principle of optical triangulation can also be transferred to two or even three dimensions. The sensor measures not only the distance to a single point on a surface, but at the same time also measures the distances to all surface points within the measuring field. Instead of a single point, a sequence of different fringe patterns are projected onto the surface. Cameras record the pattern. A 3D point cloud can then be calculated from the data. The new surfaceCONTROL 3D 3500 from Micro-Epsilon works according to this principle. A matrix projector projects the sequence of different fringe patterns onto the surface of the measuring object. The diffusely reflected light of the patterns is recorded by two cameras. From the recorded image sequences and knowing the arrangement of the two cameras to each other and to the projector, the sensor's computer calculates the three-dimensional surface of the test object.

The high-precision surfaceCONTROL 3D 3500 fringe light sensor from Micro-Epsilon is suitable for applications in geometry, shape and surface inspections.
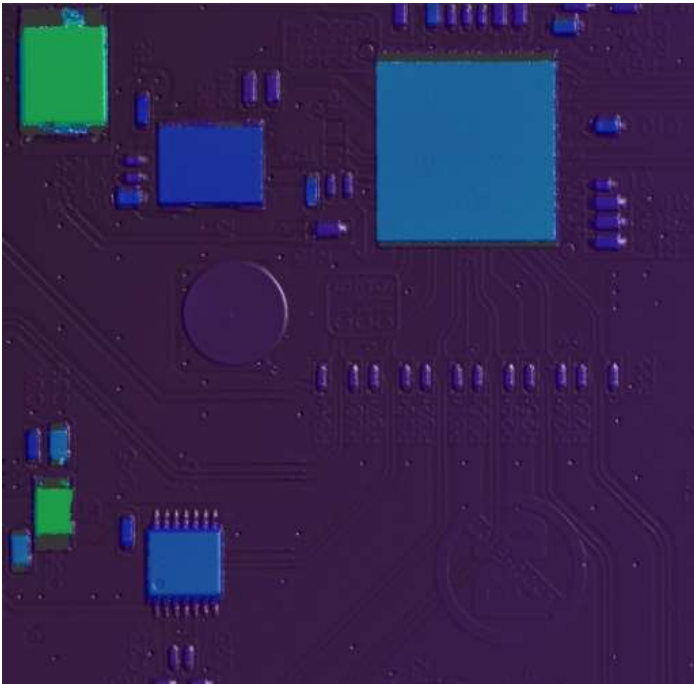
Outstanding precision

The surfaceCONTROL 3D 3500 is available in two versions, which can measure an area of either 50 mm x 80 mm or 120 mm x 75 mm. The measurement precision is outstanding: the repeatability of the height measurement in the z-axis is up to 0.4 µm. In addition to high precision, Micro-Epsilon focused particularly on two properties during development. As the sensor is to be used primarily for inline quality control, the measurement must be very fast. In addition, the industrial-grade equipment is important, including easy integration into the application and suitable interfaces: Gigabit Ethernet (GigE Vision / GenICam), PROFINET, EtherCAT and EtherNet/IP are available. Four parameterizable digital I/Os can be used, for example, as triggers or for output of sensor states. The compact, fully integrated sensor is housed in an industry-optimized enclosure and uses passive cooling to achieve the high IP67 protection class. Three mounting holes enable reproducible and the corresponding centering sleeves enable reproducible mounting.

Typical applications in manufacturing operate at approx. one-second intervals. The measurement of the component must therefore be carried out in one quick shot. During this time, the measuring object must not move. With the surfaceCONTROL 3D 3500, the projection of up to 20 different fringe patterns and the acquisition by the two cameras are completed from 0.2 seconds, depending on the measurement task. The computer then takes over the calculation of the 3D point cloud - the measuring object can already be transported further to make room for the next workpiece. In total, the sensor can deliver up to 2.2 million 3D points per second.

Optimized for high-precision 3D Snapshots

The processing time for a 3D point cloud depends strongly on the measurement parameters and the complexity of the measuring object. Thanks to an optimized algorithm for processing, the point cloud calculation for the surfaceCONTROL 3D 3500 is usually completed in just under one second, making the sensor ideal for quality assurance applications in manufacturing processes where production takes place at corresponding cycle rates.
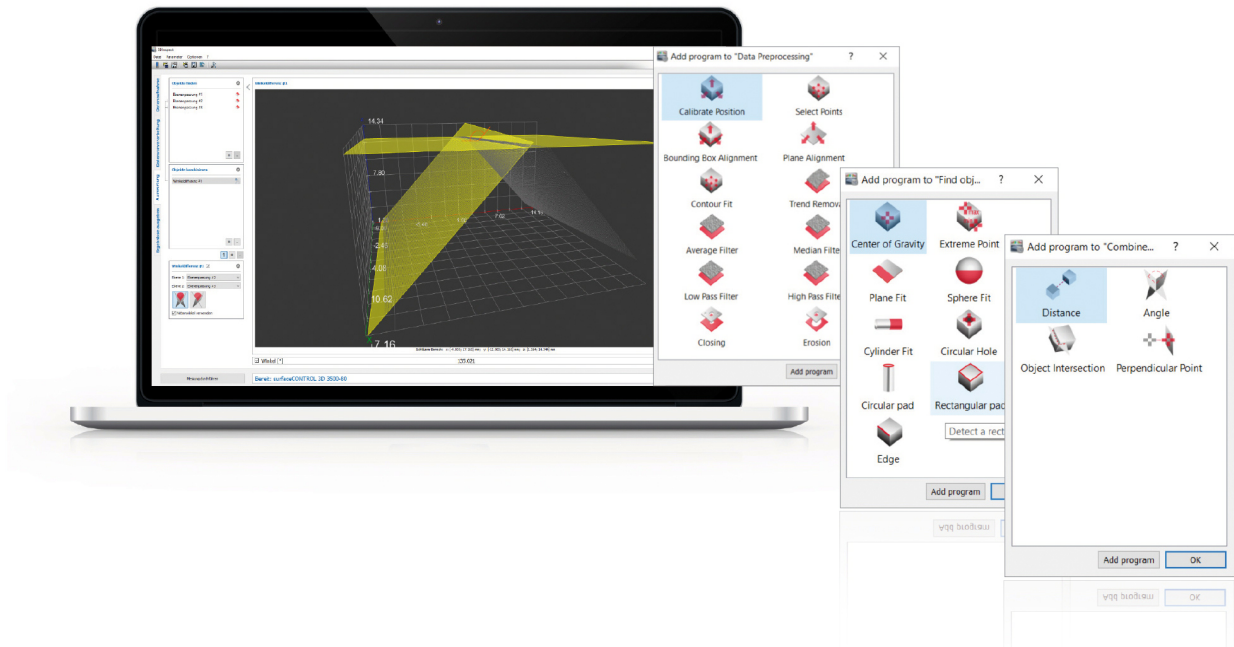
Examples of such applications where automated inline geometry, shape and surface measurements are required include, e.g., PCB manufacturing where flatness is checked. The surfaceCONTROL 3D 3500 can ensure the necessary measurement precision of 2 or 3 µm. Even with densely populated PCBs, such faulty assemblies are detected reliably and quickly.

The inspection of PCBs in electronics production is one of the most common applications for the surfaceCONTROL 3D 3500.

Powerful software tools

To integrate the 3D sensor, the user has several options. First of all, the 3D-View software, which provides a convenient user interface with which the surfaceCONTROL sensors can be addressed. The software enables quick commissioning and evaluation of the sensor. It offers set up and optimization of parameters and ensures the correct positioning of the measuring object and sensor. The software can also be used to start data acquisition. In addition, Micro-Epsilon supplies the 3DInspect software together with the sensor, which is used for sensor parameter set up and for implementing industrial measurement tasks. This software transmits the measurement data from the sensor via Ethernet and provides the data in three-dimensional form. Predefined measurement programs simplify the evaluation of the measurement data. This makes the software extremely powerful and yet very intuitive to use.
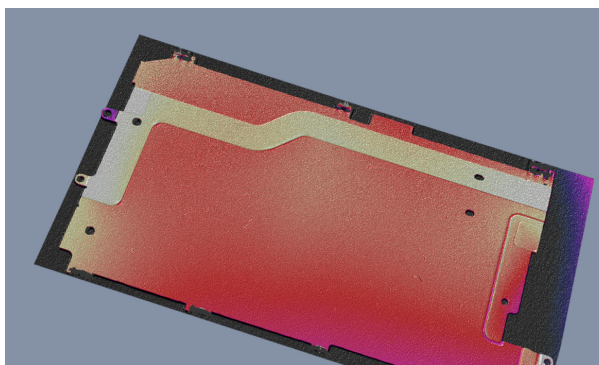
The 3DInspect software is intuitive to use and still offers a wide range of functions.
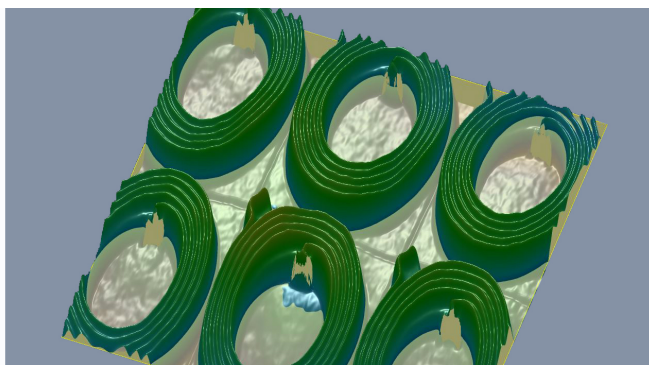
Connection via SDK

If the user uses an alternative image processing solution or wishes to develop one, a comprehensive SDK is available. This is based on the industry standards GigE Vision and GenICam and provides numerous function blocks. A C/ C++/ C# library with numerous sample programs and documentation supports software development. Accessing the sensor via GigE Vision is also possible without SDK if you have a GenICam-compliant software from a third party.
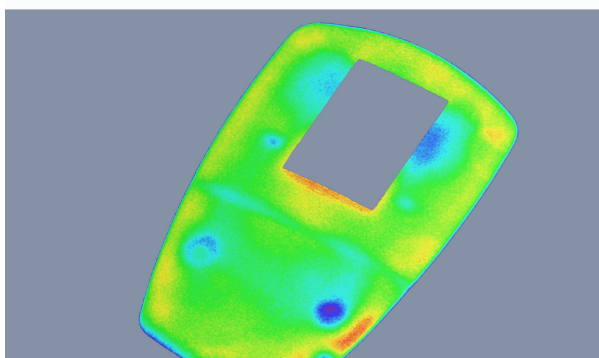
Versatile applications

The surfaceCONTROL 3D 3500 snapshot sensor is characterized by a combination of high precision and high speed. With its compact design, it is suitable for applications in inline quality control. This includes, for example, the 3D measurement of mounting surfaces on complex components where the spacing of the holes and the coplanarity are important. With injection-molded parts, deviations in the shape of the surface can be detected at the points where fastening ridges are molded onto the back. And a very common application is the inspection of PCBs in electronics manufacturing - both before and after assembly. The surfaceCONTROL 3D 3500 is an optimal solution for all these and many other applications.
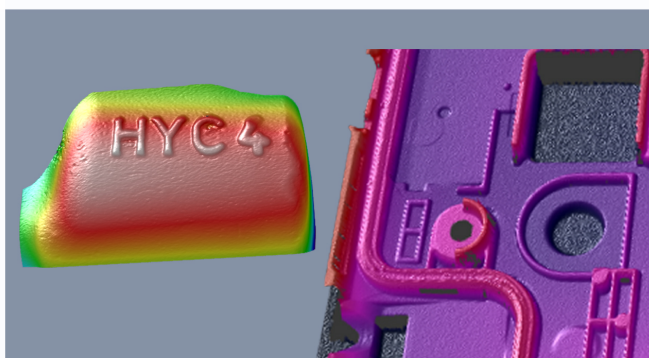
Flatness inspection of high-precision middle boards of smartphone carrier plates

Planarity inspection of unpopulated PCB substrates

Determination of shape deviation defects of injection-molded parts

3D text recognition and inspection of height and thickness

About Micro-Epsilon

Micro-Epsilon is a global specialist in precision sensors and measurement systems and offers a worldwide unique range of sensors, measurement systems and customized inspection systems. Continuous development efforts, extensive know-how and a wide cooperation network enable the creation of innovative, high precision products. The sensors from Micro-Epsilon are helping to conserve resources, automate production processes and to ensure high quality in production processes.

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