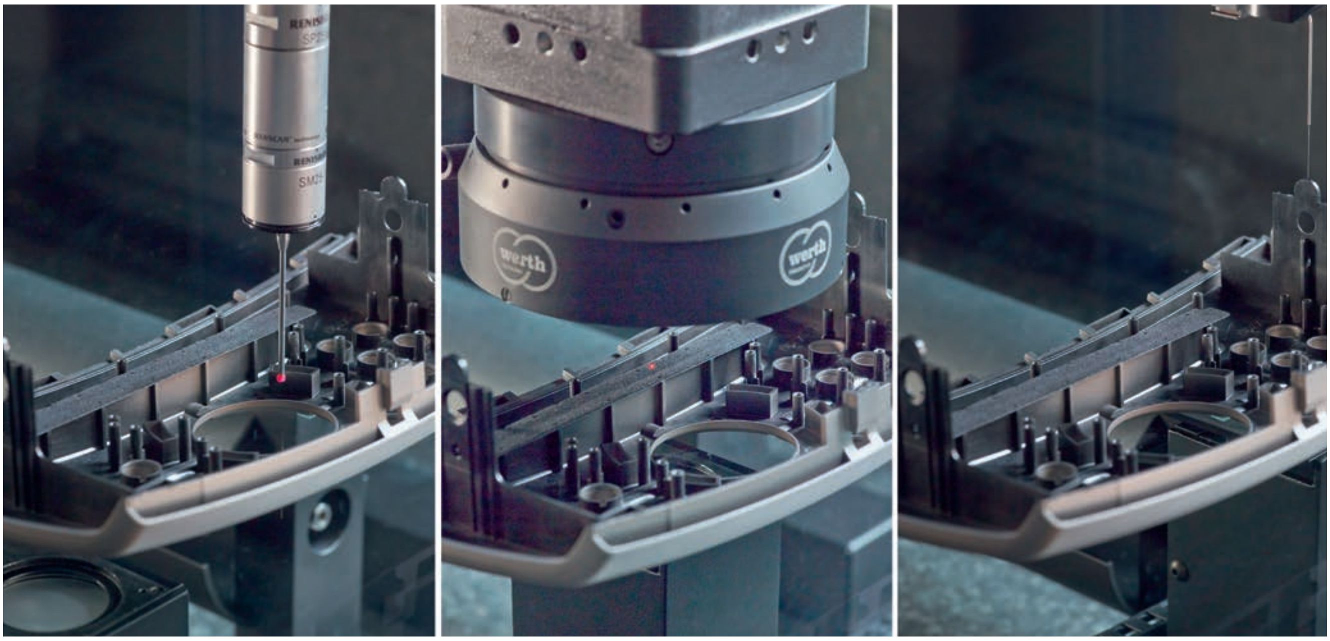

Figure 1. The datum features on a cover are defined using a conventional stylus system, then the flatness is measured with a laser distance sensor, and the flexible tab is measured with a fiber probe. (© Werth)

Which Sensor Is Right for Which Workpiece

Tactile And Optical Measurements

PRACTICAL TIP Coordinate measuring machines with image processing sensors are especially good at rapidly measuring workpieces like profiles or 3D plastic components. Conventional probe systems are typically used to capture the geometry and geometrical deviations in 3D space of large, cubiform workpieces. Multisensor coordinate measuring machines can be used to completely measure many workpieces in a single setup.

Bernd Weidemeyer

MULTISENSOR- coordinate measuring machines present abundant choices: All kinds of measurement tasks can be handled, but which sensors are most suitable? There is no perfect sensor that can handle every measurement task. Every sensor has its strengths and weaknesses. For example, elastic rubber profiles can be measured optically with very low measurement uncertainty, but the workpiece deformation from a tactile measurement would falsify the measurement result. On the other hand, hole diameters cannot always be determined by an image processing sensor because of chamfers, so a tactile measurement of the interior of the hole is preferred.

Tactile Sensors for Large, Cubiform Workpieces

The conventional probe is a flexible sensor with full 3D capability. Using various probe configurations and a rotary/tilt joint, all surfaces of a workpiece can often be captured. For example, vertical planes and cylinders can be measured using a vertical probe with a large probe sphere (Figure 1, left), while lateral grooves require a star or disk probe. The measured geometric elements are used to derive the drawing dimensions, including geometrical deviations. Because the probe uses a contact method, workpieces made of metal and strong plastics can be captured reliably. Typical measured objects are large, cubiform workpieces, such as machined parts, housings, engine blocks, and cylinder heads.

The conventional probe is not suitable for measuring workpieces made of soft materials, such as elastomers or other plastics that would deform and falsify the measurement result. For very small geometries, as well, such probe systems reach their limits, because probe spheres below about 0.3 mm in diameter are not practical due to high contact pressure and susceptibility to breakage. When using conventional probes, the measured objects must be fixed in place due to the probing force of a few tens of millinewtons, in order to guarantee stable positioning of the workpiece during the measurement process.

For measuring very small geometries, the tactile-optical micro-stylus Werth Fiber Probe WFP is the sensor of choice. Its small probe sphere diameter, for example 50 µm, can be used to easily measure contours of microstructures. In the patented fiber probe, the stylus shaft is used only to position the probe sphere. The deflection is captured optically. The fiber probe has a very low probing error, which is often required for microgeometries due to their tight tolerances.

The low probing force due to this principle allows measurements of even sensitive surfaces and flexible workpieces (Figure 1, right). Despite its small probe spheres, the Werth Fiber Probe leaves no marks or scratches on the surfaces. It is not necessary to clamp the workpiece in a fixture. Typical measured objects include spray holes in fuel injector nozzles, micro-gears, and optical components.

Measure Without Contact Using Optical Sensors

Optical sensors are non-contacting and capture many measurement points in a short time. Because the sensor maintains an adequate distance from the workpiece surface, no time-consuming travel around the workpiece is needed (Figure 1, center). For non-contact measurements, damage to the workpiece is eliminated, along with falsification of measurement results due to deformation. Because of the resolution of the probe element (such as the focal point) for optical sensors in the range from a few tenths of a micron to a few microns, even very small structures can be measured.

Unlike the stylus, the image processing sensor can be used to measure workpiece edges directly (Figure 2). This feature is critical for cutting edges on tools, for example. Color transitions on surfaces can also be measured, such as for cross sections of colored cable insulation or printing on labels and currency. Other typical objects measured with optical sensors are plastic components of all types and sizes, circuit boards, extruded aluminum, plastic, or rubber profiles, and optical components with sensitive surfaces.

Optical distance sensors and image quality with incident light are based on light reflection, and therefore depend on the quality of the surface. A change in reflectivity can cause difficulty in probing, but this can be prevented with image filters and light controls. For distance sensors, the angle between the sensor axis and the workpiece surface is critical. The closer this angle is to 90°, the better the surface can be measured. For severely angled surfaces, angles near 90° can be achieved by deploying the sensor on a rotary/tilt joint or by chucking the workpiece in a rotary axis.

Measure in One Setup With Multisensor Technology

Due to varying requirements, the use of several sensors to completely capture workpieces is often necessary. All measurements can be performed on a multisensor coordinate measuring machine without remounting; the measured elements are linked to each other in the same coordinate system.

For example, the image processing sensor can be used to set the coordinate system for plastic parts, measure various 2D features, and determine the positions of holes. The axis alignment and shape of holes, and the undercuts, are then measured in the same coordinate system using a conventional stylus. This is often the only way to measure the various features, such as the distance between an edge (using image processing) and a surface (tactile), in compliance with the drawing. In addition, a laser sensor, for example, can quickly determine flatness.

Multisensor systems minimize set-up times and increase flexibility in solving daily measurement tasks. The perfect integration of multisensor systems is found in machines where various sensors are located on various axes. This allows multisensor coordinate measuring machines to be used universally without the sensors interfering with each other. ■

Translated by Werth Messtechnik GmbH

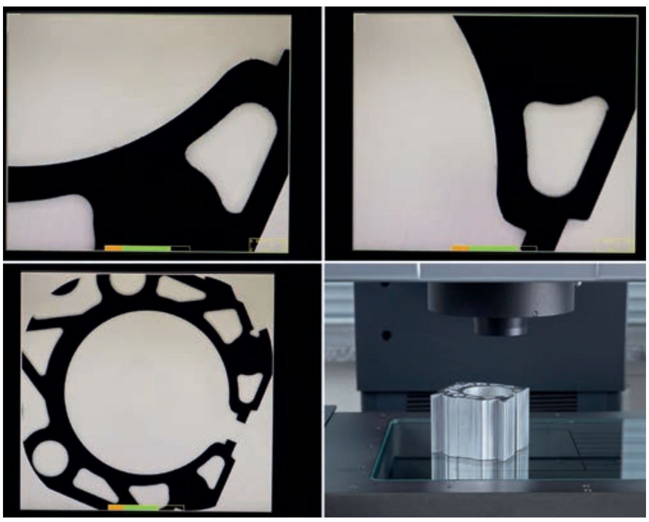

Figure 2. Tracing the workpiece edge with raster scanning using the image processing sensor (© Werth)

INFORMATION & SERVICE

CONTACT

Werth Messtechnik GmbH
T 0641 7938-0
mail@werth.de
www.werth.de

QZ ARCHIVE

This article can be found online:
www.qz-online.de/1796719

Masthead Publisher: Carl Hanser Verlag GmbH & Co. KG, Kolbergerstr. 22, 81679 Munich