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Optimal measurement with multisensor technology

Selection of sensors on
multisensor coordinate measuring machines

Werth Messtechnik GmbH **www.werth.de**

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PRACTICE TIP For the fast solution of complex measuring tasks, different measuring sequences can be created semi-automatically with multisensor coordinate measuring machines and intelligent software procedures. The machines allow combined measurements with different sensors and replace several single-purpose machines due to their flexibility. Their modular design allows them to be upgraded to the latest state of the art at any time.

Bernd Weidemeyer

A coordinate measuring machine must meet various requirements. First, all necessary measuring tasks must be solved with the required accuracy. In addition, the shortest possible measuring time. as well as simple and time-saving operation, are important.
Another factor is cost: in addition to an acceptable purchase price, maintenance costs must not be too high. All these characteristics must also be taken into account when selecting a sensor. One of the main advantages of multisensor coordinate measuring machines is the versatile combination possibilities (Fig. 1). With just a few rules, the operator can optimize measuring time and accuracy, and thus has the ideal coordinate measuring machine for every measuring task.

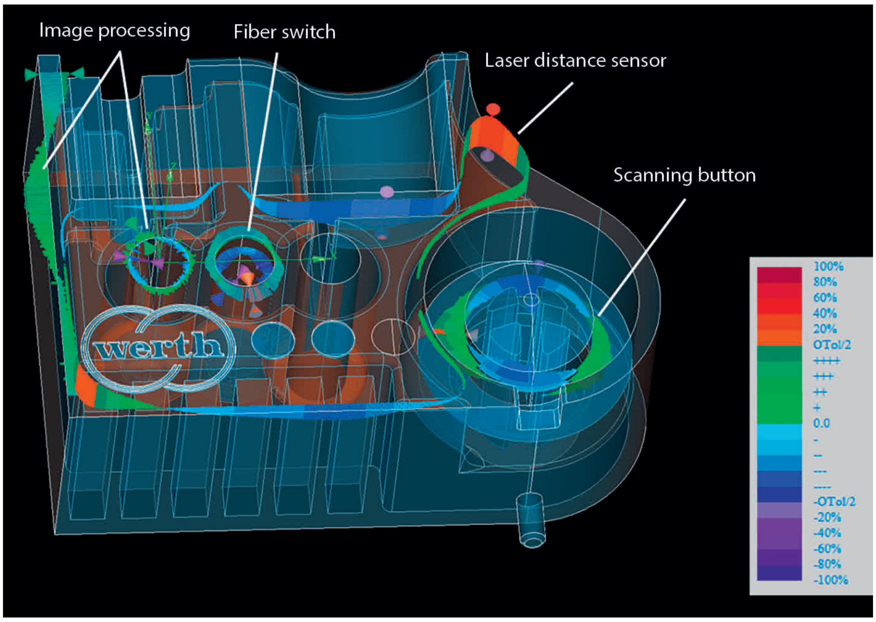

Fig. 1. Multisensor measurement: The image processing sensor allows a fast edge measurement; small bores are easily accessible for the tactile-optical micro probe. With the laser distance sensor a fast scanning in the plane can be performed, with a touch probe and the vertical cylinder can be measured as well. (© Werth)

Suitability of the sensor

If lateral measurements in one plane are required (for example the edges of a bore hole) the image processing sensor is the best choice. Zoom optics provide a good overview at low magnification levels and enable highly accurate measurements at high magnification. Due to the non-contact measurement, the sensor achieves a high measuring speed. Speed and accuracy can be further increased by methods like raster scanning HD. With continuous image acquisition, the selected area or a (3D) default path is automatically scanned. The images are superimposed to form an overall image, which allows fast measurements “in the image” with increased accuracy.
Different optical distance sensors are available for axial measurements. With the WLP, the position of the workpiece surface is determined according to the Foucault principle, from the position of the reflected asymmetrical laser beam on a differential photodiode. The sensor is integrated into the beam path of the image processing sensor, so that the entire measuring volume can be used for combined measurements without

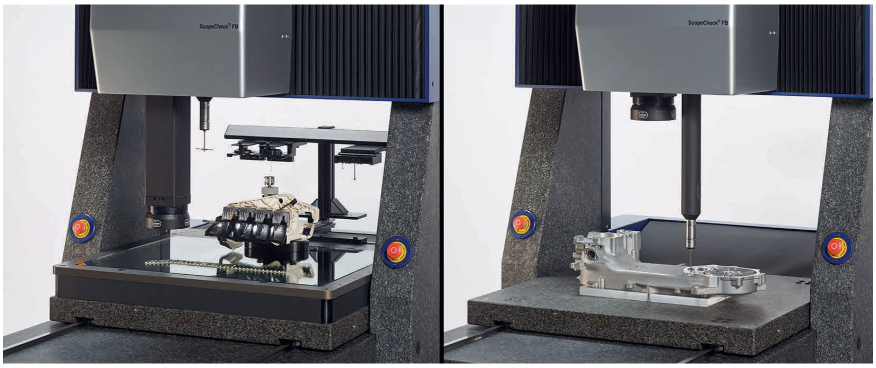

Fig. 2. **The compact bridge-type machine allows multisensor measurements without measuring range restrictions due to the double ram design (left) ; heavy workpieces can be measured directly on the measuring table (right).** (© Werth)

any offset between the two sensors. With the patented Werth Laser Probe (WLP), it is possible to measure single points, as well as to scan contours.

For reflective surfaces, the Chromatic Focus Point Sensor (CFP) is a good choice. The measuring principle is based on the different working distances of the different color components of white light. The reflected wavelength with the highest intensity is focused on the workpiece surface; the corresponding working distance is the distance to the surface. The CFP achieves high accuracy, is largely independent of the surface properties, and is also suitable for scanning and point-by-point measurement. If complete surfaces are to be scanned, the Chromatic Focus Line Sensor (CFL) is also used in addition to the CFP. By measuring approximately 200 points simultaneously, about three million points per second can be scanned with high accuracy.

Tactile sensors such as conventional touch probes and the patented Werth Fiber Probe (WFP) are used, for example, on side faces or in vertical bores, while the micro probe WFP can be used for highly accurate measurements of very small geometries. For measurements of surface topography even at different brightness levels, the Werth 3D-Patch area sensor using the focus variation method is available. For special measurement tasks, confocal sensors are also used to measure surface topography, the Werth Interferometer Probe (WIP) for measurements in narrow bore holes, or tactile-optical contour sensors for integrated roughness measurements on the coordinate measuring machine.

Optimization of measuring time and accuracy

The basic problem of measurement technology is the conflict between measurement speed and accuracy. An example of this is image processing sensors with low and high magnification, which allow fast and accurate measurements, respectively. The CFP can be adapted to the respective application with different sensor heads, which differ in the measuring range. Lenses with a large measuring range enable fast scanning on a preset path, while those with smaller measuring ranges have a higher resolution and thus accuracy.

To solve the measuring task, the operator first identifies all sensors that are suitable due to the workpiece properties and the maximum permissible measurement uncertainty. In addition to the surface quality already mentioned, the workpiece properties also include the type and size of the geometries to be measured. From the suitable sensors, the sensor or sensor combination that achieves the highest measuring speed is then selected.

The measuring speed can be further optimized by creating a measuring schedule. For this purpose all elements for which the same sensor is to be used should be measured directly one after the other. Only after that another sensor is exchanged. The coordinate system must be defined once at the beginning of the measurement; after that, all sensors refer to it. To determine geometrical properties (such as distances between planes or circle centers), the measurement results of the different sensors are automatically linked by the measurement software.

Multisensor measurements in practice

With multisensor coordinate measuring machines, almost all workpieces can be measured (Fig. 2). For example, a clock board can be completely measured with image processing sensor, CFP and WFP. The image processing sensor enables a fast measurement of bore positions and chamfer widths. After the position of the holes has been determined optically, the cylindrical shape and perpendicularity to the base surface can be measured with the fiber probe. With the CFL, the surface of the entire workpiece can be scanned very quickly to determine the height dimensions. On large metal workpieces, the diameter, position, shape, and location of the bores are first measured with the touch probe. Since the touch probe is faster than the WIP, the WIP is only used for roughness measurements in deep, small bores that are inaccessible to the touch probe. The 3D-Patch also allows for an area-based angle measurement.

With a multisensor coordinate measuring machine, all dimensional measuring tasks arising in a company can usually be solved. Due to the versatile combination possibilities, new measuring tasks can often be solved with the existing device. If the measuring speed is to be optimized or completely new requirements are added, new sensors, as well as hardware and software components, can be retrofit according to the modular principle.

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Masthead

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