

# Creating Measurement Sequences Efficiently

## Multisensor Coordinate Measurements Using CAD Data

**PRACTICAL TIP** The programming of coordinate measuring machines can be very time-consuming, especially for complex workpieces. If a 3D CAD model is used to help with programming, this process can be accelerated significantly. This can be done either “online,” directly on the machine, or “offline,” at a workstation away from the machine, so that the machine remains available for measuring workpieces.

**THE FIRST STEPS** for machine programming using digital models were taken in the 1980s, when CNC measuring projectors were used to measure aluminum profiles. The measurement programs were created offline using the same software that was used to create the CAD model. The measurement programs that this produced were then translated into control code for the measuring machine by a post-proces-

sor. In conjunction with the integration of this function in the actual measurement software for machines in 1996, Werth Messtechnik introduced the terms 2D CAD Online and 2D CAD Offline. At first, image processing sensors were supported, then later came additional sensors, especially trigger and scanning probe systems, as 3D CAD data became usable. Online programming using 3D CAD models allows ergo-

nomous, interactive operation here as well (Figure 1). Today, using modern software, complex measurement sequences that use a wide variety of sensors can be created entirely from the 3D CAD model both online and offline.

One of the great advantages of programming from a CAD data set is that no manual positioning of sensors is required. This applies to image processing, optical

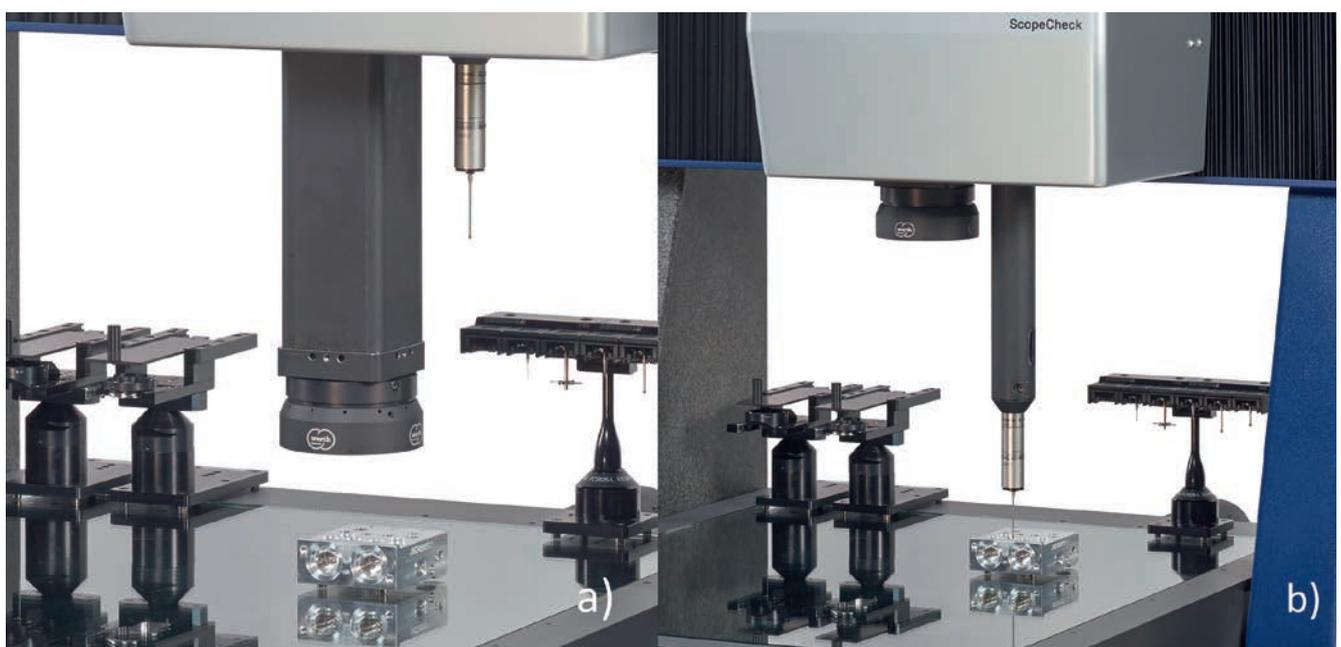


Figure 1. Programming from a CAD data set for ergonomic multisensor measurement. Application example: combined measurement using image processing (a) and tactile probe (b) (© Werth Messtechnik)

distance sensors, and the various tactile sensors.

### Positioning Image Processing Sensors Automatically

The advantages are especially evident for high-precision measurements using image processing. Relatively high magnifications are used here in order to achieve the required resolution. This means that the field of view is small and depth of field is short, which means that only a relatively talented operator has the finesse to manually position the sensor.

For example, in order to determine the diameter of a hole that is larger than the field of view, the sensor must move to several positions to take a measurement "on the image." The position of a segment of the circle to be measured is captured in each of these sensor positions. With CAD support, this process occurs automatically when the appropriate CAD element is selected. Such functions are available for measuring a wide range of geometric elements, and CAD curves and patches can be selected for measuring in the graphic image.

### Distance Sensors Measure Surfaces

The use of distance sensors has been similarly simplified. For example, when measuring a surface to determine flatness, the geometric element should be captured as fully as possible. To do so, meandering or spiral paths are often used when scanning. Often, however, the surface to be captured is interrupted with steps, holes, or other structures. It is also possible that only certain areas of the surface are functionally relevant.

In such cases, the surface must be divided into sections, scans programmed for each section, and the results merged after scanning. It is much more efficient to let the software handle this task, using the CAD data as a basis. WinWerth automatically detects interruptions in the surface and adjusts the scanning paths (Figure 2). Users are also actively supported for measurements in deep, blind holes that are very difficult to see into. With the click of a mouse on the desired patch in the CAD model, the software automatically calcu-

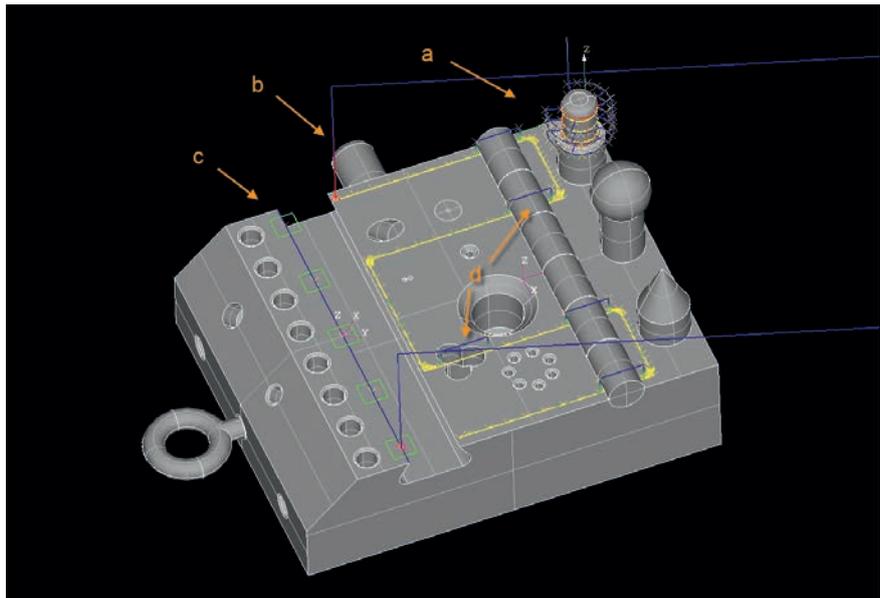


Figure 2. Measurement sequence using various sensors on a 3D CAD model: a) measuring probe system, b) laser, and c) image processing. Travel paths are marked in blue, scanning paths on the CAD model are yellow, and measurement windows for image processing are green. Interruptions in the CAD patch, such as holes, are detected automatically (d). (© Werth Messtechnik)

lates the travel path and captures the desired measurement points when using 3D CAD Online. This minimizes the risk of collision, as any obstacles on the workpiece are taken into consideration when calculating the travel path.

### Tactile Sensors Scan 3D Surfaces

Especially for tactile measurements there is a substantial risk of collision between the sensor and the workpiece. When creating measurement programs, the user must carefully consider all clearance positions. In order to measure a cylinder with tactile points, for example, the operator must define five measurement points in advance, along with many clearance positions.

Today a single mouse click on the element to be measured is sufficient. When using tactile probes in scanning mode, the software can handle the automatic distribution of scanning paths using predefined strategies. For example, cylinders can be measured as surface lines, circles, or helical lines, and planes can be measured using meandering paths, star patterns, circles, or spirals.

The time saved by creating programs with CAD Online and CAD Offline is sub-

stantial. For complex workpieces, the programming time for creating a measurement sequence on a CAD model can quickly be reduced by several hours per workpiece.

Another advantage of offline programming is particularly relevant for production monitoring. Even before the first workpiece has been made, the measurement program can be created offline. The workpiece can then be measured immediately after it is produced, and corrections can be made as needed. This minimizes downtime of the measuring machine and the production machines, increasing the efficiency of the entire production chain. ■

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