Inspection is an essential part of any quality program, but can be a time-consuming process. Now more than ever, companies are on the constant look out for ways to reduce the time and cost of getting their product to market or responding to their customers, without compromising quality. One method of doing so, which is gaining popularity, is computed tomography (CT), a technology which opens up new possibilities for measuring quickly and accurately without the need for pre-treatment or destruction of the product.

The manufacturing process often requires the measurement of complex parts, such as medical valves or precision, multi-cavity, injection molds. In addition to the dimensional inspection of workpiece functional elements, typically with tight tolerances, evaluating such products often involves the inspection of free-form surfaces.

Complete acquisition of such components requires the use of many rotary and tilt positions. Programming of such measurements requires experience and is time-consuming. Some sensors also require that the component be pretreated, such as being sprayed with white paint to obtain sufficient contrast for optical measurement.

Computed tomography, however, offers increased speed without compromising accuracy, enabling the complete measurement of a part in a single measurement run. It works by placing a workpiece on a revolving stage and rotating it through 360 degrees. X-ray images are taken at several orientations, measuring the sizes, angles and diameters of the structures inside the part.

The scanner processes the CT measurements, and quickly constructs a 3-D point cloud of the entire part with all surfaces and inner geometries, including voids and bubbles. This information is combined with exact measurements of tight tolerances, taken with tactile and optical sensors.

In the Werth Tomoscope, an image processing sensor enables the operator to make fully automatic, highly accurate measurements of compli-
cated, extremely low-contrast work pieces in the back-lighting and surface-illumination mode. An additional laser sensor allows for the measurement of surface profiles. Tactile sensors with probe tip diameters down to 20 microns enable measurements of workpiece characteristics which are inaccessible to optical sensors.

The reconstructed model describes the complete geometry of the workpiece, including interior geometry and undercuts of complex components. The point cloud can be evaluated by software for all types of applications—inspection, FOT testing and first-article inspection.

The precision of tomography was originally limited by disturbance effects that lead to false interpretation, and a large number of system parameters which are unknown or not constant. However, when tomography is combined with precision sensors; rapid, complete workpiece acquisition is possible. A mathematical process allows correction of the process-related errors in computed tomography.

This can be done by acquiring control points on the workpiece with a high-precision sensor, and correcting the surface of the CT-generated point cloud so that the deviations between the control points and the CT point cloud are minimized. This allows manufacturers to obtain measurement points using computed tomography with unprecedented speed and accuracy.

Such systems have considerable potential for improving any quality programme, particularly where there is a need for inspection of free-form surfaces. Good examples of applications are measurement and digitising of plastic, light metal and graphite parts. Current usage includes inspection of metal aerospace and automotive parts, as well as plastic parts such as mobile phone casing and medical inhalators.

**Proven technology**

Companies who produce precision components, medical devices or turbine blades for example, must maintain very tight tolerances, to meet tightly regulated production requirements. When supplying products such as inhalator valves which will be relied upon to deliver the correct drug dosage to a patient, it is essential to produce parts without a single defect, as even minor variations can be costly.

The 3D image produced by the Tomoscope, quickly details every feature of the component, allowing for the very quick, thorough inspection. Proven sensors from multisensor CMMs ensure measurements are traceable to the standard of length, the metre, maintained by the UK’s national measurement institute, the National Physical Laboratory.

The high-powered image processing system allows for reliable and automatic measurement of objects, even when there is low contrast and object characteristics fluctuate. Measurements made with a combination of X-ray, optical image processing, 3-D tactile—dynamic scanning and touch trigger—and laser sensors extend the flexibility and application range of this new CMM technology. This makes the Tomoscope an exceptional piece of measurement technology for the workshop and the laboratory.

The precision specification of the instrument is in accordance with standards and guidelines for coordinate measuring machines (ISO 10 360 / VDI 2617), so that it can be compared with typical measurement machines. Length measuring error when using the appropriate sensors and magnifications, is, for instance, \( E_3 = 4.5 + L/75 \) micron.

The benefit to the user is that of increased speed and reduced chance of scrapping good parts or keeping bad parts. Ultimately this means less time spent on inspection, without compromising quality. This allows companies to develop products and respond to their customers more quickly.

This can have a significant impact, especially in competitive, growth industries where accuracy is of the utmost importance, and speed can be an important factor in winning and retaining customers. Furthermore experience across Europe and the USA shows that by reducing time spent on inspection, these systems represent significant opportunities for cost savings.

Manutech Sales are the UK distributor for Werth Messtechnik’s measurement machines

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