

3D NON-CONTACT MEASUREMENTS

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1. Introduction

Measurements are obligatory steps in every production process. Quality of products is closely related to the measurements and these links are given in the cycle of quality assurance. Inspection and measurements of products are carried out in all phases of product development. Control and measurements are undivided part of production in automatized and mass production. Every type of production contains its own type of control and measurement.

All methods of measurements can be divided into tactile and optical. That was the base for construction the measurement devices for appropriate conditions. Classical measurement devices were not discussed in this paper. The topic of this paper are coordinate measuring machines and various kind of probes.

2. Coordinate measuring machines

Coordinate measuring machines are modern systems for inspection of workpieces and machines and for reverse engineering purposes. CMM's enable fast and accurate inspection of workpiece characteristics and features such as holes, gaps etc.

Probing systems of CMM's as main parts of coordinate measuring machines can be:

- tactile such as a touch trigger sensors and
- optical laser sensors.

These two groups of probes have a lot of advantages compared to conventional devices. Nevertheless, the optical sensors are more efficient in scanning features such as holes, slots and gaps. This devices are typically used in automotive applications. Traditionally, features are inspected using tactile probes mounted on CMM's.

3. Scanning possibilities of CMM

Scanning techniques were applied for probing metrology with high speed non-contact approach for future measurements. Laser scanners have already proven their use and benefits in areas of quality control such as first article inspection, off-line inspection and troubleshooting. Compared to traditional touch probe testing, laser scanning enables fast acquisition of accurate 3D pointcloud models that can be subsequently used for full part inspection or reverse engineering applications. However, fast and accurate inspection of features such as holes, slots, gaps are kind of a challenge in modern measurements.

Scanning devices can be mounted on CMM to increase possibilities of CMM's. The latest invented type of scanner is cross-scanner. This sensor is specially intended for measurement purposes. It consists of three laser striped scanners, whose planes are rotated by 120 degrees. The total throughput speed of the scanner is three times 6400 points per second, meaning 19200 points per second. The single laser stripe scanning method measures the intersection of a laser plane with an object from a single view direction.



Fig. 1 The Cross Scanner (Metris XC)

The lightweight scanner is a laser stripe sensor which operates by projecting laser line onto the surface of workpiece while a CCD camera views the line as it appears on the surface. This approach cannot capture information outside areas that are not viewable by both the laser plane and the viewing direction. This characteristic of single laser stripe scanners requires that multiple zones must be taken from different directions. Objects having several features require at least three scanners to obtain a sufficiently detailed digitised surface.

The cross sensors introduce a number of advantages that represent a breakthrough for laser digitising. A higher speed and increased flexibility are obtained for real 3D measurements by avoiding the use of an motorised six axis that can introduce errors compared to a traditional laser stripe scanner mounted on.

Another important advantage is better resolution of special scanner for future measurements since the object is digitised with an optimal density in all directions.

The most important is achieved by having real 3D measurements resulting in an accurate representation of the measured feature. The cross scanner consists of three cameras that are distributed over 120 degrees and slightly tilted.

3. Area of applications

Typical applications are found in automotive industry where features, holes, slots are present. The inspection of sheet metal products and work pieces uses 3D measurements. Especially these kinds of measurements will be used in molded plastics such as cell phones and similar parts, as well as in power equipment with complex geometry features like blades.



Fig. 2 Typical applications of cross scanning

For special measurements where fast, accurate and better results have to be obtained, laser measurements are important devices. The data acquired using

laser scanner are used for comparison to the nominal data of product and produced workpiece. The data can be used for reverse engineering.

Inspection using 3D measurements is future way of measurements in production of parts with narrow tolerances, in automation of measurements, analyses of thickness of walls of thin walled constructions.

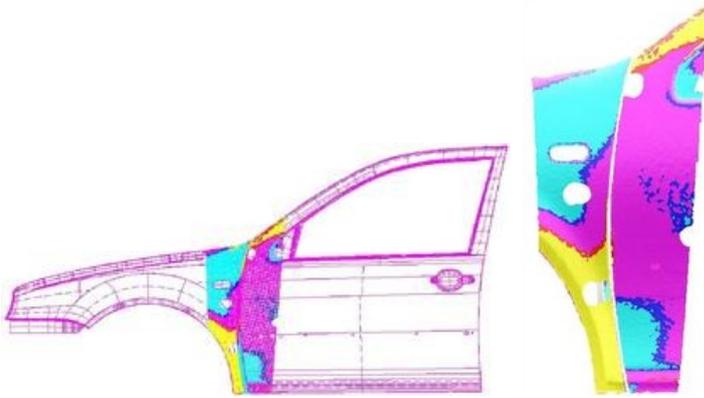


Fig. 3 Typical application of cross scanning

The measured data can be used for automatic alignment of surface normals, smoothing of pointclouds, mesh quality diagnosis, easy dimensioning and other.

4. Conclusions

3D measurements with laser cross scanner mounted on CMM is the contemporary manner for fast, accurate and reliable data acquisition in modern industrial and research applications. Besides this new designed device there are several other laser sensors with weak possibilities in measurement tasks. The touch trigger technique is present in automotive parts inspection, but scanning techniques with cross scanner have numerous advantages.

5. References

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Summary

Quality of products depends on various factors. The most important are inspection and measurements. Workpiece and finished part or final product have to be controlled in all phases of manufacturing. Parts in automotive or medical devices production, time saving devices, sport equipment, have to be controlled in all phases of production. The most important usage is in sheet metal workpieces inspection. One of the latest invented technique is a scanning method with cross scanning laser devices. This paper treats advantages and areas of use of this laser scanning method.

Key words: CMM, laser measurements, cross scanner