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Influence of normal vectors on the accuracy of product's geometrical specification

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Abstract

Today, there is high demand of quality evaluation of products in terms of dimensional control through 3D measurement technology in automatized production environment. Each product has a geometric surface structure formed by a series of geometric elements, e.g. shape, dimensions, which together generate the actual integral surface. To determine the size of the product on 3D coordinate measuring machine, we need to associate the expected ideal geometric elements (e.g. line, cylinder) to non-ideal (integrated) real surface. The paper deals with the normal vectors, which have to be taken into account at each measured product and the creation of the measuring program, because incorrect choice of these vectors can influence the measuring process in such way, that result will not be the true value of the measurement of geometric elements.

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1. Introduction

Many of metrological laboratories and quality control departments are equipped with various modern measuring devices. The market contains a wide range of devices that simplify work of control employees and these devices also open up new opportunities for research and checking geometrical product specifications. By combination of these

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various measuring equipment, accessories and strategies allows us to compare measurements of the product specifications with drawing documentation or CAD model.

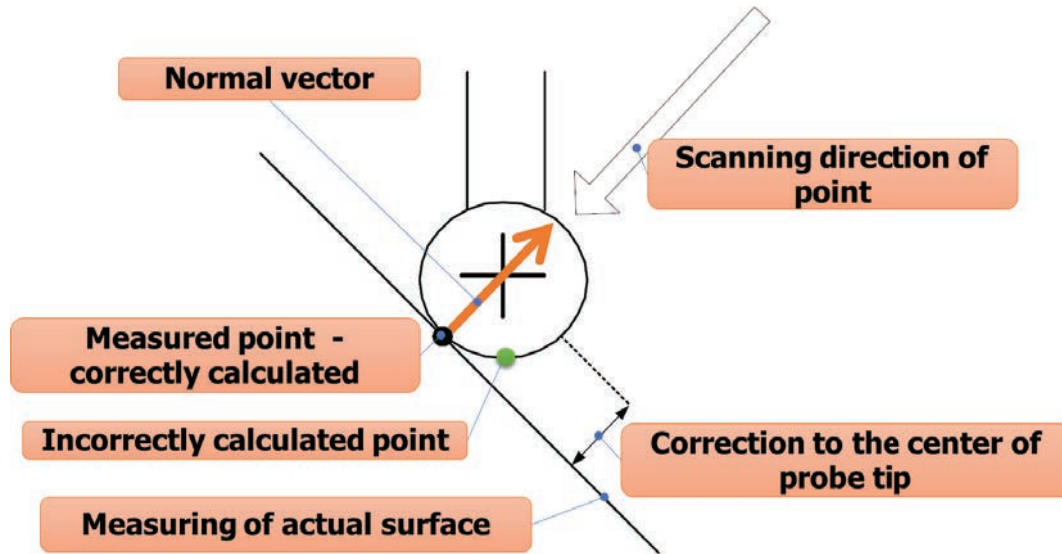


Fig. 1. Effect of the normal vector to the accuracy of the scanning points

In the result of the contact measuring method is included - the geometry (shape and size) of the scanning element (sphere), position in coordinate system and the geometrical shape of the measured surface. Position of scanned contact points can't be determined without mathematical correction of the known coordinates of contact sphere's center. For precise correction must be measured scanning shape element (correction of scanning sphere). In addition, it is necessary to scan more points on the measured geometric element. The error arises from the omission of the correction depends on the diameter of the probe sphere, so that the smaller the diameter, the less error. Large diameter probes can inhibit small deviations of structure in the surface layer of the product. This mechanical filtering can either positive or distorting affects on the results [1,2].

Tip of contact measurement probe touches the component by its circuit and its center of radius is determined by comparative measurement with a gauge. If the center and the radius tip are known, then the scanning head touches the workpiece and coordinates are mathematically compensated towards tip radius to the point of real contact. Compensation direction is determined automatically by the method of rectification. [3,4,5]

The choice of a proper measurement strategy (method of sensing points) depends mainly on the shape of the measured components and the required precision of measurement. Distribution and number of measuring points are important.

The higher numbers of points we scan, the more accurate measurement we get. In terms of measurement accuracy it is very important to know which point of the measurement object is scanned. The various types of contact points also contribute to the formation of measurement uncertainty. A major step in the development strategy of measuring is the extraction of main geometric elements (e.g. point, plane, straight line, circle, cone, etc.) from the surface of the inspected object. Any geometric element is constructed in program for operation of measuring devices based on a number of scanned points, taking into account the normal vectors. (Figure 1) [6,7]. These scanned points contain information about the normal vector on which the measuring device knows in which direction and position of scanning has to scan the points of the relevant geometric element. The article deals with the normal vector, which we must take into account at each measurement component and the creation of the measuring program, because incorrect choice of vector or his conversion can affect measurement process affect adversely, that the result will not be the actual value of measurement specifications, but false value of the measurand.

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