MODERN MEASURING METHODS AND EQUIPMENTS

Yusufjonov Otabek G‘ayratjon o‘g‘li
assistant of “Applied Mechanics” department, Fergana Polytechnic Institute.
Ruzaliyev Xojiakbar Shermaxammad o‘g‘li
assistant of “Applied Mechanics” department, Fergana Polytechnic Institute.

Abstract. In order to increase the functional, useable, spatial, and aesthetic values of architectural items by valorisation—the act of quantifying and modeling them—the author tackles the subject in this article. Above all, the laser scanning method, which yields results in the form of a point cloud, enables the user to obtain a very detailed, three-dimensional computer image of the measured objects and to conduct a number of analyses and expert investigations, such as those into the technical condition (deformation of construction elements) and the spatial management of the surrounding environment, all the while the measurements are being taken and processed.

Keywords: 3D scanner, signals, measuring machines, coordinate measuring machines.

СОВРЕМЕННЫЕ ИЗМЕРИТЕЛЬНЫЕ МЕТОДЫ И ОБОРУДОВАНИЕ

Аннотация. Чтобы повысить функциональную, полезную, пространственную и эстетическую ценность архитектурных объектов путем повышения их ценности — акта их количественной оценки и моделирования — автор решает эту тему в этой статье. Прежде всего, метод лазерного сканирования, дающий результаты в виде облака точек, позволяет пользователю получить очень детальное трехмерное компьютерное изображение измеряемых объектов и провести ряд анализов и экспертных исследований, таких как в техническое состояние (деформация элементов конструкции) и пространственное управление окружающей средой, в то время как измерения проводятся и обрабатываются.

Ключевые слова: 3D-сканер, сигналы, измерительные машины, координатно-измерительные машины.

One of the most cutting-edge measurement techniques is used because a 3D scanner is used in many areas of the building industry, geodesy, and other industries. A 3D scanner-assisted measurement session produces a large number of points, allowing us to precisely represent the scanned object. Using a Leica ScanStation C10, which was employed in this work, which can register up to 500 000 points per second, this technology may provide scans very quickly that are incredibly accurate. A three-dimensional model of an object is created using a point cloud, which is an accurate representation of the scanned space and can be freely manipulated.

The results of the scanner are visually attractive and easily processed, hence the variety of their use in different spheres of life. Only in civil engineering and architecture, scanners are a universal tool useful for inventory, as well as plans and projects of buildings, preservation of historical buildings or analysis of deformations of building structures. Three-dimensional scanning can modernize and accelerate construction processes, in which it meets the expectations of the modern construction market.

Laser scanning is a cutting-edge measuring technology, which is still developing rapidly. This technology has an almost unlimited range of applications in many domains of contemporary engineering, where precision and high quality of performed work is of the utmost importance. Architecture and urban space studies are worth being distinguished among these disciplines, as they shape the space and ambient environment occupied by people, thereby having an immediate effect on their lives. Making measurements with a laser scanner is a more complex undertaking than with more traditional measurement implements, like a laser rangefinder or a measuring tape, and must adhere to a specific procedure, the aim of which is to obtain three-dimensional coordinates of buildings in their surrounding space. Accuracy, rapidness, safety and non-invasiveness are the principal advantages of this technology which appeal to

attract building engineers, who use 3D laser scanner in practice, for both historic and contemporary architecture. Using laser scanning is particularly fitted for large-scale engineering objects, where application of traditional techniques would be much more cumbersome as well as time- and labour-consuming due to the presence of some hardly accessible areas and the geometric complexity.

Coordinate measuring machine (CMM) - a device for measuring the geometric dimensions of an object.

The machine can be controlled manually by an operator or automated by a computer. Measurements of the coordinates of the surface of an object are carried out by means of a sensor (probe) mounted on the moving part of the machine.

Measuring sensors differ in principle of operation (electro-contact, inductive, optical, capacitive, piezometric, tensometric), output signal (analog, discrete), measurement method (contact, non-contact), type of measurement (scanning, trigger) and others.

The classic model of a control and measuring machine (CMM) is represented by three axes - X, Y, Z. The axes are perpendicular to each other and form a typical three-dimensional coordinate system. The operator or computer instructs the coordinate measuring machine to read data from the sensor. Next, the machine determines the X, Y, Z coordinates of each of the given points. Based on the data of these points, all further calculations are made. [1].

Works performed with the help of a control and measuring machine:

- Measurements of geometric dimensions of parts;
- Measurements of the profile of parts;
- Measurement of deviations from the technical requirements of the drawing.

The quality manager has a responsible task: to check the quality and ensure that the manufactured parts meet customer requirements, specifications and tolerances. To do this, experts mainly rely on coordinate measuring machines (CMMs), which are the most accurate and reliable metrological equipment.

Today, there are several alternatives in the metrology market that allow quality control professionals to offload CMMs and make accurate measurements in the manufacturing process directly on the shop floor - handheld 3D scanners and portable CMMs. In practice, the measurements made using these alternative solutions are insensitive to external interference and, most importantly, very accurate. [2].

In recent decades, market interest in high quality products has grown significantly. Manufacturers have to produce higher performance products to meet these expectations. To guarantee high consumer properties and product quality, it is necessary to check the quality of a larger number of parameters and do it better. Accordingly, technical control departments need more metrological equipment and, accordingly, more metrologists-operators.

The new tools in the metrology suite offer two important benefits:

1. The load on the CMM is reduced to an acceptable

This is relevant in cases where bottlenecks at the stage of control using CMM arose so often that important criteria had to be sacrificed - the representativeness of the sample and the frequency of inspections. Since adding the alternative of a handheld 3D scanner to your metrology toolbox offloads the CMM, you can return to the same quality control standards.

2. Working with 3D equipment does not require high qualifications

Portable solutions can be used by less skilled non-metrologists. This will greatly facilitate the task of QCD managers, since experienced metrology specialists are often hard to find. New employees will learn the ins and outs of the job faster, which reduces the risk associated with employee turnover, especially in large companies. Training new employees will be faster and easier. Experienced metrologists will be able to devote themselves to equipment that requires more experience, such as CMMs. [3].

Coordinate measuring machines will always be at the forefront of metrology laboratories. This is by far the best and most accurate metrological equipment. That is why it should only be used for specific, important and precise inspections such as first product geometry inspection and final inspection of parts with tight tolerances. For

such tasks, the CMM is the optimal measurement tool that cannot be replaced by another technology.

However, consideration should be given to reducing the load on CMMs by adding alternative solutions to the metrology kit - portable 3D scanners and CMMs. Since these technologies are specifically designed to eliminate external interference (they use optical components to do this), it is possible to increase the number of inspections in production areas. In addition, these gauges are easy to use and set up, and therefore accessible to less skilled workers. [4].

Finally, not only can quality control standards be restored, but more inspections can be carried out, which makes it possible to improve the process, increase productivity and obtain better quality products.

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