POSITION SYSTEM FOR ULTRASOUND SCANNER FLAW DETECTION WITH CONTROL OF STL FILES

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СИСТЕМА ПОЗИЦИОНИРОВАНИЯ УЛЬТРАЗВУКОВОГО СКАНЕРА-ДЕФЕКТОСКОПА С УПАВЛЕНИЕМ ОТ STL ФАЙЛА

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Аннотация. *Данная работа посвящена созданию системы позиционирования для ультразвукового сканера-дефектоскопа. Особенностью данной системы является возможность исследования объектов абсолютно любой формы без построения дополнительных алгоритмов исследования объекта, посредством управления головкой сканера заранее полученным STL файлом, что позволяет значительно снизить время исследования объекта.*

To date, in any industrial production there is the problem of marriage in products. Often, when standards of manufacture's quality are required we can see, that product obtained will not meet the quality requirements stated. A small defect on the surface or inside the product could result in higher costs and unfortunate consequences. To prevent unnecessary costs and preserve the reputation of the company, the manufacturers drew attention to detect these defects and to prevent substandard products into turnover.

Today, there are many ways to determine the presence of a defect:

- The method of deviation from the nominal value

In this method, one or more physical parameters are compared with original calculated nominal values of the parameters of benign details. With this method we can only detect the presence of a defect; its size and position in the details remain unknown. This method is simple and does not require huge investment of resources and time, but it will not give us any information about the location of the defect.

- Method of obtaining one projection

This method considers detail only in one projection, we will see all defects from one side only. We cannot determine the exact location of the defect in the details as in the previous method.

- Multi-axes method

In this method, the object is viewed from several sides, and then the data is synchronized, and we can see the model of the detail. By increasing the number of projections considered, we can significantly increase the accuracy of determining the position of the defects in the part.

This research considers the measurement method in multiple coordinates, because this method can provide more complete information on the defects of details. In order to get information not only on the presence, but also the position of the defect in the detail, we need the exact coordinates of the binding defect to the parameters of the details. To do this, in turn, we need to organize a positional system of the measuring element, which allows to determine the location of the sensor relative to the details.

Possible embodiments of the positioning system measuring element in the multi-axis scanners:

- Mechanical system

The principle of operation of this system is that the sensor moves along a specially exposed legs through the control of motors. Coordinates of the sensor are determined by reading the steps of the motor in either direction. The movement sensor may be implemented by a pair of helical, V-belt transmission, gear reducer and in many other ways. The company «StepMotor» offers positioning system «DriveSets», whose accuracy in a special mode achieves a precision of 0.025 mm. To achieve this result in practice is difficult, because screw set not give a precise movements, and the length of the belts of plastic and rubber depends on the temperature, which can cause backlash, and later inaccurate measurement [4]. The disadvantages also include cumbersome installation, because legs occupy the major portion of the space. Changing the position of the sensor is occupied most of the time, which can be avoided in other positioning systems. The advantages include ease of implementation only.

- Moving manipulator

A feature of this system is the ability to move positioning of the sensor at the details, but not moving the sensor along it (Fig.1). Coordinates sensor detects the amount of turns the wheels or rollers special reader in one direction or another. Such a positioning system may be used to locate defects in the items of simple shape such as rails or pipes.

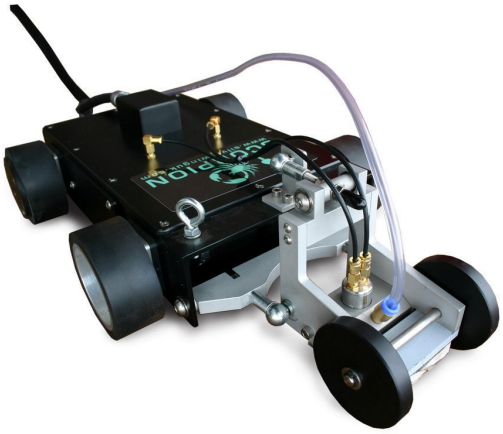

Fig. 1. Roll flaw Silverwing Scorpion BP

The company "Spectrum" provides non-contact ultrasonic flaw detector scanner "A2075 SoNet» with the accuracy of positioning of 1mm. The advantages of this method are the portability of the device, high-speed operation (7m/min), as well as the ability to scan large objects that are difficult to access or rather cumbersome to move. The disadvantage is inability to work on the details of complex shapes and low positioning accuracy.

- Ultrasonic triangulation method

This method is based on the detection waves emitted by three ultrasonic sensors, and determination of the relative position coordinates obtained by the ultrasonic sensor signal. The implication is that the distribution of

the ultrasonic waves will be registered through the vibration transmitted detail. The algorithm for calculating the coordinates obtained of the shape of measurement surface [1]. The method has several advantages as follows: clarity of mapping defects, work in real time, an opportunity to focus on problem areas. Disadvantages of this algorithm is a complexity in obtaining coordinates, inability of working in the automatic mode and also dependence on ultrasound velocity by the environment temperature.

- Optical positioning (optical tracking)

Work of optical tracking systems is based on the same principle as the human stereoscopic vision. Since a person sees with two eyes, he is able to determine how far away an object is and how it is oriented. For the construction of an optical tracking system using from 2 to 24 cameras operating in the infrared and passive infrared reflectors (or active infrared beacons) on disposable objects, the position and orientation of which is necessary to define [2]. Advantages of optical tracking systems are relative simplicity and low cost, small size and weight of the reflectors, the possibility of passive reflectors that do not require power. Disadvantages of optical tracking systems are necessity of accurate calibration of cameras. The larger work area, the more cameras should be installed and the harder the calibration procedure becomes, the low positioning accuracy and angles, the need for direct line of sight between the cameras and reflectors, difficulties in identifying passive infrared reflectors located at different sites.

- Electromagnetic positioning

In the electromagnetic positioning the measured magnetic field strengthens. The magnetic field is the result of passing a current through the electromagnetic coil. The current passing through the coil turns it into electromagnets that can determine its position and orientation in space [3]. Such a system does not work near any metal objects and devices that can affect the electromagnetic field. The advantages of both electromagnetic positioning is good accuracy of the coordinates and angles, does not require time-consuming calibration with a specially prepared room, works with details, which have a complex shape. Disadvantages of the system is necessity to build a specially prepared room that does not contain metallic elements, magnetic sensor mounted on a moving object cannot be made because of the large wireless energy consumption.

In my research, we used a mechanical positioning system, as well as made the laboratory setup for the practical test. In the future we plan to abandon the mechanical positioning system, and to design a system of ultrasonic triangulation for a portable device that allows the system to form a positioning accuracy of which is independent of the mechanical parameters.

REFERENCES

1. Agranat, B. (2007). Fundamentals of physics and technology of ultrasound. The Highest School
2. Kozlowski E. (2002). Art positioning. Around the World, no. 12 (2795). P. 204–280. M.: Retrieved December 1, 2006.
3. Karshakov E. (2003). The calibration of the electromagnetic system relative positioning. UBS, 37, Retrieved October 13, 2006. 250–268 pp.
4. Sawicki S. (2012). Methods and means of nondestructive testing. Electron, 2012, p 54.