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Possibilities of 3D laser scanning

Andrej ČERŇAVA, Pavol KUDELA
University of Žilina, University Science Park, Slovak Republic
{Andrej.cernava, Pavol.kudela}@uniza.sk

Abstract

The perspective of using modern technologies in production processes is more and more promoted in 3D scanning technologies. These technologies are mostly used to control products, reverse engineering, control of quality etc. Therefore, this paper describes 3D laser scanners that are located in University Science Park of the University of Zilina. Laser 3D scanners are now considered to be the most accurate devices due to product verification and prediction of adverse effects. In this paper, possibilities of digitalization by the 3D laser scanners will be described.

Keywords: 3D scanners, digitalization, laser

Introduction

Section of Intelligent manufacturing systems is now considered to be one of the key in the Slovak Republic and Europe. In this section reverse engineering is introduced. Its main task is digitalization of existing objects of different sizes.

Digitalization of objects has developed considerably in the last century and has now been modified to the latest version of 3D scanning modern technologies.

History of 3D scanning

In the initial experiment, the 3D digitalization was the biggest obstacle in spatial complexity of an object´s measure in space. First scanners were developed in the 80s. Main disadvantage of such device was its lengthy measurement. However, this device was still able to create detailed models.

Moving towards the development, optical probes were able to measure faster compared to touch probes and they also had a great advantage because there was no need of contact with a measured object in order to prevent its damage. The most modern and latest technology belongs to devices capable of rapid frequency scanning of the objects without touching.

Its big advantage is the high precision and ability to identify impassable holes. Its main disadvantage is its higher price.

Dividing of 3D scanners

Thanks to the technology of 3D scanners, it is possible to capture a three-dimensional real object in a digital model. Most of 3D scanners are based on a principle of capturing points with a result of object being recorded in a computer that appears as a cloud of points. From the perspective of using scanning technology, it is possible to divide it into the following types:

- Touch
- Touchless
- Mechanical
- Optical
- Laser
- Destructive
- Ultrasound
- X-ray

Operating principle of 3D laser scanners

Laser scanners use transmission of laser beams that are reflected on the surface of a scanned object. Recorded time and the angle of reflection of the laser beam return to the scanner. Based on these parameters recorded data of points and these points create a 3D model in a computer. While laser beam being thicker, digital model is more accurate.

The main disadvantage of laser scanners is the inability to capture the texture of the scanned model. In order to resolve this problem, laser scanners are used in a combination with optical scanners.

Moreover, the advantage of a laser scanner is its ability to identify non-penetrating holes.

Operating Principle of 3D laser scanners

Mantis Vision F5

It is a small, light, compact and hand 3D scanner consisting of video camera and light projector.
This device is mounted at the ends of an anodized dowel. Mantis Vision Camera MVC projects infrared light onto the scene through a slide. The light source of the Mantis Vision projector is an 808nm VCSEL ARRAY Laser. Its beam is shaped and manipulated in order to achieve a suitable beam profile needed for our application. The laser source itself emits a beam with a maximum power of QCW 30 watt (class 3B). [1], [2].

Scanner specifications:
Imager size: 33cm x 16cm x 6cm
Field of view (VxH): 38° x 44°
Simultaneous Imaging Range: 0.5m - 4.5m
Single frame Accuracy: up to 0.5mm at a range ≤ 1m
3D Resolution: 50,000 points/frame 10 frames/second
Continuous acquisition time: 1 hour
Eye safety: Class 1M

Figure 1 – Mantis Vision F5

Kreon Aquilon 3D laser scanner

This device is suitable for precise measurement of parts with the precision up to 5 µm. This high precision can be applied in mechanical engineering or in automobile industry when checking produced parts of simple as well as complicated shapes. The device works with the MetrologX software. Thanks MetrologX a digital model is created to compare a virtual and scanned model.

Scanner specifications:

- Speed: 1 000 000points/sec.
- Accuracy: 5 µm
- Laser line width: 50mm
- Line resolution: 25µm
- Stand of distance: 60mm
- Field of view: 75mm
- AQC
- Temperature compensation
- Red class 2M laser [3]

Improvement of production quality is one of the qualities. This is thanks to faster quality measurement of complex parts and possibility of storing exact data of individual products for a long period of time. Thanks to this data, it is easier to identify a repeated mistake that can be made during production of parts. Therefore, it helps us to find out more about imprecise production.

Figure 2 – Kreon Aquilon

Faro Focus X330

It is a portable 3D laser scanner with a rotating mirror, wifi and touch display. This device can be used for scanning of building and big constructions with no need of ultimate precision.
Device parameters:

- Range: 0,6-330m
- integrated camera 70 Mpx
- Scan speed: 976 000pts/sec

- GPS module
- Location precision of point 1mm to 25m by 90% of reflectivity
- Visual field of 360° horizontally x 300° vertically
- Integrated colour display with 50 Mpix resolution, with automatic brightness correction
- Integrated scanner control with no need of external displaying device
- Integrated hard disk
- option to use scanner from a PC
- option to use scanner via smartphone or tablet (remote-controlled)

Device uses a tripod, 5 reference balls and accessories for a mobile function. All these parameters and accessories improve and facilitate work.

Figure 3 – Faro Focus X330

Conclusion

Fast product control is very important nowadays, since the production has increased and product imprecision can result in a huge waste of time. That is why production companies are constantly seeking possibilities of product control. Modern 3D laser technologies can now store checked information. This helps in foreseeing potential sources of imprecision that emerge at the beginning of production. 3D laser technologies used in reverse engineering represent a tool for a company productivity increase. One of the main advantages is no direct contact with a scanned item during digitalization. That is why 3D laser scanners are considered to be the future in the field of digitalization.

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