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## REVERSE ENGINEERING AND 3D SCANNING IN THE AIRCRAFT INDUSTRY

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The article discusses modern methods of designing parts used in the aircraft industry, such as reverse engineering and 3D scanning. The tasks that can be solved using these methods are described. The process of designing parts is described, and the principle of operation of the laser scanning unit is considered. The advantages of these methods are presented.

There are a lot of different modern technologies in the world today that simplify our lives and save our time. There are also a lot of different technologies that are being developed and implemented in various industries. The aviation industry is no exception.

Aircraft engineering is one of the promising areas where the introduction of additive technologies, such as reverse engineering and 3D scanning, will make aircraft design easier.

These new technologies will help solve problems such as reducing the weight of aircraft, creating products with unique properties and geometrically complex parts, reducing the production cycle and costs, and of course saving materials and equipment.

Reverse engineering is the creation of parametric surface and solid-state CAD models of any complexity with a given accuracy relative to scanning data [1].

The initial process involves the scanning of the components with a 3D scanner, which can scan both large-sized and small-sized parts, and can also scan parts of varying complexity. The component is scanned, and subsequently the program creates a cloud of points similar to this part.

A point cloud is a large set of points obtained using 3D laser scanning or other technologies and allows you to create 3D representations of existing structures.

Then the work is executed by such computer programs as the Geomagic Design. There this scan is processed, namely structured grids are created from these point clouds, holes are filled, their appearance is improved, and in the end you create planes, grids that repeat the contour of the detail. And then, for the convenience of work, one can switch to other programs for creating 3D models of components, such as Compass, NX. There is a large number of such programs, and they are available in different versions. And in the end, you create models of these components there [2,3]. Talking about a 3D scanner, let's look at the Hexagon ABSOLUTE ARM machine [4]. The principle of operation of the machines is based on calculating the coordinates of the measuring element of the machine using data from angular displacement sensors and data on the lengths of segments between angular displacement sensors.



Figure 1. General view of 3D scanning machine

Structurally, the machines are interconnected segments mounted on the foundation. They include a counterweight, a processor control board and a power supply as well.

A set of contact probes of different diameters, as well as contactless laser scanning systems are used as measuring heads. The machine is operated in a manual mode.

When using contact sensors, the coordinate of the center of the probe ball is determined when touching the measured surface.

When using a laser scanner, the coordinates of a set of points on the measured surface within the field of view of the scanner are determined. The coordinates of the points are determined by the width of the scanning window and the focal length, the values of which are different for different models.

Thus, the application of the presented new technologies provides a number of advantages: facilitating the design of parts, accelerating the launch of a product to the market, designing complex parts, optimizing existing resources, reducing costs, going beyond the existing capabilities and expanding design capabilities.

Now let's look at the advantages and disadvantages of 3D scanning. Advantages:

1. They make it possible to scan objects located at a remote distance and in places inaccessible to the presence.

2. They have the ability to "read" not only colors and images, but also to transfer the texture of the surface.

3. Significantly accelerate the process of "removing" data from any object, even very complex in shape, with a large number of planes.

4. A variety of models allows you to choose the most convenient version of the scanner, including a handheld or portable one that you can easily take with you.

Disadvantages:

1. Some scanners are not able to recognize transparent or black-and-white objects. In this case, their preliminary preparation (treatment with a special compound) is required.

2. I don't always display complex objects correctly, with a lot of inserts and partitions.

3. To get a high-quality result, they require skills and abilities to work with certain computer programs to create 3D models.

4. In case of constant violation of the rules of operation, it may be necessary to repair expensive equipment.

If you need high-precision and high-quality three-dimensional copies of objects, then you can not do without a 3D scanner. It makes it possible to work in almost any conditions – indoors and outdoors, and with any objects in appearance and size.

In conclusion, reverse engineering is the process of creating a solid-state 3D model of any object. This 3D model can be used to create technical documentation and drawings, repair, modification or production, as well as modeling physical processes. This technology is actively used in the automotive industry, shipbuilding, aviation, and industry

## **References:**

1. Reverse engineering [Electronic resource]. URL: <u>http://en.wikipedia.org</u> /wiki/Reverse\_engineering (Accessed 23.11.2023)

2. 3D Systems Geomagic Design X Software [Electronic resource]. URL: <u>https://www.ddmlab.ru/catalog/geomagic-design-x/</u> (Accessed 23.11.2023)

3. Overview of popular computer-aided design systems (CAD) [Electronic resource]. URL: <u>https://www.pointcad.ru/novosti/obzor-sistem-avtomatizirovan-nogo-proektirovaniya</u> (Accessed 23.11.2023)

4. Portable measuring manipulators | Hexagon [Electronic resource]. URL: <u>https://hexagon.com/ru/products/product-groups/measurement-inspection-hardware</u> /portable-measuring-arms (Accessed 23.11.2023)

5. Beiser, L. Short Course Notes from the SPIE/IS&T. Laser Scanning Technology in Scanners and Printers. Symposium on Electronic Imaging Science and Technology. San Jose, CA, 1991.