Секция 3. ФИЗИЧЕСКИЕ, ФИЗИКО-МАТЕМАТИЧЕСКИЕ, МАТЕРИАЛОВЕДЧЕСКИЕ И ТЕХНОЛОГИЧЕСКИЕ ОСНОВЫ ПРИБОРОСТРОЕНИЯ

REENGINEERING DETAILS BY ADDITIVE TECHNOLOGIES

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Abstract. Repair of body parts is a very responsible process because such breakdowns can destroy the protective function, make adjustments to the operation of the mechanism itself. Many repair methods are currently used, but they have significant drawbacks. Reengineering is a new perspective, and the use of additive technologies is one of the modern and effective ways to repair parts.
Key words: 3D-printing, 3D-scanner, reengineering, repair.

РЕИНЖЕНИРИНГ ДЕТАЛЕЙ С ИСПОЛЬЗОВАНИЕМ АДАТИВНИХ ТЕХНОЛОГИЙ

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Аннотация. Ремонт деталей корпуса – довольно ответственный процесс, так как такие поломки могут снизить функцию защиты механизма и оказывать нежелательное влияние на его работу в штатном режиме. На сегодняшний день используются множества способов ремонта элементов корпуса, однако, в каждом из них можно отметить значительные недостатки. Реинжиниринг – это взгляд на известные проблемы с новой стороны, а использование аддитивных технологий – один из современных и эффективнейших способов ремонта деталей корпуса механизмов.
Ключевые слова: 3D-печать, 3D-сканер, реинжениринг, ремонт.

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Goal of the work. Advancement of methods in administrative technologies, relevance, and reengineering in the daily reengineering of details.

Reengineering of parts. Expansion of traditional methods of repair of basic body parts:

1. Elimination of cracks: using couplers, using fonts, using on-layings.
2. Repair of a broken protruding part (bracket, lugs, rod) is carried out: by installing an insert or plug, welding the broken part to the body.
3. Repair of worn holes is carried out: by the installation of a repair sleeve, surfacing of holes.
4. Repair of the worn-out nests under clamps is lever carried out: by the installation of a repair stopper, installation of an overlay [1].

All methods have their drawbacks: the impossibility of using surfacing for shafts of small diameters, splined joints, internal holes; large losses of metal on spraying; the need for special types of wire and special power supplies – the disadvantage of the surfacing method; insufficient stability of the plasmatron, high gas consumption, low powder utilization, especially when restoring parts of small diameters for the method of plasma spraying.

Currently, there are other ways to repair, such as using 3D-printing to repair damaged parts. All you need for such a repair is a 3D-model of the required product.

Methods of construction of three-dimensional models. Construction of three-dimensional models of renewable parts can be performed in a CAD CAD module or using a 3D-scanner [2].

Regarding classical drawing, there are many programs for this. The most famous of them are КОМПАС-3D, NanoCAD, FreeCAD, ABViewer, CATIA, INVENTOR, and others. Each of them has a number of advantages and disadvantages, but most of them are compatible with different models of 3D-printers, the ability to perform 3D-scans, save in various formats and more.

Another option is a 3D-scanner. 3D-scanning is a technology for creating 3D-models of real-world objects [3]. 3D-scanning works like this: the scanner takes several pictures of the object, then the pictures are combined into a 3D-model, which is an exact three-dimensional copy of the object that can be rotated and viewed at different angles. The scanner works like a video camera, ie it captures an object. The camera, however, takes two-dimensional photos, while the scanner captures the geometry of the surface of the object, and the images taken are converted into a 3D-model, not video [3]. 3D-scanning is performed as follows and is divided into the following stages: data collection, data acquisition, modeling selection depending on the scope and possible verification.

1. By scanning method: contact, contactless, active, and passive.
2. Accuracy: high-precision, low-precision, and general application.
3. By scan object size: for small, medium, and large objects.
4. By scope;
5. By level of mobility: manual and stationary.

3D-printing. The scope of 3D-printing today is very diverse. For example, Boyce has launched its 3D-printing, with the task of quickly creating parts with high-quality and reliable results [3]. Another example, the German railway Deutsche Bahn, which is one of the largest transport companies in the world, uses 3D-scanning and later 3D-printing in case of need to replace old parts, this reduces the cost of maintaining warehouses and unnecessary production.

3D-printing covers several manufacturing technologies that create parts in layers. Each of them differs in the method of forming plastic and metal parts and may differ in the choice of material, surface treatment, strength, speed of manufacture, and cost [3]. There are several methods of 3D-printing:

- Stereolithography (SLA);
- Selective Laser Sintering (SLS);
- PolyJet;
- Fusion Deposition Modeling (FDM);
- Digital Light Processing (DLP);
- Multi Jet Fusion (MJF);
- Electron Beam Melting (EBM);

One of the most well-known methods of 3D-printing is SLA, which is also called laser stereolithography. SLA is a technology of three-dimensional printing using raw materials in the form of a liquid photopolymer, which hardens under the influence of laser light radiation, forming a solid surface at the point of projection of the laser.

Main advantages:

- excellent positioning accuracy, surface smoothness;
- production of models of any complexity (thin-walled and small details);
- rather high, in comparison with other technologies, speed of creation of object;
- no technological problems with printing (overheating, delamination, collapse underweight, failure of the route of the head, poor adhesion, de-gluing corners) [4].

SLS – this method is similar to the previous one, except that instead of liquid photopolymer, the crushed powder is used, which is sintered by a laser at the point of contact and thus increases the structure of the object being manufactured.

The advantages of this method include first of all:

- the ability to print objects without the use of supporting structures under overhanging surfaces;
- a variety of different materials that can be used for printing;
- the high strength of products, which can be achieved by using the appropriate material (currently available as raw materials nylon, glass, plastic, ceramics, various metals).

But the most popular method is FDM. It is based on inkjet printing technology. FDM is a technology of layer-by-layer surfacing of plastic, which is continuously fed to the contour of the future part through a thin forming nozzle.

Advantages of this method:

- inexpensive and widespread raw materials for printing (polymers and plastics);
- easy to manufacture and repair mechanical part of the device;
- the ability to use a wide range of colors for printing;
- low cost of printing.

Conclusions. Thus, the use of additive technologies in the repair and restoration of parts and components allows to speed up and significantly reduce the cost of these processes. However, assessments and justifications are required: the choice of method of obtaining a 3D-model of the product, the method of 3D-printing and the quality of the obtained part or assembly.

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