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## **TECHNOLOGIE PROJEKTOWANIA 3D ORAZ DRUKOWANIE CZĘŚCI GARDEROBY**

**Streszczenie:** W artykule opisano możliwości praktycznego użycia drukowania 3D do wytwarzania elementów dekoracyjnych ubrań, stosując uprzednie zaprojektowanie. W pracy opisano zastosowanie technologii 3D w modelowaniu gorsetu – jako części garderoby. Stosowano środowisko oprogramowania specjalistycznego ‘Marvelus Designer’. Za pomocą tego oprogramowania przeprowadzono symulacje komputerową, w tym symulację mechanicznej interakcji w systemie człowiek-ubranie. Modele 3D dla elementów dekoracyjnych będących pewnymi bryłami ciała stałego również były wykonane. Mają one służyć do dekoracji finalnego produktu.

**Słowa kluczowe:** drukowanie 3D, części garderoby, dekorowanie, gorset

## **TECHNOLOGIES OF 3D DESIGN AND PRINTING OF CORSET GARMENTS**

**Summary:** The practical possibility of using 3D printing in the manufacture of decoration elements of clothes on the basis of the pre-design works is demonstrated. 3D technologies in the modeling of corset garments tested in this work. Computer simulation and simulation of mechanical interaction parameters in the human-clothing system have been presented in the Marvelus Designer software environment. 3D models of solid-state decor elements are realized for decorating the finished product.

**Keywords:** 3D printing, garments, decorating, corset

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## 1. Introduction

The trends in manufacturing products using 3D technology are very popular [1] and are close to the field of light industry, so the “breakthrough”, that is the transition from traditional technologies to 3D ones for making clothes will change the whole world, since mobile and digital technologies have made the world different. Nowadays, the use of 3D technology in the light industry is limited due to the weak research and experimental base for the possibility of using 3D printing directly in the process of creating clothing. Therefore, the relevance of the topic lies in the analysis of the latest technologies for creating clothes using 3D printing systems, matching them with fashion trends and developing a process for their manufacture [2].



*Figure 1. Fashion collection based on 3D printing [1]*

Printers with 3D printing technology are gradually mastering the field of apparel production, and first of all, the production of models for high fashion. Not long ago, Dutch designer Iris Van Herpen presented the Voltage Collection (Fig.1), all of which were created using 3D printing. The collection was unveiled at the Paris Fashion Week [1].

## 2. 3D printing in manufacturing product of light industry

The advantages of 3D printing are [3]:

- Variety of opportunities. With 3D printing it is possible to make absolutely any product. Anything imaginable can be embodied as a 3D model which will be reproduced using a 3D printer;
- Speed. It's one of the main advantages of 3D printing which differs favourably from traditional production methods. Instead of weeks and months of painstaking work the 3D printer prints the product in hours;
- Wide range of materials. Huge amount of 3D plastic and photopolymer resins are available. Each material has specific properties and is suitable for a wide range of tasks. In addition, most of them are available in different colors;
- Ability to produce modular structures. If the projects are too large-scale even the largest of the existing 3D printers (not counting the construction and manipulator robots) are not able to fully realize them, it is always possible to split the 3D model into several parts which will then come together manually;

- Easy processing. Most 3D printing methods allow easy processing of finished products. That is, if the product involves dyeing, then it can be painted repeatedly, and the properties of the material will have no effect.

3D printing technology is not so perfect. We have to find a compromise between

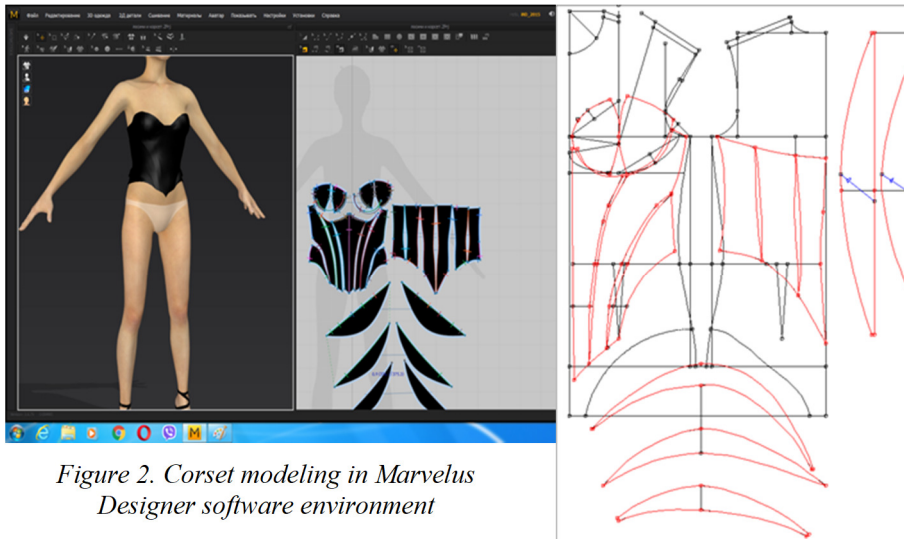


Figure 2. Corset modeling in Marvelus Designer software environment

stiffness and strength. 3D printers create an object by layering, and this process is strikingly different from how fibers are transformed into fabric [3]. Until the problem with the material is considered, the printed clothing will look more like a work of art rather than a wardrobe item. At present, printer-printed clothing can be used to develop models of stage wear that involves spectacle, external design, vivid imagery then functionality becomes a secondary issue. Stage attire can have the most bizarre shapes, even sometimes turning into elements of a performance scenery.

### 3. Application of 3D modeling, printing and decoration in the production of corset

Today there are many kinds of variety art, among them circus art, choreography, vocal, cinema. Analyzing them, you can highlight one of the most inverse elements of clothing - the corset. Among many scenic types of costumes the most rationally offered is to make a 3D printer corsets, since the traditional manufacture of it takes a long time, so complex designs of corsets can be simplified by printing it on a 3D printer. With the help of corsetry products can emphasize the beauty of the natural forms of the female body, or to give the figure the desired proportions and shape of its individual parts[3]. Properly selected modern corsetry products do not interfere with movement, do not violate the function of the circulatory and lymphatic systems, respiratory and digestive organs, that they are, hygienic. This is a significant difference from their corsets which were used in women's clothing before [4]. 3D printing uses a variety of materials also depending on which category the printer belongs to. The most common are plastics (ABS, PLA), synthetics

(polyamide (nylon), fiberglass, photopolymers, polycarbonates, epoxy resins, wax). FLEXIBLE Plastic - Elastic 3D printing material is used in FDM desktop 3D printers. But the most suitable material behind a set of operational characteristics is flexible plastic. This material is very reminiscent of rubber and suitable for the manufacture of products of the appropriate structure. Thus, it comes with excellent plugs, membranes, covers for phones and other equipment, and much more. Otherwise, Flexible 3D Printing Plastic is a great material for your purposes. His only drawback is the complexity of the work.

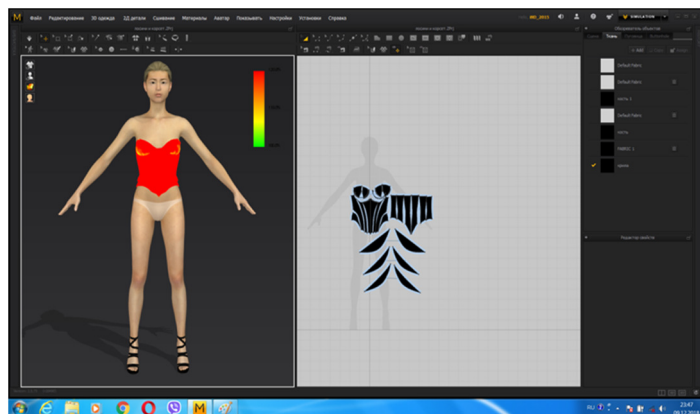


Figure 3. Loading map in system "men-clothing"

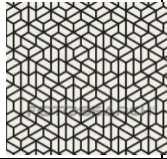
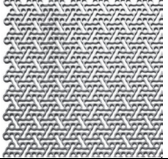

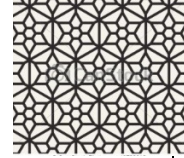
Significantly accelerate the process of creating and visualizing clothing designs is possible based on specialized programs of three-dimensional graphics [5]. Therefore, the programs were considered suitable for performing three-dimensional modeling of clothes on the figure of a person. One such software environment is Marvelous Designer (otherwise known as MD), a software for creating 3D clothing for the film and television industries, video games and so on [6]. In the environment of this program, a corset was simulated using parameters close to the plastic of the 3D printer. The results are presented in Figure 2.

One of the most interesting features of this program is the ability to visually reproduce the load zones of clothing on the human body (Fig. 3). The load zones are presented in different colors: the highest load is red, the medium load is yellow and the small load is green. The figure shows that the model of the corset is tight enough to the figure, which in turn provides the wearer of the corset of an elegant appearance.

In same time, there exists a possibility to decorate a garment with material printed on a 3D printer. By varying materials in color, texture, structure, pattern, as well as harmoniously combining them in one form, it is possible to combine completely different materials, ABS or PLA plastic will give additional rigidity and exclusivity of the design. FLEXIBLE plastic will give the product a spectacular look.

Various patterns were considered for finishing the women's corset and analyzing them. The authors presented a proposal of 4 types of decoration, which calculated the time it would take to print the details, the estimated cost, and the weight of the material to be used for printing. The results of the calculations are given in Table 1.

Table 1. Schematic representation of different textures for ABS and PLA plastic

Type of texture				
Sample	M1	M2	M3	M4
costs ABS plastic	28 g 1,09 hour 3,2 Euro	75 g 2,10 hour 8 Euro	45 g 1,12 hour 7 Euro	35 g 1,03 hour 6,7 Euro
costs PLA plastic	33 g 1,20 hour 5,3 Euro	50 g 1,56 hour 8 Euro	40 g 1,20 hour 9 Euro	36 g 1,12 hour 6 Euro
costs FLEXIB LE plastic	25 g 1,04 hour 10 Euro	44 g 1,27 hour 13 Euro	29 g 1,37 hour 12 Euro	31 g 1,02 hour 11 Euro

According to the results of research, 3 models of decorating were proposed from three different materials, which are the most rational and less time consuming for the further development of 3D models. Available materials include ABS plastic, PLA plastic, and FLEXIBLE. It is proposed to make 3D models of model M1, M3, M4.

#### 4. Conclusion

Performing design work using computer technology in three dimensions has long allowed designers in other industries to provide excellent quality and high speed of development. Thus, in full or in part, it is possible to avoid the process of "manual manufacture" of the suit, which involves a large number of preparatory and design works, selection of a package of materials and methods of processing parts, and a number of other technological operations. The idea of computer modeling is reinforced by the fact that the technology of manufacturing any product using a 3D printer is actually formed. The cost of this technology is constantly decreasing. Manufacturing of garment accessories or their elements based on 3D printing is already available today. Computer modeling of the product, including clothing, is becoming relevant.

#### REFERENCES

1. The designer presented the first collection of clothing, folded on a 3D-printer. Internet resource ESPRESSO:

*[https://espreso.tv/news/2015/08/03/dyzayner\\_prezentovala\\_pershu\\_kolekciyu\\_odyagu\\_\\_stvorenogo\\_na\\_3d\\_prynteri](https://espreso.tv/news/2015/08/03/dyzayner_prezentovala_pershu_kolekciyu_odyagu__stvorenogo_na_3d_prynteri), 01.07.2019.*

2. KOLOSNIChENKO M., PROTSYK K.: Fashion and clothing. The basics of designing and manufacturing clothing: A textbook., KNUTD 2011.
3. Internet resource. Techno Couture: clothes printed on a 3D printer: <https://www.obozrevatel.com/tech/hi-tech/16432-tehno-kutyur-odezhda-raspechatannaya-na-3d-printere.-foto.htm>, 01.07.2019.
4. KATONA A., TAMAS P.: A particle based cloth simulation with internal friction. Proc. Inter. Conf. Design and Light Industry Technologies (ICDLT-14), Budapest 2014, 13.
5. PHOEBE R.: Apeageyi Application of 3D body scanning technology to human measurement for clothing Fit / Phoebe R. Apeageyi. International Journal of Digital Content Technology and its Applications, 10(2010)7, 58-68.
6. Internet resource. Marvelous Designer: <https://www.marvelousdesigner.com/>, 01.010.2019.