ISSN 1561-6894

NR 13(215) 2020

Nauka i Studia

Przemyśl
Nauka i studia
2020

Wydawca: *Sp. z o.o. «Nauka i studia»*

Redaktor naczelna: Prof. dr hab. Koretskiy M.H.

Adres wydawcy i redacji:
37-700 Przemyśl, ul. Łukasińskiego 9
☎(0-16) 658 32 10

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Druk i oprawa:
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G. V. Sokol [1], A. P. Lytovchenko[2], A. A. Kirakosyan[1], V. V. Shut[1], A. O. Shugailo[1]

[1] National University "Yuri Kondratyuk Poltava Polytechnic", Poltava, Ukraine

[2] Limited Liability Company "Trading House" of Poltava Automotive Aggregate Plant", Poltava, Ukraine

3D MODELING OF COMPLEX SPATIAL FORMS BY COGNITIVE PROGRAMMING TECHNOLOGY METHOD

Abstract. This article examines the problem of harmonization of 3D modeling and 3D prototyping of complex spatial forms within the framework of cognitive programming technology. The ways of its solution is offer on the example of the 3D Studio MAX environment.

An analysis of the strategic trend of the development of digital programmable technology, from the mathematical modeling of physical, biological and other natural processes when the production-element basis of the nano-level has been reached, has led to the creation of a technology for the direct reproduction of three-dimensional spatial objects of complex forms. Informatics is not only an ontology of projects, but also its spatial materialization. Biological objects are artificially reproduced based on cognitive programming technology.

Now in the world in all areas of knowledge there is a burst of digital modeling: through computer engineering and digital modeling is practically any new product. At Japanese exhibitions, a demonstration of the bulk copy process is already underway: digital input of objects is performed at the input, then processing in the 3D modeling environment - and as a result you can print a copy of the prototype.

A printer that prints parts for itself, an electric battery with a variable battery, gadgets communicate with each other and are responsible for the comfort of the owner - the reality of the new digital world, which is formed now. With regard to the programmable technology of info communication, not the bandwidth of the channel,

but the transformation of the properties of the communication of physical nature in the properties of biological nature and social needs is important.

Keywords: *3D modeling, sculpting, fast prototyping, cognitive programming technology*.

1. Cognitive programming

Digital 3D technologies and cognitive programming open unique opportunities for reproduction of the most complex spatial forms, objects and engineering structures, mechanisms. The implementation of these capabilities is associated with digital technology for the management of material particles in the three-dimensional environment of 3D technology tools, where the technological process that determines the properties of the reproduced object. Innovations in industrial technology lead to the breakdown of conventional production chains and entail a new stage in the development of world civilization. On the one hand, cognitive programming technology is an innovative process of digital creativity, industrial and artistic production within digital programmable technology. On the other hand, even before the Renaissance, natural forms of reflection of the world around and the perception of nature were sculptures, complicating the development of civilization, the process of cognitive creativity.

In fig. 1 shows a conceptual diagram of digital cognitive programming, when creative, artistic, design projects are created in the form of digital spatial objects, mock-ups, models.

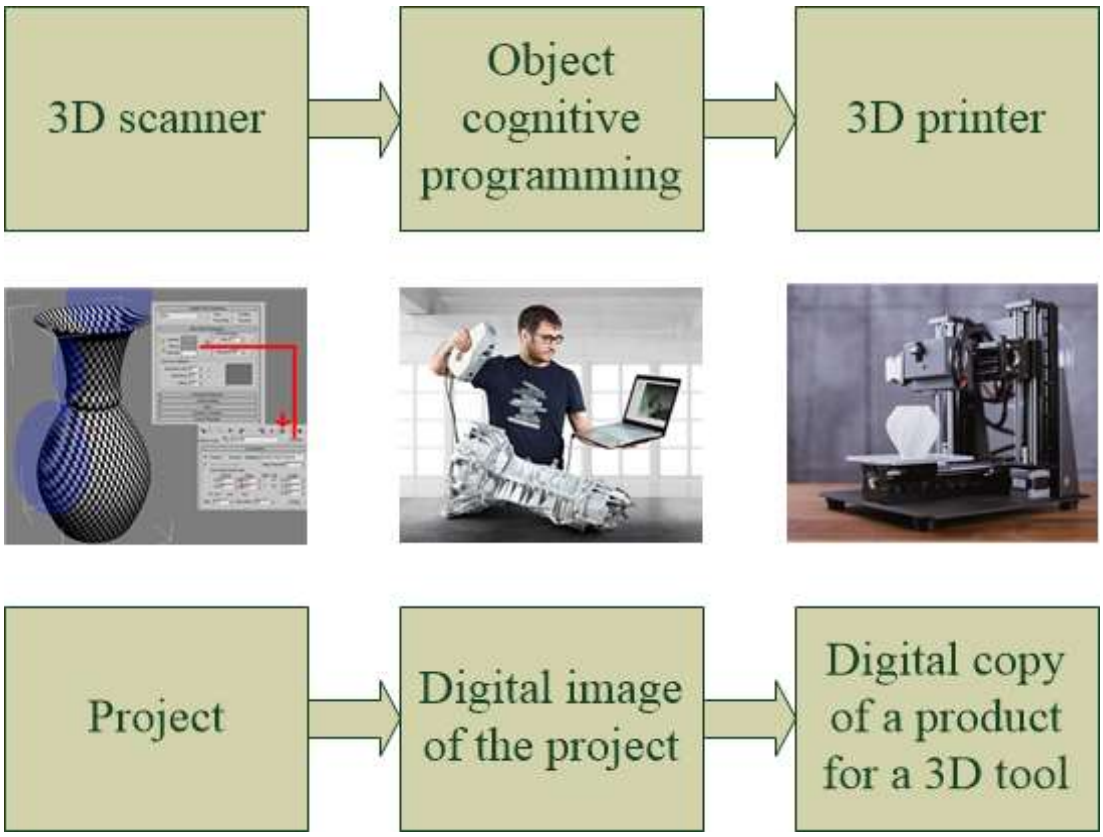

Fig. 1. Conceptual diagram of a cognitive programming system

For systems of three-dimensional computer modeling of spatial objects the palette of tools is constantly updated, for each direction of 3D equipment digital copies of a product - software prototypes of their reproduction are developed. Cognitive programming innovations lead to the replication of complex spatial forms, even those that are virtually impossible to reproduce without the use of 3D prototyping technologies.

Architecture, inorganic and organic objects, protocells filled with electronics, are all areas of application of digital programmable rapid prototyping technologies.

Examples of digital copies of products implemented on a 3D printer, including in the development of the concept of cognitive programming concepts are shown in (fig. 2). It should be noted that the picture complex spatial shapes hard reproduced on any other equipment except 3D-printer.

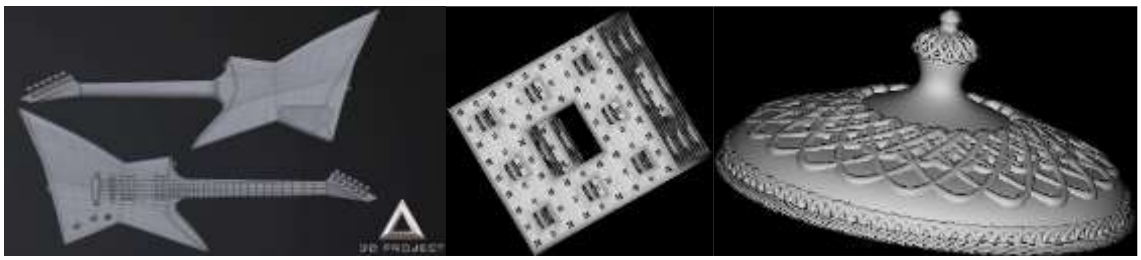

Fig. 2. Examples of the implementation of complex spatial shapes using 3D prototyping technology

These complex three-dimensional objects are made on a Connex 500 3D printer from Object, which uses photopolymer technology PolyJet Matrix. It should be noted that the mathematical model of the continuous undifferentiated Weierstrass function - fills the space of the curve (ZPK) can be visualized as a material (physical) object only on a 3D printer.

2. The problem of coordination 3D models and 3D prototyping

The problem with the use of 3D prototyping is that the 3D printer can print only the relief that is created on the basis of polygons, is a polygonal grid. However, there are different ways to create relief on the surface of the object in 3D graphics, especially when it comes to small details of a complex three-dimensional model.

For example, different patterns, pattern of scales, skin, etc. easier to create on the basis of material maps than on the basis of polygonal modeling. But the maps of materials do not cause a real shift of the polygonal grid, ie create only the image, the illusion of three-dimensional relief, not the relief itself. And the 3D printer cannot print the relief created not by a polygonal grid, but by the drawing that is simulating the scope.

3D Studio MAX has the ability to model reliefs in different ways. For example, using material maps and special modifiers capable of working with these maps, modifiers such as Noise and Displace modifiers, as well as Bump material editor channels and Displacement, Noise material maps noise, Normal Bump material maps, and Displace volume deformation. The fundamental difference between terrain modeling by the above methods is that a number of modeling methods, such as the Displace modifier and the Displace volume deformation, are able to create relief by

using special material maps, so-called shear maps. In her thesis I used the 3D MAX program, in (fig. 3) the author's my work is presented.

Fig. 3. The author's work by A.A. Kirakosyan

This shifts the polygonal grid of the object, so this method of creating a relief is one of the options for polygon modeling without the use of the modifiers of polygon modeling. This method of relief construction is based on the ability of the program to build the height of the terrain in accordance with the color gradation of the material map - from white to black - by shifting the vertices of the grid of the object selected as the basis for landscape construction. Material maps required for proper operation must be black and white. This method of construction provides a fairly high accuracy in the construction of relief in accordance with the intended appearance of the future relief. However, the object to which any of the above methods of forming a polygonal grid is applied must be highly polygonal, otherwise the relief will be constructed incorrectly.

The relief constructed by any of the above methods, ie built on the basis of the offset of the polygonal grid, can be printed on a 3D printer. Unlike the above methods of forming a polygonal relief, the channels of the material editor Bump

(Relief) and Displacement (Offset), regardless of the type of maps used to build the relief, do not cause a real shift of the polygonal grid in the polygonal object, so only an illusion of volume and cannot be printed on a 3D printer.

The landscape in fig. 4 was created using Offset (Offset) volumetric deformation. The front view shows the object's polygonal mesh. It is the polygonal mesh that the 3D printer recognizes when printing an object. The primitive Airplane (Plane) is selected as the basis. As a map with a subject, the map is a material made in Adobe Photoshop.

The landscape in (fig. 5) was created with the Displace modifier.

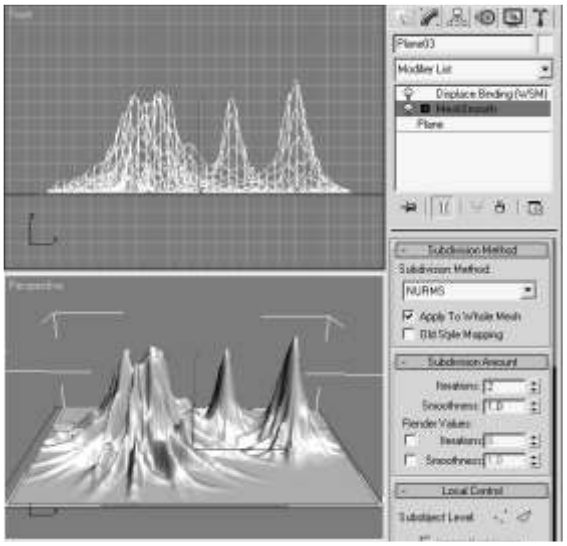

Fig. 4. View of the terrain created in 3DS MAX using the volumetric deformation Displace (Displacement).

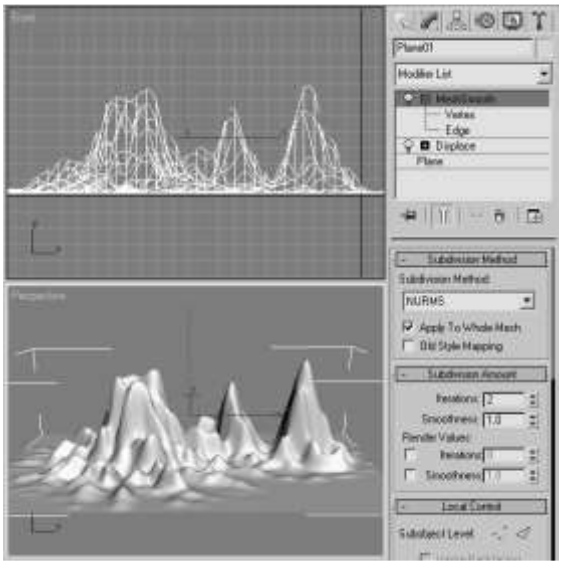

Fig. 5. View of the terrain created in 3DS MAX with the Displace modifier.

In this rank, one can judge the shape of the object, which will be done by a 3D printer. However, great accuracy can be achieved with great ease by setting the profile in this way. That is, when you open trivial models, you can change the polygonal model Edit Mesh and Edit Poly.

3. Conclusion

The development of digital programmable technologies has led to the possibility of direct digitization of three-dimensional objects, computer 3D modeling and object replication. For adequate implementation of 3D modeling objects by rapid prototyping technology, it is necessary to take into account the limitations described above. Created in 3D Studio Max for further printing should be performed using polygon modeling operations, not using material maps.

Economic efficiency of 3D-technology in its qualitative non-alternative, waste-free and significant reduction of prime cost at serial and mass production. At the same time, the 3D-technology - a test on the intellectual level of science, education and professional training of human resources and industrial development.

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