



Digital Technology in the Design of Nonlinear (Parametric) Objects Environmental Space

Gladilin V. A.¹, Mandritsa O.², Chalova A. A.³, Kazakova I. N.⁴, Zolotukhina I. V.⁵

¹Stavropol branch Moscow state pedagogical University, 354011, Russia, gladilin@mail.ru

²MIREA - Russian Technological University, branch in Stavropol, Kulakova Avenue, 8, Stavropol 355000, Russia
mandritsa@mail.ru

³Stavropol institute of cooperation (affiliate) ANO VO Belgorod University of Cooperation, Economics, and Law,
Department of Economics and Management, Russia, chalova@mail.ru

⁴Stavropol institute of cooperation (affiliate) ANO VO Belgorod University of Cooperation, Economics, and Law,
Department of Economics and Management, Russia, kazakova@mail.ru

⁵Stavropol institute of cooperation (affiliate) ANO VO Belgorod University of Cooperation, Economics, and Law,
Department of Economics and Management, Russia, zolotukhina@mail.ru

ABSTRACT

Time "parametrisation" today most people know like a designers world. But still debate regarding the integrity of and independence parametric directions and opportunities the allocation of his in a separate style. There are many errors value and the essence of the term "parametric". However, this style the direction of the parametric, based on the use of new architectural elements transformers space and gives objects movement finds all more fans. So it is especially relevant in today there are search and application relevant digital technology for the realization of all theoretical design features in the real creation objects environmental space.

The modern idea of the world based on paradigm nonlinearity, in which develops the idea of the universe as many systems who live at laws of self-organization. Development of ideas nonlinearity considered as a result create the new methodology nonlinear design, lesser extent guided historically formed rules of shaping or subjective artistic experience designer. Therefore, the basis of new methods put principles of artificial morphogenesis, synergistic paradigms of simulation biotic and inanimate nature which open unprecedented prospects in the field forming and offer new techniques and ways of describing and organizations architectural objects. So the notion of "nonlinear architecture" brings together a number of areas that develop in parallel: parametric, the on-tech, electronic Baroque, BLOB-design, landfermann and others. Arose these areas as a result the evolution of ideas previous styles: bionics structuralism, organic design [1].

Key words: Digital technology, modeling, design, non-linear parametric.

1.INTRODUCTION

Parametric represents new global style in modern architecture and design that come on change of post-modernism. A new direction arose on the basis of

different areas science: computer technologies of arts, biology, architecture mathematics, sculpture. The term "parametrisation" originates math has in mind use certain editable parameters and variables in the result which varies the result on the target system. Greek the language of the word "parametrisation" translated as "map" and denotes the amount figure characterizes any property device or process. Name a new direction due to the method design. At the initial stage architect specifies the parameters designer counts its form, and change the settings displayed on shaping structures. Development computer technology allowed to provide most creative freedom of the architect in creating a variety of the shape of the buildings [3].

The founder of this style considered to be Frei Otto, who one of the first began to use for design method "search form" using simulation of physical processes. Further penetration digital technology and programming in architecture made a huge influence on many architects of the avant-garde, which have been actively to apply in his work tools computing design [4].

Other well-known architects-parametric-considered ZahaHadid, Greg Lynn, Norman foster. Parametric direction different from other styles defined features: elegance fluidity without seam; a combination of a large number of individual elements in a unit; dynamic form; individuality architecture; it is based on parameters and geometric forms; all strictly calculated.

It should also to emphasize that parametrisation born from digital methods animation. Attraction parametric modeling and relevant forming tools give this the process radically new goals and values. Parametric modeling significantly different from the usual two-dimensional drawings or three-dimensional modeling. The principle of creating architectural forms: parametric the method is described not one form, a certain set forms, with changing the settings, present in mathematical expressions, impact the geometry forms [5].

Parametric after modernism great style. It closes transition the company, which was generated the crisis of modernism, and marked such movements like

postmodernism, deconstruction and minimalism. Parameters requires scale in everything from architecture and interior design to large urban design.

As a conceptual definition the parametric you should contact to the definition Patrick Schumacher, that offers the following formula: the parametric means, all architectural the elements have to be parametrically related providing flexibility of the entire system. Parameters in together with algorithmic methods of shaping, define fundamental ontological slip inside basic key elements that define this style. Almost instead of the classic composition perfect geometric figures, instead straight lines rectangles cubes, cylinders and pyramids, used new items – dynamic, adaptive, geometrically modified [7].

In General, parametric shows awareness as a new Outlook and innovative development in related fields knowledge, coupled with technical opportunities new designs and materials create the need working with complex information models architectural objects on computer based technology [6].

2.MATERIALS AND METHODS

Parametric projects received the opportunity the embodiment only with the creation of algorithms able to visualize computational geometry. Software tools such as, for example, a plugin grasshopper for three-dimensional environment modeling rhinoceros, allowed designer to create the algorithm, performing which is based on the originally set output parameters the program generates 3d model. The principle build parametric models almost fully automated: most often as an output the parameter acts as the set of points line or lines. Search best the solution is under the program, man creates "tree building", which, upon closer proceedings visually decorated software code [6].

Parametric direction has in view of the changes space robotic ecosystem materials respond to changes in environmental environment and so on. And this makes it possible development time, for example, it is a convertible, collected again the building that gradually being completed. This means gradual a departure from static the idea of the environmental space. Fully change strategy development and it is the view such objects. Appears a lot materials membrane type, textile and filmy materials there is a powerful the development of the textile industry. Early architecture rested in stone structures – concrete or glass. That is appear new materials which carry in another story and give others ways of working with form and functions. After today it is possible to create morphogenetic structure where each element can offline, but according with neighbors to change shape so that will change properties environment such as illumination, temperature, the air flow through, color, texture and much more. And if it is associated with natural the principle flexibility and elasticity living matter it will designers in the future on another level the formation of environment accommodation [6].

According to the new paradigm the parametric you can expect many new auxiliary styles enrich and bring the advent of digital era (digital age). Today parametric

brings together many different directions parametric urbanism, morpho-ecological design digital Baroque, parametric ornament, digital morphogenesis etc., each of which has its own own tools and aesthetic features [7].

Among the latest architectural development the parametric it is possible to allocate following [8]: cultural center name Heydar Aliyev project Studio ZahaHadid made by all the canons the parametrisim; office building media-ict is designed Studio architect Enrica Ruiz gels with inflatable façade; the project google campus that soluble in the surrounding environment due plastic translucent shell that transformations by the prescribed features structure; pavilion from ICD and that repeat the structure of the exoskeleton the beetle, in this work were United achievements robotics and biometrics [3,4].

Thus it should be noted, what parametric design based on geometric modeling object using parameters elements the shape and proportions between these parameters. The emergence of powerful software systems parametric modeling, such as catia (dassaultsystemes), generative components (bentley systems), rhinoceros + grasshopper (Robert Mcneel & associates), Revit + Dynamo (Autodesk), allowed to create extremely difficult objects that simulate the natural structure. At the heart of algorithms computer programs are geometric equation describe the curves and surface (Nurbs, Spline, Bezier, etc.). Camera geometric modeling provides mathematically accurate representation surfaces arbitrary imitating counterparts with world live nature that further allows you to translate in the life of the project, based put bionic form any complexity [2].

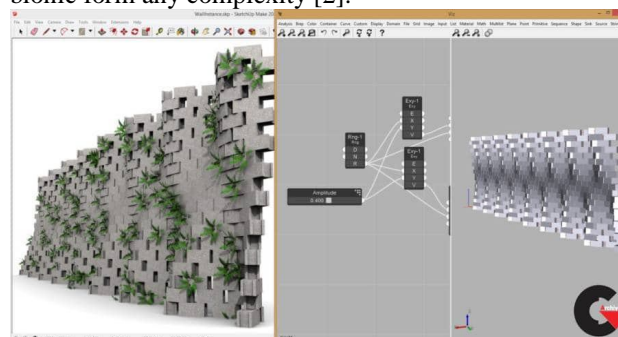


Figure 1: VR-parametric modeling in SketchUp

In figure 1 we see VR-parametric modeling in SketchUp, by using simple 3D models.

So digital parametric architecture – progressive the direction in the development of modern styles. In her based on the principles virtual and real reality. The project parametric architecture created using computer technology and programming [8].

One of the important problems of modern pair. Metric architecture there are difficulties in implementation projects. Probably use in the future 3d printers and print individual blocks will allow to optimize the process of construction Grand buildings [7]. The difference parametric method architecture from traditional approach is that following installed designing, architect designs structures and contemplating functionalism each element. In parametric the architect of the specifies the parameters and the computer on their basis creates thousands of variations structures.

In creating architectural projects of the xxi century. Goes the analysis of patterns environmental the world, and apply the same principles creating the artificial environment. As an organizational system parametric architecture actively used composite reception, modern analog ornament – pattern or pattern [3].

Modern architectural objects in parametric so complex that to create them traditional ways was would be impossible. For their simulation should spend original research to create mathematical algorithms and ask logical the conditions that must reply the specified requirements. This kind work as previously connected with the design, aesthetic functional components however the form is important not only to figure out but also to simulate and procedural to describe. Existing diversity forms developed by geometers and famous engineers-architects but this list can be extended and supplemented, thanks to the methods build for using computer modeling and visual programming. For a more accurate the use computer graphics is note on the classification surfaces in according to method build CAD [4].

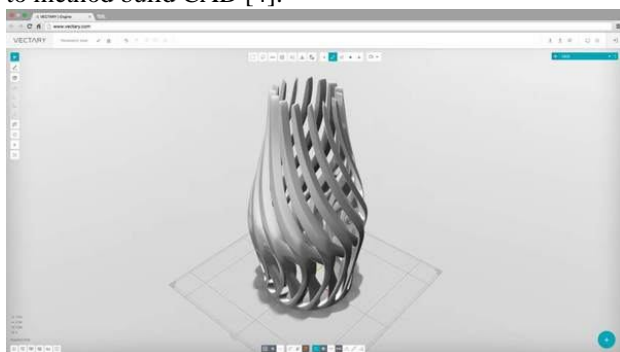


Figure 2: Parametric 3D design with CAD

In figure 2 we see parametric 3D design object with CAD-technology. There are various technicians computer modeling, using which ask form shell (table 1). The selection of the or other equipment will be determined specific project tasks. For example, for create sketch proposals you can "sculpt blank" forms in one from programs digital sculpting or on the basis photos any the object of nature to make an analogue surface bionic shape [11].

To create accurate and details worked project shell can be used such programs parametric modeling, as, for example, rhinoceros + grasshopper (Robert Mcneel& associates), Revit, + Dynamo (autodesk). In the future using export third-party applications you can perform constructive calculation to create models for production, photorealistic visualization. As a rule, design used complex geometric objects obtained the result operations easier [10, 11]. The term "operation" understand the set actions on single object or a group of objects, directed the creation new geometric object. The set actions that change the object without changing his nature call modification or edit (move, rotate, scale, mirror reflection changing the shape). Thus, edit object is to change the values it data when unchanged structure. Geometric the objects are described scalar values and vectors and editing results to change these the scalar and components vectors [4].

Table 1: Basic techniques computer three-dimensional modeling [4]

Technique	Description	Software
1	2	3
Polygon modeling	Cubic modeling. Form is modeled using manipulation over the geometric primitives. Modeling on sides along a given contour	3Ds Max (autodesk), Blender (Blender foundation)
Modeling using curves	Surface built on the basis of splines curves, nurbs, curves Bezier and other tools using such operations as lofting, rotation and other	Maya (autodesk), rhinoceros (Robert Mcneel & associates)
digital sculpting	Methods: offset (displacement), volumetrica	ZBrush (Pixologic), Mudbox (autodesk)
Parametric (procedural or algorithmic modeling)	create model on tasks parameters generation forms occurs algorithmically (via visual programming)	generative components(Bentley systems), rhinoceros+grasshopper (Robert Mcneel& associates)
Modeling on the basis of image	create three-dimensional object on the basis of the two-dimensional image determined point of view adjusted promising and optical curvature	imageModeler (autodesk), Photomodeler (eos systems inc)
3D scanning	digitization real the world with special equipment	Zscan (creaform), cronos

In turn to surfaces free form from-worn surface different from canonical (cube, plane) which can to be obtained by pulling profile along three-dimensional curve build spline surface control dots, smooth message between the two pieces and such operations [13-18]. Thus, technology create surfaces arbitrary form, first apply for mechanical design (create complex technical objects, such as blades (blades) turbine fuselage flying apparatus), today used in architectural design in the simulation surfaces shells. The surface free forms are created on the basis of modeling using curves, of which using various operations created floor-no (lofting, squeezing profile the like) or directly edit surface, for example through the control point. the largest distribution got the system, building surfaces which is based pigwig (created on the basis of heterogeneous rational B-splines or t-splines) [12]. In addition, this used creation methods objects on based surfaces Bezier Koons and garden. properties the surface free forms are set such parameters as a control point

number "rags", degree (density control points on the plot). thus, it is worth noting again, in contrast from the classics and modernism, where applicable hard geometric structure and in the composite the underlying cause are relatively simple geometric shapes (cube, cylinder, pyramid), parametric style the direction is on the application other, absolutely new geometric objects, such as splines and pigwig. Construction blocks are the new system such as "metabole", "hair," bubbles created and modifierade using visual-PR-ingramophone. so developing new architectural aesthetics is born at the junction of geometry, design ideas and modern digital technology [18].

3.CONCLUSION

Parametric design is still at an early stage development, but modern research show that in the near the future it will be embedded real design. the development of new methods becomes fundamental condition future success. new method design develops not only because of technology but also the new software security that will make parametric design available for architects. most popular parametric trends in design XXI article linked with the rapid development computer technologies. use opportunities modern computer technology (computer programs 3d modeling), all this has allowed to create a large variety of parametric designs. in the world the principles the parametric in addition to the architecture actively used in sculpture, furniture design and industrial design. That is the future further research.

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