

## **Parametric Design as an Approach to Inspire Nature in Product Design**

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### **Research Introduction**

Nature is the First source of inspiration for the designer in product design process in search of unconventional techniques of formal and construction solutions, in additional computer knowledge is essential in product design, the use of computers has necessitated a new way of helping to develop new methods of design, it required the use of computers to find a new way to help and thus develop new ways of designing.

The process of creating new forms of industrial products, especially those of irregular and complex nature, requires the designer to explore many alternatives and innovative design solutions and rely on non-traditional methods in designing the shape, Since nature is the source of inspiration and creativity for the designer, the parametric design was the entrance of the designer to inspire from nature in the design of the industrial product and an entrance to achieve creativity and innovation in the form of the product, It provides a modern tool that enabled the designer to deal with the forms, especially the complex one, which was impossible to recognize the structure or it's form, in addition to enhancing the designer's ability to explore the wider horizons of design and development of creativity and innovation.

As a result of a large wave of systematic innovation and continuous research to develop the design process and to explore new ways of inspiration from nature, a new design style known as parametricism has emerged; this establishes the concept of parametric design. It is a style characterized by characteristics and formalities through the complexity and dynamics of its curved lines, for its various components and elements.

The concepts and techniques of computing determine the characteristics of this new style Parametricism has been built to fill the space with organic forms as if they are fluid flowing and connected, forming a dynamic path within it gives a sense of continuity and the movement between forms and is an introduction to simulate nature in organic forms.

It has shifted the focus of the designer of the form making like use of traditional methods of creativity such as paper and pen to find a form that relies on physical models and methods of computer creativity, which gives the results of mimicking nature.

Instead of the principle of classicalism and modernity in design as a set of simple overlapping elements, parametric principles emphasize that the design involves the writing of dynamic forms as if they were musical compositions containing large numbers of elements such as natural forms that organized within interconnected and adaptive systems, Parametricism is the basis of parametric design, which aspires to make all elements of design variable and mutually adaptive to achieve the formal objectives of design.

**The research problem** revolves around the need to activate the use of parametric design to obtain design solutions for the forms inspired by nature in product design.

**The importance of research** is the ability to analyze some forms in nature and trace its structure and characterization in simple theories, in addition to developing a curriculum that supports industrial design students in understanding and inspire shapes from nature.

**The research aims** to benefit from the parametric design in analyzing some complex and irregular shapes inspired by nature through Presentation and review of the most important theories on which the parametric design depends on the inspiration of forms which found in nature.

**Research hypotheses** is that using the parametric design to solve the forms inspired by nature, this leads to the easy codification of shapes and thus support the trend of inspiration from nature in the design of products.

**The research is based on** the inductive method.

**Guiding words:** Parametric Design, Product Design, Nature Inspiration, Fractal, Voronoi.

### **The Concept of Parametricism**

The concept of parametric design is based on the principle of Form Forming, where Antoni Gaudi is the first designer based on this approach to obtain different and innovative forms, as it is a method of building enriched by nature. Parametric design is a method of design that differs from traditional methods. Through other design processes, the designer cannot interact with the idea or with the materials or product resulting from it during the concept stage, until it can be done after modeling stage where the designer is allowed to conduct operations, analyzes and tests as the durability and performance on these models after the completion of the idea.

On the other side the parametric design approach proceeds otherwise, where most of the design requirements are integrated into parameters within the concept stage in an integrated way with the creative sense of the designer, which greatly affects the output of the design process, where it gives results and alternatives more creative and realistic accompanied by great feasibility for manufacturing.

### **Definition of parametric design**

It is known that the process by which the design problem is described by relying on the specific variables and changing the values of these variables by the designer produces many alternatives called generation and then the final solution is chosen based on a set of

determinants related to performance or ease of construction or budget requirements or user needs or aesthetic requirements or a combination of these metabolites.

The parametric design enhances the creativity of the designer through the production of thousands of designs called generation and thus opens the door to the designer to explore unconventional forms, which he could not imagine alone, **so the importance of parametric design:**

- Explore a wide range of design options.
- Producing designs that are difficult to produce.
- Ability to modify and self-arrangement of design elements in accordance with changes in the design environment.
- The ability to produce new structures and forms.
- Ability to produce complex forms.
- Promote the creative designer.
- A suitable technique for the conceptual stage of the design process.
- Time saving.
- Reduce the cost by reducing the relative size of the material and reducing the modeling of many alternatives

### **Parametric design Types**

Parametric design provides a number of patterns of shapes that simulate shapes in nature and the designer can use it to simulate nature such as:

- Form synthesis,
- Lattice and surface optimization,
- Topology optimization,
- Trabecular structures.

### **Parametric design theories based on nature formations**

Parametric design organize a number of forms that exist in nature, such as voronei forms and fractal forms, in theories that make it easier for a designer to inspire nature in product design.

#### **1. Fractal theory**

According to Cambridge Dictionary fractals is a complicated pattern in mathematics built from simple repeated shapes that are reduced in size every time they are repeated, it is interested in studying structures that are composed of molecules and patterns that exist in nature and describes many situations and structures that cannot be explained or studied in classic mathematical It has several properties of them:

- Any part of it, no matter how small, is the same as the overall shape and be self-similar and multi-scale.
- Fractal comes in a regular and irregular form and formed by repetition.
- The shape may have some distortions as a result of the repetition.
- Contains clear and multi-dimensional elements and interspersed within the space of the object.

## **2. Voronoi Theory**

Georgy Voronoi defined it as a division of random plane into a group of regions named as voronoi cells based on distance to points in a specific subset of the plane. That set of points called seeds, to be easy to control and have applications in a large number of fields, especially in the arts voronoi forms such as other structural systems of nature that it is stable and adapted and perhaps one of the most important uses in the design of products

Voronoi forms can mimic many natural phenomena that occur naturally, such as soap bubbles, on which Frei Otto has relied on the method of finding shape in the search for new concepts of the product.

### **Voronoi forms can be constructed in several steps**

Step 1: Determine a set of points on a specific plane to be organized and divided into known areas.

Step 2: Draw a line connecting the adjacent points.

Step 3: Draw perpendicular lines stemming from all of the lines midpoints to the specified boundary

Step 4: The perpendicular lines connect to form new points

Step 5: The original lines drawn in step two are removed to reveal a new grid called a voronoi diagram

### **Results of Research**

The study confirmed the importance of parametric design in practice inspiration from nature in a computerized and in a philosophical framework for a new style of design known as parametricism which has a principle that sometimes shares nature with many organic, inorganic and functional structures.

- Raise the aesthetic value of the product through the use of the parametric design in the inspiration and organizing of the forms of products because of the possibilities that help in the formation of lines more streamlined and achieve aesthetic standards easily.
- Parametric design is a flexible tool that enables the designer to understand the complex forms in nature and to deal with them in a simplified way through computer tools.
- Formal results are achieved through parametric design by the theories underlying many forms of nature such as molecular theory and the Voronoi theory.
- parametric design enhances the designer's creativity in inspiration from nature and emphasizes the importance of studying computer programs in which the parametric design is achieved through it.

### **Discussion for some research result**

The parametric design is an entrance to inspiration from nature based on a new design trend called parametricism, supported by several theories that facilitate the organization of forms inspired by nature such as molecular theory and the theory of Voronoi, It also enhances the creativity of the designer and increases the aesthetic value of the product because of the tools that facilitate the process of creativity accompanied by a great ability to implementation because of link the parametric design close to the computer..

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