The Application of Fractal Art in Ceramic Product Design

Xingrui Lin¹, Wenming Liu ²*
¹Student Management and Service Center, Liaoning University of International Business and Economics, Dalian, Liaoning, 116052, China
² School of Design and Art, Shenyang Jianzhu University, Shenyang, Liaoning, 110168, China
*Corresponding author’s e-mail: 83373734@qq.com

Abstract. Starting from the meaning of fractal geometry and fractal art, this paper discusses the artistry of fractal, and draws a conclusion through the introduction and analysis of four kinds of classical fractal patterns, that is, fractal art can be called real art. It can be found that fractal art has great artistic charm and practical value in ceramic product design by applying fractal art pattern to the field of traditional ceramic daily necessities and handicraft design. However, as a designer, the art pattern of fractal processing cannot be directly attached to the surface of ceramic products. Further researches and innovation are needed to make fractal art more suitable for ceramic products and enhance the artistic value of ceramic products.

1. Fractal Geometry and Fractal Art
The fractal geometry has been applied for nearly 40 years since the mathematician Mandelbrot discovered the fractal theory in the 1970s. Its research fields include medicine, biology, soil mechanics, physics, graphics, seismology, music, computer and so on. It has been widely used in textile industry, wallpaper industry, product packaging, product design and so on.

The basic idea of fractal geometry is that objective things have self-similar hierarchical structure and are composed of individuals with similar characteristics. Although fractal geometry belongs to the category of mathematics, it can find its aesthetic existence form in nature, which makes fractal geometry have practical value in the field of art.

Fractal art belongs to the concerned fractal in fractal geometry, that is, the self-similarity description of graphics in different dimensions (self-similarity is the similarity of local and global shapes in graphics), the detail structure of which can be enlarged infinitely. Fractal art can be classified into fractal art by using the same basic unit and calculating formula, even if it is not a professional fractal.

Fractal art only appeared after fractal geometry was produced for a period of time. Although fractal geometry can produce inexhaustible and diverse shapes, it was not regarded as a work of art in the early day, until people gradually discovered the artistic value of fractal geometry.

By transforming the equation into visible fractal patterns, fractal art realizes the organic combination of modern science and technology and aesthetic art, and achieves the fusion of mathematics and art through the transformation and combination of orderly and disordered patterns. Different from the asymmetric beauty of Euclidean geometric form, aesthetic works with artistic value are formed.

Fractal art is a branch of visual communication art. Nowadays, fractal artists have penetrated into the fields of product design, art design, graphic design and so on. Fractal art as the visual expression of electronic image, the artist quickly accepted its artistic value, and created a series of aesthetic products through mathematics. Although fractal art is realized by computer computing, it still needs a certain
2. The artistic value of Classification Art

Is fractal art real art? Some have affirmed, others have been tit-for-tat, and there has been a long debate on this issue.

In fact, the conclusion is very clear. If fractal art patterns give people a feeling of beauty, then it can be called art. In that case, of course, we do not have to explore how it came about. When we can think of others, we are impressed by the amazing workmanship of nature, which has produced countless wonders of beauty, and we have been deeply impressed by these beautiful sights, but we cannot deny that they are valuable aesthetics because they come from nature and are not artificially crafted.

The patterns obtained by fractal technology are not necessarily works of art in the direct sense. We need to process and deal with them. People need to affirm the existence of fractal art, even though the results derived from a few fractals have no artistic value, but more derivative results are artistic. Fractal is a new concept emerging in modern times. Whether you appreciate it from the perspective of science or aesthetics, fractal art will give many people a feeling of beauty.

Now let's look at some classic fractal models: Mandelbrot, Julia, Newton, Nova

Figure 1, The fractal graph of Mandelbrot
Figure 2, The fractal graph of Julia
Figure 3, The fractal graph of Newton
Figure 4, The fractal graph of Nova

Figures 1 to 4 have a traditional aesthetic sense of Euclidean geometry, reflecting the criteria of traditional aesthetics, such as balance, harmony, symmetry, etc. Apart from that, these pictures also contain many new art forms that are superior to traditional aesthetics. For example, its equilibrium is dynamic equilibrium, which is the equilibrium of all parts of the image in the process of change, its harmony is mathematical harmony, and the most special one is the symmetry in fractal art, which is neither horizontal nor vertical symmetry. In essence, the symmetry of fractal art is the symmetry of the small part and more part of the picture, or the symmetry of the part and the whole.

From the above fractal figure, fractal art as a new art category can be called real art.

3. Application of Fractal Art pattern in Ceramic Handicrafts

The patterns processed by fractal art can give people a feeling of beauty and convey a sense of beauty different from traditional art. These fractal works of art are mainly derived from the formula based on computer, then the aesthetic view is used to process the art in the later stage, which produces amazing works of art.

After appreciating the effect of fractal art, the application value of fractal art in ceramic products is
analyzed, the art of typing is not simply to attach the pattern of fractal processing to the object, but to merge the modern science and technology with the traditional technology into one, and to form a new form of visual impact.

3.1 The fractal patterns on teapots

The decorative patterns on the traditional teapot are usually plants and poems. We tried to apply the fractal patterns in figure 1 and figure 2 to the teapot design, as shown in figure 5 and figure 6:

![Figure 5, The fractal teapot of Mandelbrot](image1)
![Figure 6, The fractal teapot of Julia](image2)

The application of the above two fractal patterns in teapot gives people a different feeling from the traditional flower and bird landscape patterns and makes people have a harmonious aesthetic feeling. Although these decorative patterns are not familiar to us, they give people a kind of endless changeable dynamic feeling, make people have fresh visual experience and make people's imagination continue to extend. To appreciate the same fractal works at intervals will give people a different feeling and thus produce ever-changing visual effects. The pattern in figure 5 is similar to the traditional pattern, but it feels more profound than the traditional pattern.

3.2 The fractal patterns on bowls

The environment and frequency of use of bowls are different from those of teapots. We cannot use complex patterns similar to Rococo. For the use of the bowl of fractal patterns, we should avoid too complex. People usually prefer to favor traditional artistic effects, so the fractal images used in bowls should be concise without losing a certain depth. From this point of view, a reasonable fractal pattern can be obtained, as follows:

![Figure 7, The fractal bowl of Julia](image3)
![Figure 8, The fractal bowl of Newton](image4)

By enlarging and shrinking the same fractal pattern and applying it to different places, we can give people different psychological feelings. Compared with the traditional pattern design, fractal pattern has a novel design idea, and it is more easily accepted by people through the innovative treatment of the pattern. Figure 7, figure 8 contains the traditional feeling, while producing dynamic rhythmic effects.

3.3 The fractal patterns on a vase

Vase is also one of the common ceramic ornaments in life. By applying fractal patterns to the external design of the vase, the results are as follows:
The fractal patterns in figures 9 to 11 give a different feel. Although vases are not as popular as bowls and teapots, they are common. Vases have a certain attention to patterns, traditional vase decorative patterns are usually flowers, scenery and figures mainly. The design requirements of these patterns are high, the occupation area is large, the design method is complex, and the design difficulty is high. Let's look at the effect of applying fractal effects to the above vase. The fractal patterns in figure 11 and figure 12 are relatively close to the traditional flower pattern decoration of a vase. Compared with the traditional decorative pattern, fractal flowers show a dynamic effect that natural flowers do not have, and are similar to the vase itself. The integration of the vase made the vase more dynamic. Figures 9 and 10 are different from traditional vases and make people feel more modern and modern. The fractal patterns on these vases are different, but there is a relative unity in the changes, that is, the motility of the patterns.

4. The conclusion

As a new subject, the artistic value and importance of fractal geometry have been paid more and more attention, and its application has been extended to various fields of product design. We can see the application value of fractal in the design of ceramic products such as teapots, bowls, vases and so on from the previous analysis. Fractal art will be widely used in the design of ceramic products.

As the early application of fractal art, fractal art plays an important role in the design of ceramic decorative drawing. However, the fractal design pattern used in ceramic decoration pattern is limited to the application of fractal pattern directly in the overall drawing of ceramic art, which makes fractal art design become "fractal art mapping" to some extent. Although this direct application confirms to some extent the feasibility of fractal art in ceramic design, as a designer, it is not recommended that the art pattern of fractal processing be directly attached to ceramic products. For fractal patterns and ceramic products, Combine mode and style to carry out necessary research, study and innovation. With the continuous development and progress of fractal art, in view of the application of fractal art, we should innovate constantly on the basis of adapting to products, so that fractal art can be integrated into product design and realize the real unity of science and technology and art. So that fractal art in the future design field can be more and more far, more and more widely used, and in the field of product design to create a higher artistic value.
References:

[1] Yao Hui, Gao Wei, Ren Zhongming, (2018) Sustainable Packaging Design in regular Fractal Geometry, Green Package, 09: 73-79.

[2] Mao Yalong, He Jingtang, Guo Weihong, Title (2014) the Lingnan Architectural School and its creation from the Fractal Perspective, South Architecture, 01: 88-93.

[3] Cheng Yi-fang, (2015) the application of fractal art pattern in decorative design, Building Engineering Technology and Design, 12: 321-321.

[4] Li Zaibo, Gao Ying-ying, (2016) Product Decoration Design and Application based on Fractal Image, Design, 069: 120-121.

[5] Luo Yun, (2017) Feasibility of Chinese traditional pattern used in modern fashion design, Dyeing and finishing Technology, 05: 8-10.