

# Research on the Integration and Innovation of Ceramic Decorative Pattern Design and Traditional Culture

-- Taking the Ceramic Design of Qilizhen Kiln in Ganzhou as an Example

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**Abstract:** Ceramics, from the initial practicality to artistry, has a profound impact on social life and its value is unique. Tracing back to the origin of Chinese ceramic art, the application of decorative patterns is legendary. These decorative arts with national and cultural characteristics have distinctive characteristics of the times. Traditional culture is embedded in decorative patterns, which are dominated by the spirit of traditional culture. It is a profound historical accumulation of national traditional culture. Looking at the decorative patterns of ceramic art, these patterns are melting the collision of thoughts, reflecting the ceramic decorative patterns of the light of Chinese civilization for thousands of years, and are also the profound embodiment of the cultural and artistic values of Chinese civilization. This article mainly takes Ganzhou Qilizhen kiln ceramic design as an example to interpret the application of traditional culture in ceramic decorative art. A curve fitting technique based on adaptive genetic algorithm is proposed. The process of curve fitting using adaptive genetic algorithm and curve tools is described in detail, and the comparison results are given. The research shows that the adaptive genetic algorithm can effectively reduce the original iteration times by 30.14% compared with other algorithms. At the same time, this method is applied to the process of pattern design.

**Keywords:** Ceramic decoration; Pattern design; Traditional culture; Integration and innovation; Ceramic Design.

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## 1. Introduction

With the change of years, ceramic decorative art has become a unique ceramic culture in China. At the same time, with the improvement of people's ideological level, people's aesthetic taste has entered a higher level, and more and more people like Chinese ceramics. Therefore, ceramic decorative art has also become a starting point for people to appreciate ceramics. Ceramic decorative art is integrated with China's excellent traditional culture, which can bring better visual impact to viewers and lead them to appreciate the charm of Chinese traditional culture. Ceramics have been handed down from ancient times to the present, witnessing the development of the Chinese nation. Ceramics have been handed down from ancient times to the present in the form of utensils. Every piece of porcelain can reflect the spiritual civilization and aesthetic taste of the ancients. Ceramic utensils are the perfect embodiment of art. The shape, material, color and pattern of each ceramic work are carefully carved, reflecting the spirit and quality of the Chinese nation. The decoration of ceramics has diversified characteristics. The content and patterns of traditional ceramic decorative themes are unique. They are rooted in the folk. They are the inheritance and accumulation of thousands of years of history and culture, have profound folk culture connotation, and are a huge treasure left to us by our ancestors. In ceramic art, pattern decoration has a wide range of applications. Different decorative patterns, including plants, animals, people, landscapes, and geometric patterns, inject vitality into ceramic arts and crafts and practical applications. From the perspective of artistic aesthetics, ceramic decorative patterns reflect the social fashion at that time and are closely related to specific historical culture. The decorative forms of ceramics are more colorful today. With the continuous progress of modern industry and the further development of human civilization, the promotion of ceramic

culture has also been reflected accordingly. The thinking of ceramic art creation has changed from a one-way thinking closed type to a multi-directional thinking pioneering type, thus a new trend of integrating multiple disciplines, skills, materials and techniques has emerged. In the development process of modern ceramics, decorative patterns are widely used. When designing ceramic decoration, ceramic designers constantly pursue innovative ideas, highlight their individuality, and strive to show the cultural heritage of their own works. The works further absorb the artistic essence of Chinese traditional patterns, complete their own modern evolution, and make modern ceramic decoration the perfect product of the combination of traditional art and modern design.

## 2. The Application of Decorative Patterns in Ceramic Art and the Integration of Traditional Culture

### 2.1. Chinese Traditional Culture Reflected in Ceramic Decorative Arts

Up to now, ceramic decoration has not lost its luster in the historical changes, but has become more and more characteristic of the oriental nation. In the simplest words, ceramic decoration is to decorate and dress up ceramic objects. It beautifies ceramic modeling through glaze color and pattern, achieves the perfect combination of glaze color, pattern and modeling, and expresses the author's creativity with the unique language of ceramic decoration. Ceramic decoration design is an important part of Chinese traditional art. China's traditional culture contains the Confucian thought of "benevolence, righteousness, courtesy, wisdom and faith", the Taoist thought of "letting nature take its course" and the Buddhist thought of "Zen relief". Ceramic decoration is also

deeply influenced by Confucianism and Taoism. For example, the use of Confucian allusions to express the theme of ceramic decoration, the use of Mencius' mother moving three times to express the hope of becoming a talented person, and the use of Taoist Eight Immortals to cross the sea, heaven officials to bless, the group of immortals to celebrate their birthday, and the combination of two immortals all reflect that Confucianism and Taoism promote the integration of culture and decoration. The ceramic works of Qili Town in Ganzhou, which will be introduced in detail in this paper, are a wonderful flower in the domestic porcelain garden (Figures 1 and 2). Qilizhen Kiln Site is located in the southeast suburb of Ganzhou City, Jiangxi Province, 4 kilometers away. It has convenient land and water transportation and rich porcelain clay and fuel resources. Since its creation in the late Tang Dynasty, it continued to the Song and Yuan Dynasties, and was once in its heyday. The products burned are of various kinds, rich glaze colors, beautiful shapes and superb workmanship. They enjoy high reputation both inside and outside the province and are one of the five famous kilns in Jiangxi.



Figure 1. Ceramics in Qili Town, Ganzhou (a)

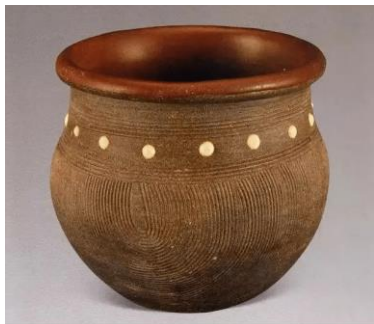


Figure 2. Ceramics in Qili Town, Ganzhou (b)

## 2.2. Pattern Design Application

The forms of Chinese ceramic decoration can be roughly divided into painting and blank decoration. Painting can also be divided into fine brushwork and freehand brushwork. No matter what kind of painting form, it is the performance of the characteristics of the development period of Chinese painting art in ceramic decoration at that time (Figure 3). In Chinese history, records show that after the appearance of the Neolithic Age, decorative patterns appeared on ceramic decoration. At the beginning, several simple and pictorial geometric patterns of counting nature gradually evolved into decorative patterns with different personalities of the times, different spiritual cultures and rich connotation expressions. The application of decorative patterns in ceramic art mainly includes individual patterns, suitable patterns, bilateral continuous patterns, and square continuous patterns. Ceramic art, whether it is daily ceramics, craft ceramics, or architectural ceramics, has different decorative patterns, providing rich expression for ceramic art modeling and

aesthetics.

(1) Innovation in modeling and expression techniques. In the processing of decorative patterns, modern technology, advanced ideas and culture are more integrated to provide unlimited imagination for the audience. The design and aesthetic concept of the artist is demonstrated through the choice, recombination, recreation and other techniques of traditional patterns. Some modern works mainly reflect the aesthetic and life values of the times. Not only is the strict "example" no longer applied in the pursuit of structure, but also the implementation techniques have gradually abandoned the unified style, and even subverted the traditional pattern design of "stereotyped" and "unified format".

(2) The combination of patterns and Chinese paintings. Traditional painting is mainly used in ceramic decoration, such as freehand painting and meticulous painting. Although freehand painting came into being earlier, meticulous painting gradually became popular after the Song Dynasty. Nowadays, the Chinese style makes more use of post-modern techniques, and the traditional structural forms are redesigned and combined to appear as symbols with another national characteristic.

(3) The combination of calligraphy in design. The combination of fonts, structures and strokes in calligraphy with ceramic decoration can form a new art. The Chinese calligraphy culture has a long history. The Chinese characters are broad and profound. The same character has different fonts and different forms of expression, which provides more innovative ideas for ceramic decoration art.

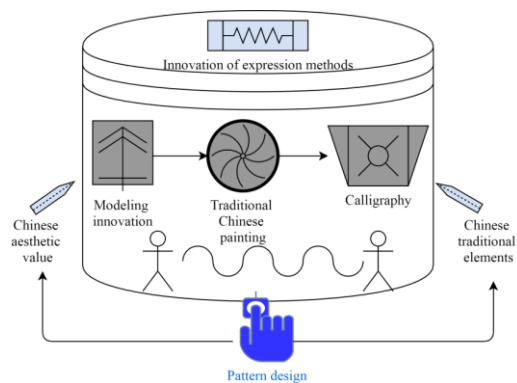


Figure 3. Pattern design application method

## 3. Copywriting Pattern Design Based on Genetic Algorithm

Before design, it is necessary to determine the range of solution space, that is, the size of pattern fragments. In the circular pattern, the shape of the segment is a sector, so the angle  $\alpha$  And radius  $r$  can uniquely identify a fragment. For the convenience of description, the quadratic parabolic curve and straight line with three type value points are selected as the basic primitives. The type value points of a conic are the fixed points and two endpoints of a parabola, and the type value points of a straight line are its two endpoints.

Since angle and radius represent two positions on the plane, they should be treated differently in theory. However, in the process of experiment, it was found that when there are few interior points, the effect of unifying angle and radius for genetic operation is also ideal. When there are many interior points, it is necessary to conduct genetic operation of a population separately. Therefore, the decimal point of the

initial population is accurate to three digits, so it can be represented by a 10-digit binary number. Binary conversion is carried out respectively, as shown in the following Table 1:

**Table 1.** Binary coding of initial population

r0	0.422	1111001000
r1	0.648	1100011101
r2	0.844	1010000100
r3	0.58	1001001111
r4	0.697	1000100011
r5	0.658	0010100010
r6	0.748	0011110001
r7	0.52	1001010110
r8	0.857	0010011110

After the initial population is generated, certain individuals are selected for genetic manipulation, and the changes of fragments and the whole are observed at the same time.

$$\eta = \sum_{i=1}^n [F(x_i) - y_i]^2 \quad (1)$$

For data points, accumulative chord length can be used to parameterize them, and for non-uniform data points, centripetal parameterization can be used. After boundary points are extracted, designers can further modify them. For example, you can add, delete, or directly perform genetic operations on curves. When the reference curve is determined, the initial population can be generated near the reference point. Let P be the first reference point. The reference curve does not need to be accurately approximated to the data point, but only needs to be constructed around the data point. This step can effectively reduce the number of iterations of the genetic algorithm.

$$P_1 - kl \langle P_1 \rangle P_1 + kl \quad (2)$$

As it is a minimization problem, the fitness function is selected as:

$$fitness = \varphi_{max} - \varphi_0 \quad (3)$$

When the number of iterations n is in the range of 3-10, the shape and color of the graph are basically the same. Exaggerate, summarize and reorganize the physical lines. In this process, computer aided design software can be used to accurately calculate the layout of a certain line or a certain flower pattern element, and the movement range and rotation angle can be arbitrarily changed in advance. Although it is only a minor adjustment, the overall effect will often be significantly different.

$$Z = Z_0 + \lambda L \quad (4)$$

where L is the size of the solution space?

Parameterize data points, use curve tools to construct reference curves, and set the generation range of initial population according to the reference points. The initial population Z is randomly generated within a certain range, and real number coding is performed according to two-dimensional coordinates. If the given iterative function is:

$$f(z) = z^n + z + c \quad (5)$$

Then the highest power n is still selected as 2, 3, 4, 5, 6.

The selection of intersections here is random, and the number of intersections can be defined by the user. After cross operation, the coordinate value of the parent control point will change, resulting in changes in pattern linearity and overall effect. If the complex number z is applied to equation (1), the

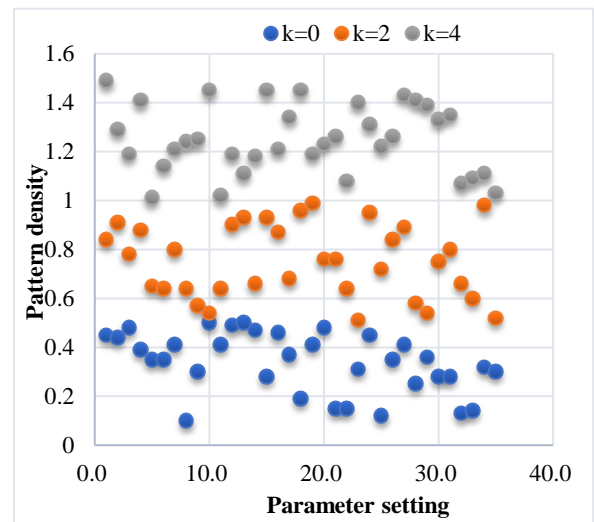
following formula is obtained:

$$z_{n+1} = z_n - \frac{f(z_n)}{f'(z_{n+1})} \quad (6)$$

## 4. An Example of Ceramic Design in Qili Town Kiln in Ganzhou

This paper takes the pattern design in Qilizhen kiln ceramics as the research object. The experimental environment is compiled based on Visual Basic, and the point, line, polynomial curve and other primitives are completed using the Open GL graphics library. When users modify the fragments, they can observe the overall changes and effects at any time to facilitate users' use. The curve fitting method based on genetic algorithm is improved and applied to the process of flower pattern interactive design. For the convenience of description, we take the suitable pattern of the circle as an example to describe, and apply the adaptive genetic algorithm to curve fitting, so as to improve the speed of curve fitting by automatically adjusting the evolutionary parameters. The main function is to import pictures in the form of bitmaps, record data points provided by users and perform curve fitting calculation. The fitted curve control points are transferred to the fragment design module or the genetic operation module.

By adjusting the key parameter k in the command that controls the color of a specific pattern area in the program, quasi regular density maps of different colors are generated, as shown in Figure 4 below.



**Figure 4.** Pattern density values under different parameters

Although the patterns are generally simple in shape and arranged randomly, they are very rich in hue levels, and there is a strong color contrast among the color blocks. The overall color contrast is large, so the visual impact is very strong, mainly reflected in hue, lightness, purity and area. The iterated function system regards the image to be generated as a collage of many small pieces similar to the whole (self-similar) or transformed to be similar to the whole (self-affine). If the initial axiom is assumed to be w and the generation rule is p, the Koch curve can be generated with different L system graphs in Figure 5 by changing the corresponding  $\ell$ , w and p values using the L system graph generation rule.

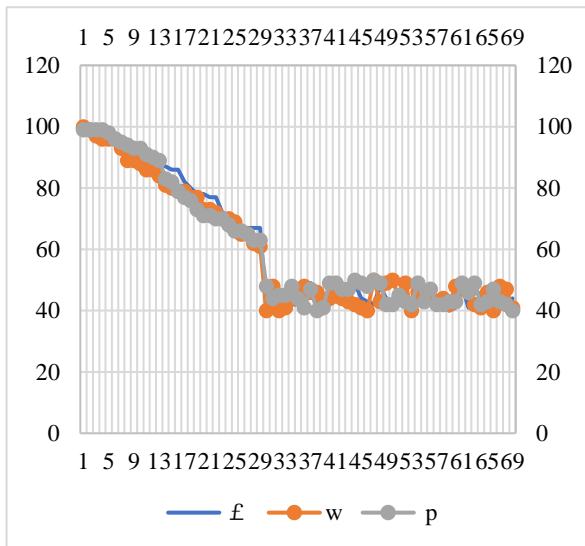


Figure 5. System graphics with different values

The coordinate values of control points entered by each user are binary coded separately. Because the coordinates of each point are composed of angles and radii. So, there will be two sets. During genetic operation. Angle value is not related to radius value. Therefore, the two sets operate within them respectively. Set the same parameters for several groups of data points, respectively use simple genetic algorithm, adaptive genetic algorithm and adaptive genetic algorithm with specified initial population range to perform cubic curve fitting, and record the number of iterations when the same optimal solution occurs (as shown in Table 2). Save when satisfactory results are obtained, and then you can choose to stop genetic operation or continue. Thus, more optional results can be obtained.

Table 2. Comparison of genetic algebras of different fitting methods

Data point	Simple genetic algorithm	Adaptive genetic algorithm	Adaptive genetic algorithm with specified initial range
A	299	297	212
B	299	397	217
C	360	201	186
D	156	288	357
E	386	160	189
F	213	179	312
G	263	394	243

To sum up, the experiment shows that the adaptive genetic algorithm can effectively reduce the number of original iterations by 30.14% compared with other algorithms. This algorithm can make many changes in the initial design scheme, and provides an effective method for innovative design of patterns, so as to help designers improve design efficiency and develop design ideas. Strengthen the theoretical study and guide practice of ceramic art decoration, and deeply consider how to better apply pattern design to ceramic decoration. In the future, the research scope of ceramic decorative art will not only focus on art porcelain, but also go deep into daily porcelain, art porcelain, architectural ceramics and sanitary ceramics.

## 5. Conclusions

In the process of historical development, different forms of national culture will emerge in each era. The decorative patterns on ceramic art have the same distinctive characteristics of the times as the modeling, and have different meanings and characteristics in terms of theme, content and form of expression. Ceramic works are the crystallization of the wisdom and art of the ancient working people of China, and are the epitome of Chinese traditional culture. When designing the decorative art of ceramics, traditional Chinese painting, calligraphy and patterns will be used to integrate traditional culture, so that the excellent traditional culture of the Chinese nation can be inherited and developed. At the same time, it can also improve the artistry and humanistic value of ceramic works, making ceramics a unique work of art and more popular. The application of decorative patterns in modern ceramic art endows today's characteristics of the times and aesthetic yearning on the basis of inheriting national culture, which not only enriches the decoration in ceramic art, but also satisfies people's yearning and pursuit for beauty through this form, and enriches people's life. Because no matter what era, no matter what development, human beings have basically the same long cherished desire for the pursuit of beauty, and their feelings for the pursuit of the heart remain unchanged. The application and embodiment of these in the decoration of ceramic art and visualization can create resonance across the times or across the nation and meet the aesthetic needs of the public.

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