

## Study on Qiang embroidery patterns creative design based on Shape Grammars

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### Abstract

*Qiang ethnic group is one of the fifty-six ethnic minorities in China, and Qiang embroidery, as an important achievement of Qiang's intangible cultural heritage, is the precipitation and testimony of the history and culture of the Qiang ethnic group. However, with the development of the times, traditional and ancient Qiang embroidery is facing a dilemma due to the problem of a single form of communication. Therefore, it is necessary to add new communication media for Qiang embroidery to help it spread and develop better. In this paper, we extract the core representative patterns of Qiang embroidery, use the "shape grammars" as the rules of morphological changes, and generate new decorative pattern patterns with the characteristics of Qiang embroidery by adding, deleting, mirroring, rotating, and other relevant rules of changes, and combine the new patterns with the rules of formal beauty to combine the layout, which is then applied in the design of different cultural creations and products. The new patterns are combined with the rules of formal beauty and applied in the design of different cultural and creative products. To provide a quantitative method for the digital protection of Qiang embroidery in the new era of Chinese traditional art, and also provide new ideas for the industrialization application.*

**Keywords:** *Qiang embroidery, Shape grammar, Innovation, Design*

### 1. Introduction

The Qiang ethnic group, which is one of the oldest ethnic groups in China, has unique aesthetic values, aesthetic shapes, patterns, and color codes. In June 2008, Qiang Embroidery was included in the "Second Batch of National Intangible Cultural Heritage List", which is of great research value [1]. However, with the development and changes of the times, the pattern form and application carrier of traditional Qiang embroidery have become single in expression and lack modernity and innovation. To better inherit and develop Qiang embroidery, it is necessary to use modern technology and design concepts to make innovative designs and turn them into artworks that meet modern aesthetics and market demand. Shape grammar, as a widely used method in the computer graphics and design field, can generate various shapes and structures through rules and variations, and has high flexibility. In the redesign of Qiang embroidery patterns, the use of the shape grammar method is helpful to better control the design process, enrich the expression of Qiang embroidery under the deduction mechanism, and inject innovative elements into Qiang embroidery while

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preserving the traditional cultural characteristics, expanding its application fields and market value. Provide ideas for the design methodology and innovative transformation of traditional patterns of various ethnic minorities in China.

## 2. Overview and Application of Shape Grammar

Shape Grammar is a computerized design method based on shape operations, which can generate new shapes according to people's design ideas and requirements by changing according to certain rules. The concept of Shape Grammar was first put forward by American architectural professor Stanley in 1975, and the article "Introducing Shape and Shape Grammar" was published in the American magazine "Environment and Planning-B" in 1980. which completely and systematically expounded the structure and system of Shape Grammar. This has also become the foundation for the development and research of the subsequent shape grammar system [2]. Shape Grammar operates based on the initial shape, following certain rules of change, such as rotation, mirroring, replacement, translation, mirroring, addition and deletion, etc. to make changes, and then derive different new shapes. The principle is to define the shapes as a parent set and form a sub-set of derived shapes by operations such as evolution rules. It is defined by the formula:  $SG=(S, L, R, I)$ .

Where (S, L, R, I) is the parent set of shape graphs: S is the finite set of initially drawn shapes; L is the finite set of symbolic labels; R is the finite set of inference rules; I is the initial shape, and SG is the subset of shape graphs derived from S under L symbolic labels after operations such as R inference rules [3]. The shape grammar inference rules can be subdivided into generative and derivative rules, Figure 1 with the letter A is used as the initial shape to illustrate the process of applying different generative rules (R1-R5) to get new shapes, the left side is the initial shape and the right side is the new shape resulting from the application of the rules. Figure 2 with the new shapes apply the derivativity rules (R6-R11) to get more new shapes. In this paper, the reasoning behind the Qiang embroidery pattern is also designed arithmetically based on such rules.

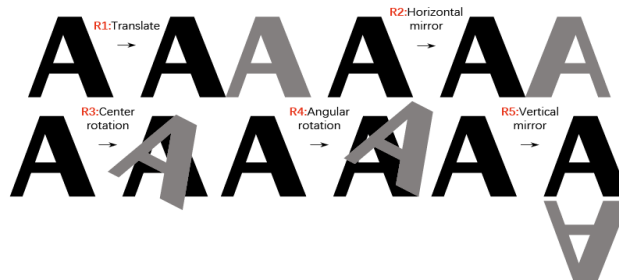


Figure 1. Generative rules

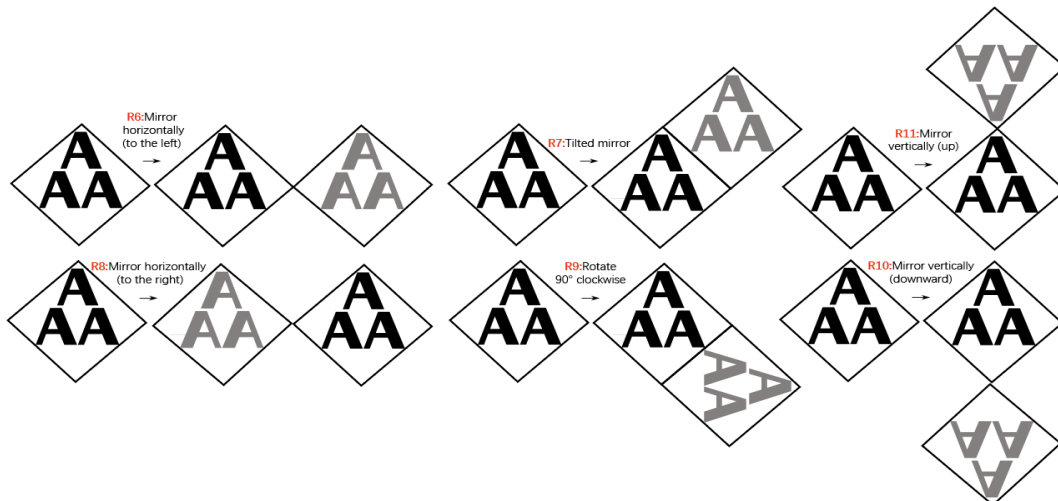


Figure 2. Derivation rules

With the development of culture and art, more and more scholars in China are now conducting research on the application of shape grammar in different fields. For example, Yuan Hao et al. studied the design process of combining shape grammar and multiple constraints in product morphology design to innovate the design of fishery machinery shape; Xu Primqi et al. used shape grammar to analyze the traditional Chinese face shape and applied it to the design of tea set shape; Li Shuxia et al. used shape grammar to study the celluloid cherry pattern in Chinese Ming Dynasty dress and combined it with the needs and aesthetic characteristics of modern female consumers. From these pioneering studies, we can see that shape grammar has been successfully proven to be reasonable in various fields such as architectural art design, product design, pattern design, etc. It is an effective method to produce new patterns based on preserving the genetic characteristics of patterns, which is of great significance to the innovative design of patterns.

### 3. The artistic characteristics of Qiang embroidery

#### 3.1 Overview of Qiang Embroidery

Qiang embroidery is the artistic crystallization of traditional folk handicrafts and the traditional culture of the Qiang people in China, which has been inherited and developed for thousands of years, and has distinctive regional characteristics and ethnic style in handicraft techniques and color application, and is one of the important representatives of Chinese embroidery art [4]. "The stitches of Qiang embroidery are mainly picking, flat embroidery, and nano-embroidery, which are mostly found on the headgear, collar, cuffs, waistband, and trouser corners of clothes, as shown in figures 3 and figures 4, and combined to form a variety of patterns. In the past, the Qiang were an unwritten people, so the appearance of patterns was especially important, and it turned into a method for the Qiang to record events [5]. Over time, the Qiang people's love for embroidery led them to create more exquisite patterns and also to use embroidery patterns as a vehicle for the spiritual and cultural needs of the Qiang people. They are very diverse, colorful, and vivid, and have a strong artistic sense. The motifs are mainly animals, flowers and plants, geometric shapes, etc. Most of the patterns are in the form of continuous symmetry. The graphic and colorful shape of the "meaningful form" highlights the Qiang people's view of life, worldview, and folk beliefs [6].

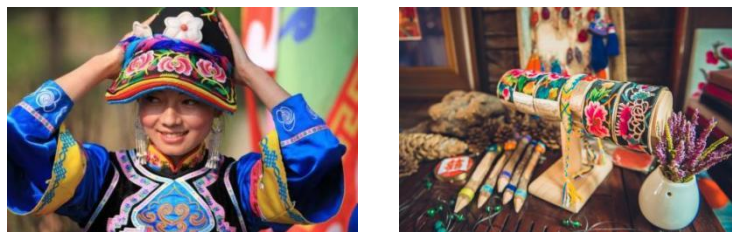


Figure 3. Qiang costume embroidery Figure 4. Qiang headdress embroidery

#### 3.2 Characteristics of the types of Qiang embroidery patterns

The Qiang people have a reverence for the natural environment on which they depend, and through their perception of nature, embroiderers use unique ways to materialize elements from nature and folklore stories into colorful ethnic decorative patterns. The elements of Qiang embroidery can be divided into three main categories: floral and botanical patterns, animal patterns, and text patterns.

Plant and flower patterns are the most common types of Qiang embroidery patterns. The Qiang people, who live in the mountains and forests all year round, are a people who live with plants and flowers, so you can often see Qiang embroidery with plant and flower patterns on Qiang costumes, such as ram's horn flower, octagonal lotus flower and pomegranate flower. Figure 5 shows that The Qiang embroidery patterns, based on the ram's horn flower (peony flower), have become one of the symbols of Qiang culture, representing happy marriage and good love; Animal motifs are also a common type of Qiang embroidery, which has a

great relationship with the areas where the Qiang people live. Various animals not only provide the Qiang people with necessary food and clothing, but also bring spiritual food and comfort to the nation. Figure 6 shows that Embroidery patterns commonly used by Qiang people include sheep's head pattern, cat pattern, moth pattern, butterfly dragon and phoenix pattern, etc. The dynamic sense of animal patterns and the static sense of other types of patterns complement each other, making the whole embroidery picture more vivid; there are also text patterns in Qiang embroidery patterns, As shown in Figure 7. such as longevity characters, ten thousand characters, and back characters, which enrich the Qiang embroidery patterns and express auspiciousness and good wishes. These characters enriched the motifs of Qiang embroidery, expressing auspiciousness, good wishes, and other expectations of life [7].



**Figure 5. Qiang embroidery floral patterns Figure 6. Qiang embroidery animal patterns**



**Figure 7. Qiang embroidery text patterns**

### 3.3 Stylistic features of Qiang embroidery patterns

Qiang embroidery pattern modeling pays attention to the combination of points, lines, and surfaces. A single point is not enough to express the artistic charm of Qiang embroidery. Line plays the role of connecting and expressing the layers of Qiang embroidery patterns. The surface is composed of expanded dots and closed lines [8]. Qiang embroidery often uses separate patterns, two-sided continuous in Figure 8 and four-sided continuous patterns in Figure 9, and suitable patterns in expressing patterns. The composition of points, lines, and surfaces make Qiang embroidery patterns look complete in structure, even in rhythm, uniform in rhythm, and strong in an overall sense and also makes the combination form of patterns more diversified, sparse, and decorative. It represents the Qiang people's reverence for nature, their aspiration for tenacity, and their positive attitude toward life.



**Figure 8. Bilateral continuous pattern Figure 9. Quadrilateral continuous pattern**

### 3.4 Color characteristics of Qiang embroidery patterns

The Qiang people reorganize colors according to their unique national aesthetics, constituting new color rules and styles. The Qiang embroidery hues are mainly white, blue, red, and green, and the overall presentation of high saturation, high brightness, and high purity characteristics leads people to focus their

eyes and gives them a strong aesthetic vision. The strong and direct contrast, high contrast color style expresses the Qiang people's reverence for nature. The Qiang people have a keen sense of color and aesthetic requirements for things in their lives. Qiang embroidery pursues an orderly color and a hierarchy of tonal sequences, and the ram's horn flower Figure 10 in Qiang embroidery is a typical representative. For example, the pistil transitions from rose red to peach red, the petals to pink, and the color transitions from saturated to bright white to create a sense of depth and order. The organization of colors through color sequence creation makes Qiang embroidery produce a sense of space at a certain distance, which is the most sincere and direct feedback from the Qiang people's observation of life [9].



Figure 10. Qiang embroidery color display


#### 4. Patterns innovation method based on shape grammar

##### 4.1 Design factor extraction

The design factor is highly recognizable and is a visual symbol that can cause users to awaken and imagine the culture embedded in the product [10]. By analyzing the artistic characteristics of Qiang embroidery in the early stage, the scope of design factor selection was positioned on morphology and color composition. As shown in Table 1, among the morphological factors, the representative patterns of Qiang embroidery are the ram's horn flower (peony) and azalea, the sheep pattern and butterfly pattern among the animal patterns, and the "auspicious cloud" pattern among the other patterns. Based on keeping the original morphological characteristics unchanged, we extracted the simplified patterns and further selected the typical samples [11]. When extracting the color factor, we extracted the color of Qiang embroidery, combined with the modern aesthetic demand, and further screened new color combinations to meet the diversified needs of modern consumers.

Table 1. Design factor extraction

Name	Source	Prototype	Linework	Pattern factor refinement	Color factor refinement												
Pattern factor 1 (Plants)	Crocus (Peony)				<table border="0"> <tr> <td></td> <td>C: 29 M:78 Y: 8 K:0</td> <td></td> <td>C: 55 M:80 Y: 95 K:32</td> </tr> <tr> <td></td> <td>C: 22 M:14 Y: 80 K:0</td> <td></td> <td>C: 73 M:11 Y: 35 K:0</td> </tr> </table>		C: 29 M:78 Y: 8 K:0		C: 55 M:80 Y: 95 K:32		C: 22 M:14 Y: 80 K:0		C: 73 M:11 Y: 35 K:0				
		C: 29 M:78 Y: 8 K:0		C: 55 M:80 Y: 95 K:32													
	C: 22 M:14 Y: 80 K:0		C: 73 M:11 Y: 35 K:0														
	Azalea																
Pattern factor 2 (Animals)	Sheep				<table border="0"> <tr> <td></td> <td>C: 57 M:14 Y: 0 K:0</td> <td></td> <td>C: 15 M:56 Y: 0 K:0</td> </tr> <tr> <td></td> <td>C: 8 M:20 Y: 0 K:0</td> <td></td> <td>C: 26 M:75 Y: 87 K:0</td> </tr> <tr> <td></td> <td>C: 4 M:11 Y: 39 K:0</td> <td></td> <td>C: 82 M:50 Y: 71 K:0</td> </tr> </table>		C: 57 M:14 Y: 0 K:0		C: 15 M:56 Y: 0 K:0		C: 8 M:20 Y: 0 K:0		C: 26 M:75 Y: 87 K:0		C: 4 M:11 Y: 39 K:0		C: 82 M:50 Y: 71 K:0
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	C: 56 M:19 Y: 36 K:0																

Pattern factor 3 (Other)	Auspicious clouds				
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## 4.2 Innovation Evolution of Qiang Embroidery Patterns

The evolutionary design of the extracted individual patterns according to the rules of shape grammar, taking different rules for each pattern, will yield different pattern evolutionary effects, which better illustrates that shape grammar can produce infinite possibilities for graphic evolutionary results. For example, in the evolution 1 in Figure 11, the pattern factor is changed by the rules of vertical mirroring, reduction, shrinking, vertical mirroring, and center rotation, and then the pattern form of Qiang embroidery with new visual effect is reorganized. In the evolution process 2 as shown in Figure 5, the same pattern material is rotated by 90° and 45° respectively, and then two different patterns are generated by using rules such as horizontal mirroring.



**Figure 11. Single pattern shape grammar evolutionary design**

## 4.3 Innovative Combination of Qiang Embroidery Patterns

Based on the new patterns generated by the shape grammar, we combined the relevant laws of formal aesthetics, such as harmony, contrast, balance, rhythm and a series of other laws, and selected the appropriate formal aesthetic laws to complete the innovative design of Qiang embroidery pattern-derived graphics according to the modeling characteristics of the regenerated patterns and the modern aesthetic needs. Figure 12 uses the design rules of size contrast and balance to design the different sizes of the patterns generated in evolution process 2 and 4 for the layout of the surface painting, focusing the visual center of gravity on the center of the picture, forming a decreasing visual hierarchy of large in the middle and small around, and achieving a sense of balance between the surrounding and the center. Figure 13 applies the symmetrical design rule, the pattern result of evolution 4 is laid out in a symmetrical way, and the pattern result of evolution 3 is added in the vacant part of the picture, making the layout more rich and full while being orderly and harmonious. Figure 14 uses the pattern result of evolution 1, and the size contrast design, and the pattern result of evolution 2 to combine the layout, interspersing the rotation structure with the square typographic structure to increase the vividness of the picture.

As shown in Figure 15, According to the extracted color samples and combined with modern aesthetic concepts, innovative color matching is carried out. The colors are selected from cool and warm colors with low purity for color matching. The picture is rich in layers, soft and steady, creating a visual intimacy for the embroidery patterns of the Qiang nationality.

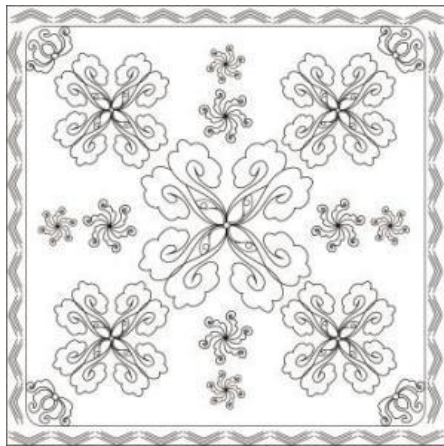


Figure 12. Pattern combination line draft

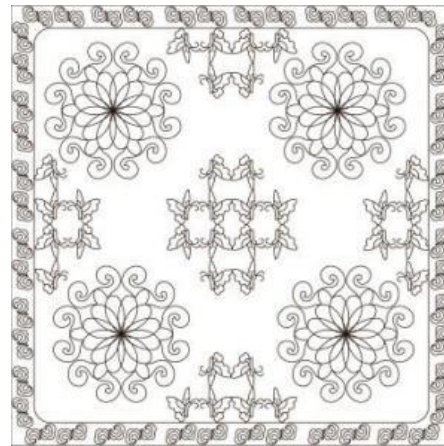


Figure 13. Pattern combination line draft

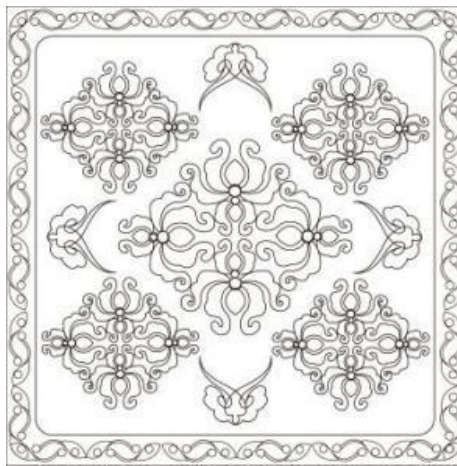


Figure 14. Pattern combination design line draft



Figure 15. Pattern innovative combination design color draft

## 5. Innovative Application of Qiang Embroidery Patterns

Qiang embroidery is one of the unique forms of cultural expression in Southwest China. Due to the regional limitations of manual inheritance, the way of transmission is relatively narrow. Cultural and creative products are products that combine cultural elements and creative designs. Applying innovative patterns of

Qiang embroidery to cultural and creative products can break through geographical limitations and expand the scope of the art of Qiang embroidery. In the process of pattern application design, it is necessary to pay attention to the selection of innovative pattern carriers. Based on the pattern's aesthetics, choose a more practical carrier, which can frequently appear in the public's field of vision, increase the appearance rate and exposure, and subtly influence Spread Qiang embroidery art in people's life. Therefore, As shown in Figure 16, daily necessities such as masks, water cups, and backpacks are selected as the application carriers of Qiang embroidery patterns. To promote and inherit the development of the Qiang embroidery culture.



**Figure 16. Application of Innovative Patterns**

## 6. Conclusion

As one of China's outstanding intangible cultural heritages, Qiang embroidery unites the artistic and cultural development of Chinese people, records the rich spiritual civilization of Chinese Qiang ethnic group, and has profound inheritance and protection value. This paper analyzes the artistic characteristics of Qiang embroidery, extracts representative patterns and colors, and innovates the design of traditional Qiang embroidery patterns with the help of shape grammar derivative rules. This paper not only retains the characteristics of traditional patterns, but also innovates and regenerates new patterns, and uses the rules of derivativeness, combined with the rules of formal aesthetics, to re-combine the layout of patterns and apply the innovative patterns in the cultural and creative products. It updates the expression and carrying medium of Qiang embroidery, proves the feasibility and effectiveness of shape grammar on the innovative design of traditional patterns, and provides innovative design sources and methods for the transformation of traditional patterns in modern culture. It also provides new ideas for the protection of intangible cultural heritage of ethnic minorities.

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