



A Study on the Visual Interpretation and Contemporary Design Innovation of Traditional Shu Brocade Patterns Empowered by Digital Technology

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Abstract. As one of China's four famous brocades, Shu Brocade boasts a long history, exquisite craftsmanship, and a rich variety of patterns, embodying profound ethnic cultural and artistic value. However, in modern society, the question of how Shu Brocade can adapt to the changing times, meet contemporary aesthetic and consumer demands, and achieve deep integration with modern life—while preserving its historical heritage—has become an urgent issue. Digital technology offers a new approach to revitalizing and innovating traditional Shu Brocade patterns. The author applies translation techniques to scenarios such as immersive cultural and museum experiences, digital cultural and creative products, apparel and home furnishings, and visual communication, thereby achieving the visual translation of traditional patterns and contemporary design innovation. This provides theoretical insights for the digital preservation, creative transformation, and market-oriented development of intangible cultural heritage.

Keywords: Shu brocade, Digital technology, Traditional patterns, Visual translation

1 Introduction

As one of China's Four Famous Brocades, Shu Brocade boasts a history of over two thousand years. It is a treasure of silk culture in China and the world, possessing immense historical and cultural value^[1]. During the Tang Dynasty, the weaving techniques, patterns, and colors of Shu Brocade reached the pinnacle of ancient silk weaving art. Featuring the Lingyang Gong pattern, Baoxiang floral motifs, linked-pearl patterns, and auspicious beast designs as its primary motif systems, it is an artistic and cultural product that integrates the ritual systems of the Central Plains, the culture of the Western Regions, and Buddhist aesthetics. Some scholars argue that Shu Brocade was endowed with its social and artistic status through the processes of selection and exhibition^[2]. In the process of modernization, the transmission of Shu Brocade faces challenges such as the high barrier to entry for traditional weaving techniques, the

advanced age of inheritors, and the fragmented nature of pattern documentation. The development of digital technology has facilitated the transmission and innovation of intangible cultural heritage. Gene theory, the Analytic Hierarchy Process (AHP), and the Semantic Extension Method can provide a scientific basis for the extraction of pattern elements, while technological breakthroughs such as generative AI, AI agents, 3D modeling, and dynamic visualization have overcome the limitations of traditional design in terms of efficiency and creativity.

While academic circles have conducted preliminary research on the extraction of Shu brocade cultural genes and AI-assisted ICH design, systematic studies on the visual translation mechanisms of Shu brocade patterns empowered by digital technology and the contemporary design innovation system remain relatively weak, lacking a comprehensive framework spanning elements, techniques, translation logic, and practical implementation. Based on this, this study draws on traditional Shu brocade patterns to address the challenges facing the preservation of Shu brocade, revitalize traditional patterns, and innovate upon them, thereby providing a practical approach to the digital preservation and design adaptation of intangible cultural heritage.

2 Theoretical Foundations and Core Concepts of the Visual Translation of Traditional Shu Brocade Patterns Empowered by Digital Technology

2.1 Definition of Visual Translation

The visual elements of traditional Shu brocade patterns are the external manifestation of cultural genes, comprising three components: graphic symbols, color, and composition^[3]. They embody both formal and cultural connotations and serve as a manifestation of the aesthetic values and ritual order of Tang Dynasty society. Visual translation is the process of transforming static two-dimensional resources from their original forms into cultural products with three-dimensional expressiveness and communicative power. It encompasses key stages such as the extraction of cultural symbols, the reconstruction of artistic forms, and the adaptation to communication media. The visual translation of traditional Shu brocade patterns is premised on preserving the core cultural DNA, while innovating through the digitization of Shu brocade patterns, experiences, and dissemination in the context of design innovation.

2.2 Digital Technology Empowerment

Digital technology empowerment utilizes artificial intelligence technologies—such as natural language processing, generative AI, computer vision, and speech synthesis—to enhance the entire visual translation process. This aims to achieve precise extraction of cultural DNA, intelligent artistic creation, personalized adaptation for dissemination, and scientific evaluation of outcomes.

2.3 A Three-Layer Design Methodology Framework for Traditional Shu Brocade Patterns Under Digital Technology Empowerment

To address issues such as visual imbalance that arise during the visual translation of traditional Shu brocade patterns under digital technology empowerment, this paper constructs a three-tiered design methodology comprising pattern symbol deconstruction and reconstruction, modern adaptation of color systems, and dynamic cross-media transformation of compositional paradigms (Figure 1). This problem-oriented methodological framework aims to provide an operational and reusable design pathway for visual translation empowered by digital technology.

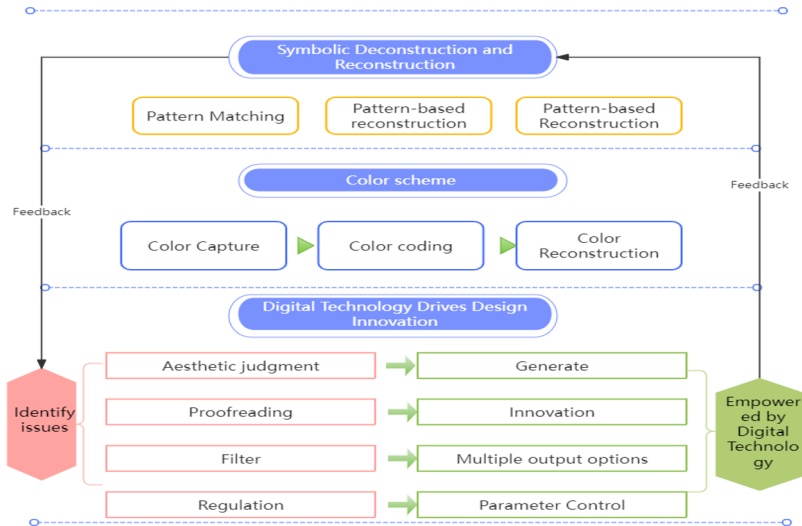


Fig. 1. A Three-Layer Design Methodology Framework for Traditional Shu Brocade Patterns Empowered by Digital Technology

2.4 Theoretical Framework

Cultural Gene Theory. Cultural genes are the primary factors in the process of cultural transmission that possess stability and hereditary characteristics; they determine a culture’s uniqueness and continuity. The visual translation of traditional Shu brocade patterns must first extract representative cultural genes from the patterns. Through digital analysis, the core elements of these cultural genes can be identified, providing the material foundation for the translation process.

Media Convergence Theory. As digital media technologies evolve, the forms of cultural dissemination also change. Digital technology serves as a new medium capable of integrating visual content to create diverse cultural experiences. Through media convergence, traditional Shu Brocade patterns can transcend the limitations of traditional dissemination methods, transforming from static displays into dynamic, interactive experiences.

Cross-Cultural Communication Theory. This refers to effective communication and exchange across different cultural contexts. Digital technology enables the personalized adaptation of visual translations of traditional Shu brocade patterns based on the aesthetic preferences and value orientations of diverse cultural audiences, thereby reducing cultural loss and enhancing the effectiveness of cross-cultural communication.

3 Analysis of Visual Elements in Traditional Shu Brocade Patterns

3.1 Graphic Structure and Symbolic Characteristics of Shu Brocade Patterns

The graphic structure of Shu brocade patterns adheres to the principles of prioritizing symbolic meaning and maintaining a regular form. Based on subject matter, they can be classified into four categories: animal patterns, plant patterns, geometric patterns, and figurative and calligraphic patterns, each forming distinct symbolic forms. Animal motifs primarily feature dragons, phoenixes, lions, celestial horses, mandarin ducks, and deer. Dragons and phoenixes symbolize imperial power and good fortune; lions represent authority and strength; and deer symbolize “lu” (official rank and salary), implying a prosperous official career. Plant motifs are dominated by the Baoxiang flower, peony, grapevine, scrollwork, and lotus. The Baoxiang flower, blending Buddhist and Central Plains aesthetics, symbolizes wealth and perfection, while scrollwork represents endless vitality and serves as an iconic symbol of the fusion of Eastern and Western cultures. Geometric patterns are primarily characterized by beaded patterns, circular nest patterns, tortoise-shell patterns, and diamond-shaped patterns. The beaded pattern originated in the Western Regions and was adapted locally to become the signature framework of Tang Dynasty Shu brocade, while the circular nest pattern’s concentric visual form exudes order and grandeur. Figurative and textual patterns include hunting scenes, scenes of foreign peoples feasting, flying apsaras, and inscriptions of “fortune” and “longevity,” representing folk customs and auspicious blessings. The graphic symbols of Shu brocade are characterized by stylization, symbolism, and inclusivity: all motifs have been artistically refined, with natural forms simplified into orderly patterns that convey cultural meanings—such as auspiciousness, warding off evil, blessings, and the divine—through homophones, symbols, and metaphors. The Western Regions’ linked-pearl pattern, the Buddhist “Baoxianghua” (Treasure Flower), and the local dragon-and-phoenix motifs together form a diverse yet unified symbolic system.

3.2 The Color System and Aesthetics of Shu Brocade Patterns

The color system of Shu brocade is based on the traditional Chinese “Five Colors,” forming an aesthetic paradigm characterized by hierarchy, symbolism, and technical mastery. The primary colors are red, yellow, black, purple, and indigo. Red is the dominant color in Shu brocade, primarily in the form of vermilion. Red symbolizes

good fortune and protection, and is mainly used in brocades for festivals and ceremonial occasions. Yellow is predominantly bright yellow, symbolizing imperial authority and sacredness, and is primarily used in brocades for the imperial court. Purple is the second dominant color after bright yellow; it symbolizes mystery and faith, and is often used in religious and aristocratic attire. Black, ochre, and malachite green are often used as background or complementary colors to express solemnity, nature, and vitality. The color aesthetics of Shu brocade combine ritual propriety with artistic expression; its color system aligns with the Tang Dynasty's hierarchical system, where colors were used to distinguish rituals and correspond to different social statuses and usage contexts. Shu brocade colors are primarily achieved through dyeing and weaving, with layered gradations; Huan'ged brocade and Shujiang brocade achieve their gradations by changing the color of the warp threads, resulting in rich and three-dimensional hues. Color is not merely a visual ornament but also a vehicle for cultural concepts; when combined with the Five Elements, Buddhism, and folk customs, it forms a comprehensive color genetic system.

3.3 Composition Principles and Artistic Value of Shu Brocade Patterns

Shu brocade patterns feature symmetrical compositions, orderly frameworks, and clear layering. There are three main compositional forms. The first is the "circular cluster" composition, which primarily uses interlocking rings and circular frameworks. The central motif is placed at the center, surrounded by auxiliary motifs. This style exudes a strong centripetal force and a solemn, majestic atmosphere, and serves as the core composition of the Lingyang Gong pattern. The "branching and twining" composition, dominated by flowers and birds, features scattered or intertwining motifs that extend across the design, creating a lively and graceful effect. The geometric composition uses diamond patterns, tortoise-shell motifs, and interlacing waves as its framework, conveying a strong sense of order and well-suited for large-scale weaving. The artistic significance of Shu Brocade compositions lies in the unity of craftsmanship and aesthetics, as well as the integration of culture and form: the compositions are tailored for jacquard weaving, combining technical feasibility with visual integrity. The compositions serve to express cultural symbolism, with symmetry conveying perfection and harmony, and layered overlaps conveying rich connotations; by integrating Eastern and Western compositional traditions, they preserve the formal rigor of Central Plains ritual systems while absorbing the dynamism of Western Regions motifs, thereby embodying the grandeur of the Tang Dynasty. The composition serves as an implicit visual gene that determines the overall visual rhythm of the pattern and is the core element to be preserved in the digital translation process.

4 Mechanisms for the Visual Translation of Shu Brocade Patterns in the Digital Age

Visual translation represents the fusion of digital technology with Shu brocade culture. Based on the preservation of cultural heritage and guided by modern aesthetics, it

involves the digital reconstruction and modern adaptation of pattern symbols, colors, and compositional paradigms, thereby establishing a translation logic that bridges tradition and modernity.

4.1 Digital Deconstruction and Reconstruction of Pattern Symbols

Digital technology facilitates the decomposition and recombination of symbols. During the deconstruction phase, AI image segmentation breaks down patterns into primary motifs, secondary motifs, and border elements, separating explicit and implicit cultural elements to retain core symbols. During the refinement stage, key symbols are selected based on weighting criteria. Excessive details are removed to enhance symbol recognition, while inappropriate symbols are eliminated, retaining primary motifs such as the phoenix pattern, the "Baoxianghua" (Buddha's face flower), and the "Lianzhuwen" (linked pearl pattern). In the reconstruction stage, generative AI is used to innovatively recombine symbols, subverting traditional arrangements by integrating traditional motifs with modern graphics to create patterns that blend the two. LORA model training is central to symbol reconstruction. Using core digital Shu brocade materials from LiblibAI as training data, we set cropping dimensions, labeling algorithms, and trigger words to enable the model to learn the characteristics of Shu brocade symbols. This facilitates style transformation and variant generation. By controlling the theme, style, and complexity of reconstructed patterns through prompts, we ensure the integrity of cultural semantics and the innovation of visual expression, thereby avoiding cultural fragmentation and stylistic homogenization. Ye Yuhong demonstrates that by deconstructing symbols to extract the formal language, color systems, and narrative structures of patterns, and by employing technical methods such as vectorization, parametric modeling, and algorithmic generation, a systematic transformation of traditional patterns into digital media can be achieved. In visual communication design practice, pattern elements that have been recreated and adapted to the medium can be integrated into diverse scenarios such as graphic design, interactive interfaces, and brand identity.

4.2 Modern Adaptation and Translation of the Color System

The translation of traditional Shu brocade colors adheres to the principles of preserving heritage, adapting to context, and aligning with contemporary aesthetics, facilitating the transition from the traditional five-color system to a modern color system. Digital color calibration extracts the hue, saturation, and brightness data of traditional Shu Brocade colors to create a standard Shu Brocade color library, preserving core colors such as red and yellow^[4]. By applying modern design color theory, the palette is refined to reduce the harshness of high-saturation tones and enhance low-saturation accent colors, thereby meeting the color requirements of scenarios such as apparel, cultural and creative products, and home furnishings. Balancing cultural symbolism with visual appeal, the project preserves the symbolic significance of traditional colors—red for celebratory occasions and yellow to convey a sense of high-end quality—while expanding the color palette's application range. By integrating with modern trends such as Morandi colors and macaron hues, the project caters to the aesthetic preferences of

the younger generation. AI-powered color matching automatically generates modern color schemes compatible with Shu Brocade's genetic characteristics, thereby improving the efficiency and accuracy of color translation.

4.3 Dynamic Composition and Cross-Media Adaptation

The translation of traditional Shu brocade compositions focuses on dynamic reconstruction and cross-media adaptation, breaking free from the constraints of static weaving to adapt to digital media and modern platforms. Dynamic transformation leverages animation technology and interactive design to convert static visual compositions—such as symmetrical balance and clustered skeletal structures—into dynamic, interactive visual compositions. This enables clustered patterns to rotate around a central axis and radiate outward, while scrollwork patterns can extend dynamically, enhancing visual appeal. Cross-media adaptation is central to this compositional translation. Composition proportions, layers, and rhythms are adjusted according to the characteristics of each medium. For digital screens, horizontal and vertical compositions are utilized to identify interactive nodes. For apparel design, layers are simplified to accommodate fabric cutting and the human form. For cultural and creative products, the underlying framework is extracted to adapt to the product's form. Digital implementation allows for flexible adjustment of compositional paradigms, enabling traditional Shu brocade compositions to transcend the constraints of the textile medium and adapt to various formats—including two-dimensional, three-dimensional, dynamic, and interactive media—thus achieving a visual transformation from traditional weaving to modern design.

5 Contemporary Design Innovations in Traditional Shu Brocade Patterns

5.1 Cultural and Museum Exhibitions and Immersive Experience Design

The Sanxingdui Museum has created the immersive theater “The Enchanted Land of Ancient Shu” (see Figure 2) through a combination of a digital light and shadow hall, VR archaeology, and 3D reconstruction. Digital techniques such as 3D modeling, VR/AR, dynamic presentations, and interactive design have been used to create an immersive exhibition on Shu brocade culture, breaking away from the traditional “static display and passive viewing” model of cultural and museum exhibitions and enhancing audience engagement and cultural identification. By projecting digitally rendered Shu brocade patterns into an immersive space and utilizing animation, lighting effects, and sound, the exhibition recreates the Tang Dynasty Shu brocade weaving process, the historical evolution of patterns, and their cultural significance. Visitors feel as though they are standing in a Tang Dynasty Shu brocade workshop, gaining a firsthand understanding of the craft. Using AR technology, visitors can scan actual Shu Brocade textiles or exhibition panels to view the digital deconstruction of the patterns, their historical background, cultural significance, and modern interpretations, thereby

enjoying a “physical + digital” experience that deepens their understanding of Shu Brocade culture.



Sanxingdui Museum's "Mystical Land of Ancient Shu" Theater



Chengdu Shu Brocade Museum: Maze of Enchanting Brocades

Fig. 2. Cultural and Museum Exhibitions and Immersive Experiences.

5.2 Digital Cultural and Creative Products and Interactive Product Design

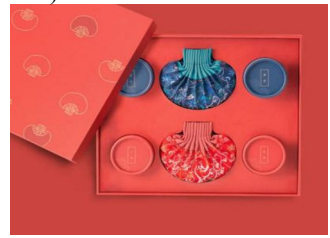
Leveraging blockchain technology, we have transformed Tang Dynasty Shu brocade patterns—a fusion of classic and modern elements—into unique digital collectibles. By capitalizing on their cultural, collectible, and promotional value, we attract young audiences. Paired with the cultural stories behind the patterns, this approach enhances the collectibles' value and promotes the digital dissemination of Shu brocade culture. Using AI agents, we have developed interactive mini-programs and apps for Shu brocade patterns. Users can enter keywords to intelligently generate patterns, which can then be edited, downloaded, and customized, lowering the creative barrier and enabling public participation in Shu brocade design. At the same time, we extract and simplify Shu brocade elements to design physical cultural and creative products such as scarves, jewelry, and tea sets. By using digital jacquard techniques to recreate the texture of the weave and leveraging digital methods to enable personalized small-batch production, we reduce development costs, integrate Shu brocade into daily life, and achieve mutual empowerment of cultural and commercial value (see Figure 3).



Shu Brocade Coaster



Shu Brocade Brooch



Shu Brocade Scented Pouches · Fragrance Gift Set

Fig. 3. Shu Brocade Cultural and Creative Products.

5.3 Apparel, Home Furnishings, and Visual Communication Design

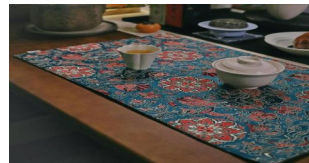
By applying Shu brocade patterns to products such as wallpaper, carpets, textiles, lighting fixtures, and furniture—and drawing on the color palette and compositional framework of Shu brocade—we innovate the Chinese home decor style^[5]. Patterns such as “tuankuo” and “chanzhi,” which are well-suited for large-scale application in home soft furnishings, create a warm and auspicious spatial atmosphere through four colors centered around the main hue. This integrates Shu brocade into daily home life, achieving a perfect fusion of traditional culture and modern living (See Figure 4). In the field of visual communication design, Shu brocade visual elements are applied to brand design, poster design, packaging design, and advertising design. By using Shu brocade symbols as core visual elements, a visual system with strong cultural distinctiveness is formed. In the contexts of cultural and creative brands, cultural tourism promotion, and the promotion of intangible cultural heritage, the visual interpretation of Shu brocade conveys its cultural significance, enhances the cultural and artistic value of the designs, and disseminates Shu brocade culture.



“A Bouquet of Flowers”
Silk Scarf Gift Set



Shu Brocade Intangible Cul-
tural Heritage Jewelry Set



Shu Brocade Table Runner

Fig. 4. Shu Brocade in Fashion, Home Furnishings, and Visual Communication Design.

6 Conclusion

Using digital technology as an enabling tool and focusing on traditional Shu brocade patterns as the subject of study, this research establishes a systematic framework comprising visual element analysis, digital technology application, visual translation mechanisms, and contemporary innovative applications to address the challenges of digitization, innovation, and marketization in the preservation and transmission of Shu brocade. The graphics, colors, and compositions found in traditional Shu brocade patterns constitute the visual DNA of these patterns and serve as the primary vehicles for the cultural heritage of Shu brocade. Digital technology enables the digital capture, extraction, modeling, and dynamic presentation of these patterns. A scientific visual translation mechanism is formed through the digital reconstruction based on cultural DNA, modern color adaptation, and cross-media transformation of compositions, ensuring that the cultural DNA of Shu brocade is passed down in a way that aligns with modern aesthetics. The results of this translation are widely applied in fields such as cultural relics and museums, cultural and creative industries, apparel, home furnishings, and visual communication, thereby achieving the living transmission and market-oriented innovation of Shu brocade culture.

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