

Digital Extraction and Innovative Design of the Patterns on Ming Dynasty Bestowed Costumes

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Abstract:

As a special series of the ancient Chinese costume system, the Ming Dynasty bestowed costumes, including python robes, flying fish robes, fighting ox robes and kylin robes, bear profound symbols of power and cultural connotations in their typical patterns. Based on a systematic analysis of the morphological characteristics and evolutionary laws of the patterns on the four types of Ming Dynasty bestowed costumes, this paper constructs a research framework of “pattern analysis - digital extraction - innovative transformation” to explore the digital living inheritance path of traditional bestowed costume patterns. The research shows that with the development of the times, the patterns on Ming Dynasty bestowed costumes present an evolutionary trend of “dragon-like”, and their morphological differences constitute a special hierarchical coding system; through high-precision digital acquisition, vector reconstruction, 3D modeling and other technical means, the complete preservation and editable transformation of bestowed costume patterns can be realized; at the level of innovative design, a three-stage strategy of “symbol extraction - contextual reconstruction - media expansion” can be adopted to integrate traditional patterns into emerging fields such as digital fashion, virtual costumes and interactive art. This research provides theoretical support and practical paths for the digital protection and creative transformation of the culture of Ming Dynasty bestowed costumes, and has reference value for promoting the contemporary inheritance of Chinese traditional costume culture.

Keywords:

Ming Dynasty Bestowed Costumes, Pattern Analysis, Digital Extraction, Innovative Design, Cultural Inheritance

1. Introduction

The bestowed costume system of the Ming Dynasty, with its imperial favor and special grant system and rich visual symbols, has become an important chapter in the history of Chinese costumes. As the core types of bestowed costumes, python robes, flying fish robes, fighting ox robes and kylin robes follow the regulatory logic of “resembling dragons yet being distinct” in their pattern design, and also contain the political wisdom of “determining seniority by patterns”. However, existing researches mostly focus on the institutional textual research, technological analysis or symbolic

interpretation of bestowed costumes. Therefore, against the background of digital transformation, how to liberate the patterns of bestowed costumes from physical carriers and realize their visualization, editability and recreation in the digital space remains an urgent research topic to be deepened.

This research focuses on the digital extraction and innovative design of the patterns on Ming Dynasty bestowed costumes, aiming to solve three core problems: first, how do the morphological characteristics and evolutionary laws of bestowed costume patterns affect the strategic choice of digital extraction? Second, which digital technologies are suitable for the high-fidelity acquisition and editable transformation of bestowed costume patterns? Third, how can the digitized bestowed costume patterns realize cross-media innovative applications? By answering these questions, this paper attempts to construct a complete methodology from pattern analysis to digital transformation and then to creative design, providing a theoretical reference and practical guide for the digital inheritance of traditional costume culture.

2. Morphological Characteristics and Evolutionary Laws of the Patterns on Ming Dynasty Bestowed Costumes

2.1. Type System of Bestowed Costume Patterns

The patterns on Ming Dynasty bestowed costumes are characterized by “dragon-like patterns” as the core. Python patterns rank first, with a shape “very similar to a dragon, only with one claw less” [1], usually having four claws, and the seated python is more honorable than the walking python; flying fish patterns come second, with the early form being “a dragon head with wings, a fish tail and a body covered with fish scales”, and the wings disappearing in the later period leaving only the fish tail [2]; fighting ox patterns are next, with a head growing downward-curving ox horns and a fish-shaped tail [3]; kylin patterns are the last, with a dragon head, a deer body, a lion tail, horse hooves and fluttering mane and sideburns, standing out among dragon-like patterns [4]. This pattern system breaks the tradition of distinguishing ranks by color and accessories in the Tang and Song dynasties, and constructs a visual hierarchical coding system centered on animal patterns.

2.2. The “Dragon-like” Evolutionary Trend of Patterns

In the middle and late Ming Dynasty, the patterns on bestowed costumes showed a significant “dragon-like” evolutionary trend. Taking python patterns as an example, the claws tended to be similar to dragon claws during the Jiajing period, such as the blue luopan gold embroidered python robe in the former collection of the Confucius Mansion preserved in the Confucius Museum; the double wings of flying fish patterns gradually disappeared, and their four-legged and four-clawed form made them hardly distinguishable from python patterns; fighting ox patterns and kylin patterns also moved closer to dragon patterns in details. This evolution is both a product of social transgression demands and a helpless choice of imperial power in design compromise. The “dragon-like” nature of the patterns is essentially the visual representation of power symbols in the process of evolution - by blurring hierarchical differences, transgressors achieved a visual illusion of approaching imperial power.

2.3. Collaborative Coding of Patterns and Forms

The patterns of bestowed costumes do not exist in isolation, but form a complete symbolic system together with costume forms, colors and accessories. In terms of

form, python robes and flying fish robes mostly adopt the Yesa style; in terms of color, bright red brocade with gold thread is the most honorable; in terms of accessories, the matching of jade belts with bestowed costumes strengthens the integrity of identity identification. This multi-dimensional collaborative coding makes bestowed costumes a visual carrier of “identity through wearing”, and also puts forward higher requirements for the subsequent digital extraction - the extraction of a single pattern, if divorced from the contextual form, will lose the integrity of its symbolic meaning.

3. Digital Extraction Methods of Bestowed Costume Patterns

3.1. High-precision Data Acquisition

Digital extraction of bestowed costume patterns is based on high-precision data acquisition. For two types of objects, handed-down cultural relics and image documents, differentiated acquisition strategies need to be adopted: for the physical bestowed costumes in the former collection of the Confucius Mansion, 3D scanning and multispectral imaging technologies can be used to completely record the morphological, color and material information of the patterns; for the image records in documents such as Veritable Records of the Ming Dynasty and Notes from the Inner Palace, as well as portrait paintings such as the portrait of Chang Yuchun and the portrait of Li Zhen collected in museums, high-definition scanning and color correction technologies need to be combined to restore the historical original appearance of the patterns to the maximum extent. Special attention should be paid to the local details of the patterns in the acquisition process, such as the number of claws of python patterns, the forking of fish tails of flying fish patterns, the direction of horns of fighting ox patterns and other key identification features.

3.2. Vector Reconstruction and Layered Deconstruction

The collected data needs to be post-processed into editable digital assets. Vector reconstruction is the core link - through software such as Adobe Illustrator and CorelDRAW, bitmap patterns are converted into vector paths to achieve lossless scaling and morphological adjustment. On this basis, a layered deconstruction method is adopted to disassemble the patterns into independent levels such as main outline, internal details, background decorations and color layers, and a structured pattern database is established. Taking python patterns as an example, they can be deconstructed into constituent elements such as python head, python body, python claws, cloud patterns and fire beads, and each element retains independent editing rights, providing a flexible operation space for subsequent redesign.

3.3. 3D Modeling and Virtual Restoration

For the overall relationship between the patterns and forms of bestowed costumes, 3D modeling technology needs to be used to realize virtual restoration. With software such as Maya, Blender and CLO 3D as the platform, a digital 3D model of bestowed costumes is established according to the cutting technology and wearing methods of Ming Dynasty costumes. The patterns are attached to the model surface through texture mapping technology, which can simulate the luster, texture and draping effect of different fabric materials (such as brocade with gold thread and interlocking jacquard). This technical path not only realizes the three-dimensional presentation of bestowed costume patterns, but also restores their wearing scenes on specific

occasions (such as court congratulations and sacrifices), providing a digital experimental field for studying the visual political functions of bestowed costumes.

3.4. Database Construction and Knowledge Graph

Incorporating the extracted bestowed costume pattern data into a structured database is the key to ensuring its sustainable utilization. The database should include basic information of the patterns (type, period, source), morphological characteristics (number of claws, direction of horns, tail shape), color parameters (RGB/CMYK values, Pantone color numbers), process attributes (weaving method, material) and related documents (relevant records in History of the Ming Dynasty and Veritable Records of the Ming Dynasty). On this basis, a knowledge graph of bestowed costume patterns can be further constructed to reveal the evolutionary relationships between different types of patterns, their corresponding relationships with historical events, and application cases in contemporary design, providing intelligent knowledge services for researchers and designers.

4. Innovative Design Paths of Bestowed Costume Patterns

4.1. Symbol Extraction: From Patterns to Design Genes

The starting point of innovative design is the symbol extraction of bestowed costume patterns, that is, refining recognizable and inheritable design genes from the complicated morphological details. This process needs to follow the principle of “capturing its spirit and shaping its form” [5]: on the one hand, retain the core identification features of the patterns, such as the four-claw structure of python patterns, the forking of fish tails of flying fish patterns and the ox horn shape of fighting ox patterns to ensure the readability of the symbols; on the other hand, remove overly complicated decorative details through simplification, abstraction, geometrization and other techniques to make them conform to the modern aesthetic logic. Taking python patterns as an example, their dynamic tension of S-shaped meandering and the sharp morphological characteristics of toes and claws can be retained, while the fish scales are simplified into geometric textures to realize the integration of traditional verve and modern form.

4.2. Contextual Reconstruction: Cross-media Visual Translation

The extracted design genes need to realize visual translation in a new media context. Digital fashion is an important application scenario - designers can apply the vectorized bestowed costume patterns to the printing, embroidery or jacquard effects of virtual costumes, preview the wearing effect in real time through software such as CLO 3D, and realize the asset-based transaction of digital costumes with the help of NFT technology. Interactive art provides a broader expression space: based on Kinect motion capture technology, the audience can interact with the bestowed costume patterns projected in the space through body movements, and the patterns deform and reorganize with the movement changes, endowing traditional symbols with new vitality in participatory experience. Augmented reality (AR) technology can overlay the bestowed costume patterns on real scenes, and users can “wear” virtual bestowed costumes on the mobile phone screen, realizing the seamless connection between traditional culture and daily life.

4.3. Media Expansion: From 2D Plane to Immersive Experience

Digital technology has expanded the presentation media of bestowed costume patterns from two-dimensional planes to three-dimensional spaces and immersive experiences. For example, Unity3D is used to build a physical and virtual museum exhibition hall [6], where the audience can walk freely in the imperial court scene of the Ming Dynasty, observe the details of the bestowed costume patterns at close range, and click on the patterns to pop up their historical origin, symbolic meaning and evolutionary process. Immersive drama goes a step further, projecting digitized bestowed costume patterns on the stage space, and creating a time-traveling visual narrative with the cooperation of actors' performances and light and shadow changes. Such immersive experiences not only enhance the audience's perceptual depth of the bestowed costume culture, but also open up new paths for the contemporary communication of traditional culture.

5. Conclusions

As a visual carrier of power symbols and cultural memories, the digital extraction and innovative design of the patterns on Ming Dynasty bestowed costumes is an important path for the contemporary inheritance of traditional costume culture. Based on a systematic analysis of the morphological characteristics and evolutionary laws of bestowed costume patterns, this paper constructs a technical framework of "high-precision acquisition - vector reconstruction - 3D modeling - database construction" and puts forward an innovative design strategy of "symbol extraction - contextual reconstruction - media expansion". The research shows that digital technology can not only realize the complete preservation and editable transformation of bestowed costume patterns, but also provide infinite possibilities for their cross-media creative applications; the modern transformation of traditional patterns is both an inherent demand of cultural inheritance and an important source of design innovation in the digital age.

Future research can be deepened in three directions: first, introduce artificial intelligence generation technology to explore intelligent design and automatic generation based on the bestowed costume pattern database; second, carry out cross-cultural comparative research, conduct digital comparison between the patterns on Ming Dynasty bestowed costumes and those on European noble costumes in the same period, and reveal the commonalities and differences of power symbols in different civilizations; third, promote the collaborative innovation of industry, university and research, and apply the digitized bestowed costume patterns to industrial fields such as cultural tourism and cultural and creative products, digital collectibles and virtual fashion to realize the dual transformation of cultural value and commercial value. With the rapid development of digital technology, the patterns on Ming Dynasty bestowed costumes are expected to break through the limitations of time and space and glow with new vitality in the contemporary context where virtual and reality interweave.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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