

# AI-Based Innovative Design Research on Female Figure Modeling with Tang Dynasty Costumes

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## Abstract

*As a quintessential representative of traditional Chinese costume, Tang Dynasty attire integrates indigenous elements from the Han and Wei dynasties with exogenous cultural influences from the Western Regions and Persia, constituting a distinctive sartorial system of significant academic and industrial value. Nevertheless, conventional manual restoration and design methodologies exhibit pronounced limitations in efficiency, accuracy, and scalability, rendering them inadequate to address the exigent demands of contemporary digital preservation and creative design. In recent years, generative artificial intelligence technologies—particularly diffusion models, Neural Radiance Fields (NeRF), and large language models—have achieved substantial breakthroughs, furnishing novel technical pathways for the digital reconstruction and innovative design of cultural heritage. Grounded in these advancements, this study takes Tang Dynasty female costumes as a case study to explore and optimize AI-assisted generation methodologies for depicting female figures in Tang Dynasty attire.*

## Keywords

*Generative Design, Innovative Design, Tang Dynasty Costumes, Figure Modeling Design.*

## 1. Background and Innovative Design Demand of Female Costume Modeling in the Tang Dynasty

### 1.1. AI-Generated Tang Female Costumes Have Great Cultural Value

The Tang Dynasty (618–907), a golden age of China with strong national power and cultural prosperity, had an open and inclusive costume culture that influenced East Asian traditional clothing. Due to incomplete relics, limited records and strong contemporary cultural revival demand (intangible cultural heritage protection, digital restoration, cultural tourism upgrading, fashion innovation), AI-generated Tang female costumes are of great cultural value. They break time-space limits, reproduce Tang costume charm, provide cultural and creative materials, and integrate traditional culture with modern technology for cultural inheritance and innovation.

### 1.2. Generative AI and Virtual Fitting Technology Advantages in Fashion Design

Generative AI has obvious advantages in fashion design: it processes massive historical documents efficiently, generates multiple design schemes quickly, improves efficiency, reduces pattern-making and sample costs, and helps enterprises optimize industrial

structures. Virtual fitting technology, integrating computer vision and deep learning, collects consumers' body parameters to present customized fitting effects, solving offline fitting time waste and online display inconsistency, improving shopping satisfaction and reducing merchants' costs.

### **1.3. Domestic and Foreign Research Status of AI Application in Fashion Industry**

Current Research Status at Home and Abroad : As a core tool for enhancing industrial efficiency, artificial intelligence (AI) has exerted systematic impacts on China's apparel industry, with relevant application research primarily concentrating on two dimensions: academic research and enterprise practice. In the academic domain, leading domestic universities have pioneered the deployment of AI-generated fashion design, where representative achievements include the joint laboratory established by Zhiyi Technology and Peking University (focusing on intelligent design algorithm development) and the ClotheDreamer project collaboratively launched by Shanghai University and Tencent (exploring text-driven garment generation technologies), thereby establishing theoretical and technical foundations for industrial applications. In the enterprise domain, AI technology has emerged as a critical driver for the digital transformation of apparel enterprises, with technological applications encompassing five core scenarios: virtual try-on, generative design, intelligent pattern making, personalized customization, and digital sampling. The industry has widely adopted a human-machine collaborative workflow characterized by "AI generation followed by manual refinement," balancing efficiency and quality. Typical application cases include: Taobao's "Wanxiang Yingzao" intelligent try-on system , enabling accurate online outfit recommendations; Bosideng's adoption of AI-optimized down jacket cutting processes to improve material utilization rates; collaborative development of innovative prints by designers SHUTING QIU and Shie Lyu with AI platforms; the application of Style 3D software for digital research and development by leading brands including Aimer, Bosideng, and Ellassay; intelligent trend forecasting and auxiliary design tools introduced by enterprises such as Diexun Technology; robotic fashion shows held at Shanghai Xintiandi to explore new presentation formats; and Wensli Silk's launch of AIGC-based customized scarf services.

Foreign research on AI began earlier than China's, with more progress in AI and fashion design integration. US AI research focuses not only on basic AI-generated design but also on artistic style generation, allowing AI to preserve brand style while innovating. As a luxury cradle and global fashion capital, France has also achieved remarkable results in this field: as early as 2013, it used AI to forecast fashion trends, greatly cutting clothing production costs and waste; in 2025, it launched a "sustainability trend score" technology to assess eco-friendly materials' market potential and reduce pollution. Japanese companies, meanwhile, concentrate on AI-driven personalized customization. It uses 3D body scanning and AI algorithms to generate accurate consumer sizes (e.g., Japan's ZOZO launched a millimeter-level service in 2024), saving labor and meeting individual needs. Foreign research also focuses on virtual try-on: in 2024, Snapchat and Google released Try-On AI for mobile virtual try-ons, with AI simulating fabric dynamics to enhance realism and boost purchase intent. Moreover, some countries have introduced metaverse fashion. For instance, Decentraland, UNXD, and Vogue Arabia co-hosted a metaverse fashion week where AI

generates virtual garments; participants can anonymously join events via Decentraland and select virtual outfits for their digital identities.

#### 1.4. Research Progress in Traditional Costume Digitalization

Research Progress in Digitalization of Traditional Costumes With the maturity of AI and metaverse technologies, the digitalization of cultural heritage has become urgent. As an important part of intangible cultural heritage, traditional costumes have become a key focus of research and inheritance. Many historical relics are incomplete or lost over time, and restoration technologies can preserve them more completely and intuitively. For example, a team under the Youth Innovation Talent Introduction Program of Shandong universities decomposed and patterned traditional costumes in the classic Tang Dynasty painting *Beauties Wearing Flowers*, extracted patterns, colors and textures, and conducted 3D modeling and digital restoration.; Wang Xu's team at Zhejiang Sci-Tech University digitally restored two collected horse-face skirts using virtual fitting technology. The study also found that combining virtual fitting technology with motion capture technology can dynamically display static museum collections, which is more conducive to the protection and inheritance of cultural heritage<sup>①</sup>; Rococo Design and Dunhuang Academy used AI to digitally preserve Dunhuang mural costume patterns. Various cultural relic apps and traditional-skill immersive apps have appeared. Culture-related games with traditional costumes have boosted young people's cultural enthusiasm and confidence. Many brands also cooperate with traditional costume culture; for example, Li-Ning used AI to combine traditional patterns with modern sportswear, creating a Chinese-style fashion series.

## 2. Cultural Characteristics and Modeling Analysis of Tang Dynasty Costumes

### 2.1. Typical Forms and Artistic Symbols of Female Costumes in the Tang Dynasty .

The prosperous and open Tang Dynasty gave women more freedom, forming diverse, colorful costumes reflecting national strength. Main forms included shirts, ru, skirts, pibo, banbi and manshan(Figure 1). Women's cross-dressing, low-cut and military styles were popular. This paper only studies female costumes.



**Figure 1.** Typical forms of female costumes in the Tang Dynasty

### 2.2. Tang Dynasty Women's Costumes and Makeup (Ruqun, Banbi, Pibo)

The Tang Dynasty witnessed evolving sartorial aesthetics across its historical phases. Early Tang costumes largely inherited Sui Dynasty conventions, characterized by small-sleeved tops (ru), two-color striped long skirts, and high-waisted or chest-high ruqun ensembles complemented by banbi (half-sleeved jackets) and gauze pibo (draped scarves). This period also featured neat coiffures and the fashionable practice of female cross-dressing. High Tang saw dramatic silhouette expansions—sleeves and skirts widened significantly, low-cut gauze garments gained popularity, and Hu-style (Central Asian) clothing became prevalent. The gradual replacement of mili (face-covering veils) by weimao (veiled hats) symbolized women's increasing social freedom. Middle and Late Tang garments became excessively voluminous and impractical, with banbi nearly disappearing from court dress. Aristocratic women adopted wide-sleeved blouses, hezi (bodices), skirts, and pibo, paired with Tubo-inspired hairstyles and elaborate cosmetic applications. Tang makeup practices comprised multiple refined techniques: facial powder (fen), cheek rouge (yanzhi), forehead floral ornaments (huadian), diverse eyebrow styles, dimple stickers (mianye), and diagonal red markings (xiehong).

### 2.3. Pattern and Color Systems

Tang textile decoration centered on four principal motif categories: Baoxiang flower (rosette), linked-bead, geometric, and scroll-grass patterns. The Baoxiang flower—synthesizing Buddhist lotus iconography with peony forms—functioned as a core status symbol representing wealth and rank, typically embroidered on garment hems and cuffs. The linked-bead pattern, demonstrating Persian cultural influence, employed circular bead chains encircling animal or floral elements. Geometric patterns exhibited plump, symmetrical configurations with pronounced chromatic contrast. Scroll-grass patterns (interlocking branch motifs) featured sinuous S-shaped vines widely applied to pibo edges and skirt waists (see Figure 2).



**Figures 2.** Major Patterns of the Tang Dynasty

Popular colors for Tang women's costumes included crimson, deep purple, bright yellow, and blue-green.(Figures 3) Crimson was dominant and often contrasted with green. Deep purple was noble-exclusive and elegant. Bright yellow was bright and widely used in matching. Blue-green was fresh and paired with red or yellow. Ochre yellow was imperial and forbidden to others.



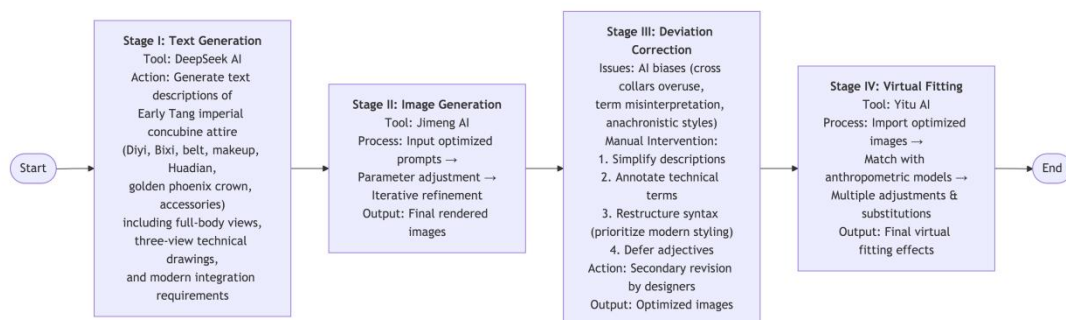
**Figures 3.** Popular colors for Tang women's costumes

Tang costume color matching logic has two types: first, contrasting colors, e.g., red ru blouses with green skirts and gold outlines in Dunhuang Mogao Grottoes murals; second, adjacent low-saturation colors (usually excluding red and yellow), such as the yellow-red chest-high

ruqun with dark red outer garments in Beauties Wearing Flowers.

### 3. Practice of Dynamic Generation Design of Tang- Style Hanfu Based on AI

Based on the aforementioned research, the author conducted an innovative design practice of Tang Dynasty female costumes utilizing DeepSeek and Jimeng AI, implemented through four sequential stages. Stage I: Text Generation. DeepSeek was employed to generate textual descriptions of an early Tang imperial concubine's court attire, including the diyi (pheasant-patterned ritual robe), bixi (knee covering), belt, makeup, huadian (forehead ornament), golden phoenix crown, and accessories, supplemented with full-body views, three-view technical drawings, and modern integration requirements. Stage II: Image Generation. The optimized textual prompts were input into the Jimeng AI image generation system, with parameter adjustments and iterative refinement to produce the final rendered images. Stage III: Deviation Correction. Addressing the comprehension biases inherent in Jimeng AI—including the overuse of cross collars at the expense of typical round and chest-high styles, superficial interpretation of professional terminology, and excessive adjectives resulting in ambiguous or anachronistically traditional imagery—a manual intervention strategy was implemented. This entailed simplifying the original descriptions, annotating technical terms appropriately, restructuring syntactic order, prioritizing modern styling specifications, and deferring adjectival modifications, followed by secondary revision by professional designers. Stage IV: Virtual Fitting. The optimized images were imported into the Yitu AI application, matched with pre-configured anthropometric models, and subjected to multiple adjustments and image substitutions to obtain the final virtual fitting effects. For detailed procedures, see Figure 4.



**Figure 4** Practice of Dynamic Generation Design

### 4. Summary and Reflection

This study systematically examined the feasibility of AI-generated Tang Dynasty female costumes through cultural accuracy evaluation and technical limitation reflection: while DeepSeek's textual descriptions of Tang women's attire were generally accurate, Jimeng AI's generated images frequently deviated from the textual prompts—modern Tang-style designs were erroneously rendered as Republican-era cheongsams, exhibiting unbalanced proportions, incorrect footwear, and deviations in traditional Chinese elements. This accuracy

deficit primarily stemmed from platform data limitations, including misunderstanding of Tang silhouettes, narrow modern clothing databases, and algorithmic biases, resulting in monotonous and inaccurate outputs, as well as homogenized, illogical, and unoriginal works caused by replicating existing designs or randomly mixing data. To address these issues, future research should pursue tripartite breakthroughs: first, enriching AI databases by expanding Tang documents, cultural relics, restoration images, and modern fashion materials to enhance data diversity; second, improving the precision of user instructions for more accurate AI utilization; and third, conducting joint optimization among technicians, consumers, and designers to correct elemental errors and design deviations while accommodating market demands.

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