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# Simulation Design of Traditional Costumes Based on Digital Printing Technology

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**Abstract**

This paper deals with the research on simulation design of traditional Chinese costumes in digital method. We take Chi-pao (Cheongsam), the Mandarin gown of the Qing Dynasty as the research object and conduct a comprehensive analysis of its structures, colors, patterns and other traditional crafts. Then a simulation digital design is made and cutting pieces are printed through digital printer. The finished product shows that the simulation of traditional costumes through this method is feasible to achieve satisfactory results. Thus, simulation design can be used as one of the ways to research, inherit and spread the traditional Chinese costumes.

*Keywords*: Simulation Design; Traditional Costumes; Garment CAD; Digital Printing; Embroidery

## 1 Introduction

After thousands of years of development, Chinese costumes have within itself rich meanings, and have become a source of inspiration for many designers. Digital technology provides a new method for the research on and inheritance of traditional costumes, with fruitful research results. Research on traditional costumes with digital technology is mainly on the following aspects: First, using digital technology for academic classification, information storage and the building of multimedia information database of the traditional costumes [1, 2]; Second, using multimedia virtual scene modeling, multimedia virtual scene display, to demonstrate three-dimensional, full touch interactive costume models, to facilitate a more perceptual, in-depth understanding of traditional costumes [3-5]; Third, developing computer-aided traditional costume design systems so as the classified display and interactive design of traditional costumes are made possible [6].

This paper deals with the research on simulation design of traditional Chinese costumes in digital method. A comprehensive analysis of Chi-pao in its structures, colors, patterns and other traditional crafts are conducted and a simulation digital design is made accordingly, through which cutting pieces are printed through digital printer. The finished product is verified as identical to the original one. Simulation products can be worn, in any environment or conditions. The

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practicalities of this method is that it significantly reduces the cost and the production time, so that the finished products, such as souvenirs, tourism products, costumes can be launched.

The significance of this paper goes beyond the study, inheritance and spread of traditional Chinese costumes, to that of other forms of traditional Chinese culture.

# 2 Chinese Traditional Costume Analysis

Chinese costume culture varies from dynasty to dynasty. Basically, each dynasty has its own costume system and its specific protocol requests. Qing Dynasty marks the most stylish time in Chinese history. The Qing costume not only shows a high degree of craftsmanship in clothing, but also reflects China's long cultural tradition and the remarkable achievements of Chinese art [7].

The simulated work copies the Polychrome Embroidered Manchurian Gown of the late Qing Dynasty, collected at the China National Silk Museum [8]. The length of the dress is 138 cm and its width is 124 cm, as shown in Fig. 1. Chi-pao, also known as cheongsam, has evolved from the Manchurian gown worn by Manchu women in the Qing Dynasty (1644-1911) [9].

Outline structure: The overall contour of the Chi-pao is straight and loose, with a feature of a large front lapel opening to the right (i.e. with buttons on the right side) and Mandarin collar. The hem reaches the ankle. There is a slit on each side that goes all the way from the hem to the armpit. The sleeve cuffs and main part of the gown form an integral whole. An extended section at the cuff reveals a distinctive feature of woman's costumes of the Qing Dynasty.

Color patterns: Prominent on this dress is a full-length flowering hibiscus embroidered on red silk fabric. Colorized embroidery patterns of the "Butterfly Loving the Flower" are also added on the sleeve cuffs, symbolizing the beauty of love. The mushroom-shaped Ruyi pattern, as a symbol of good luck, expands outward from the straight line of the edging to form a flowing arc end at the armpit.

Edge: Black silk borders are used for the collar, along the front panel, or around hemline and cuffs, part of which are also embroidered. Woven laces are used for outlining the whole shape. This piece of garment is complicated, but of exquisite beauty.

# 3 Digital Simulation Design

The simulation design is of three steps: pattern drafting of the gown, simulation design of color patterns and edging process, and layout design of cutting pieces. The digital simulation of embroidery color patterns is the key to the whole process.

## 3.1 Pattern Drafting

Size: The picture image provides only two sizes: a length of 138 cm and a width of 124 cm which is far from enough; therefore, the size of each part needs to be calculated proportionally by two known sizes according to the tiled dress. The flat-cross pattern is used in traditional Chinese clothing to ensure the best utilization of fabric. It means the front, back, and sleeves are all in one piece, so the outline of flat pattern forms a cross-shape [9]. An 1: 1 model is drawn according


Fig. 1: Polychrome Embroidered Manchurian Gown of the late Qing Dynasty, collected at the China National Silk Museum [8]

to the size in a two-dimensional (2D) CAD software, as shown in Fig. 2.

In the pattern drawing, apart from the garment body structure of the Chi-pao, details of the partial decorations of the dress, such as the edge and the woven lace should be made according to the calculated data. Then 2D CAD format file can be exported to DXF format file for simulation design in graphics software.

## 3.2 Simulation Design of Color Patterns

Pattern unit drawing: Adobe Illustrator vector graphics software, which we use, guarantees that the color pattern is not affected by resolution ratios, graphic zooms, and has high fidelity. Because most of the designs are embroidery patterns, in the design of digital simulation, the principle of the plain stitch (flat stitch) technique is adopted in the process of embroidery. Patterns with different colors and different layers are drawn separately according to the color transition, forming a closed and complete graphics in each layer, making it easy to add texture and shadow to simulate the real effect of embroidery, as shown in Fig. 3.

The overall design of pattern: According to the structural relations of the pattern, single flower and leaf with similar shapes are copied, changed to form complete flower, as shown in Fig. 4. The design of the shape and size should be consistent with the original design, and then the complete pattern is converted to bitmap graphics, i.e., the AI format files should be exported as PSD files for further effect processing in Photoshop or Painter. During the format transformation, resolution should be set between 200-300 ppi (pixels per inch), so as to meet graphics precision of digital printing.

Pattern texture: Embroidery effect with digital method is the focus of this research. In the plain stitch technique, lines are arranged neatly and evenly on a flat face of base material. The

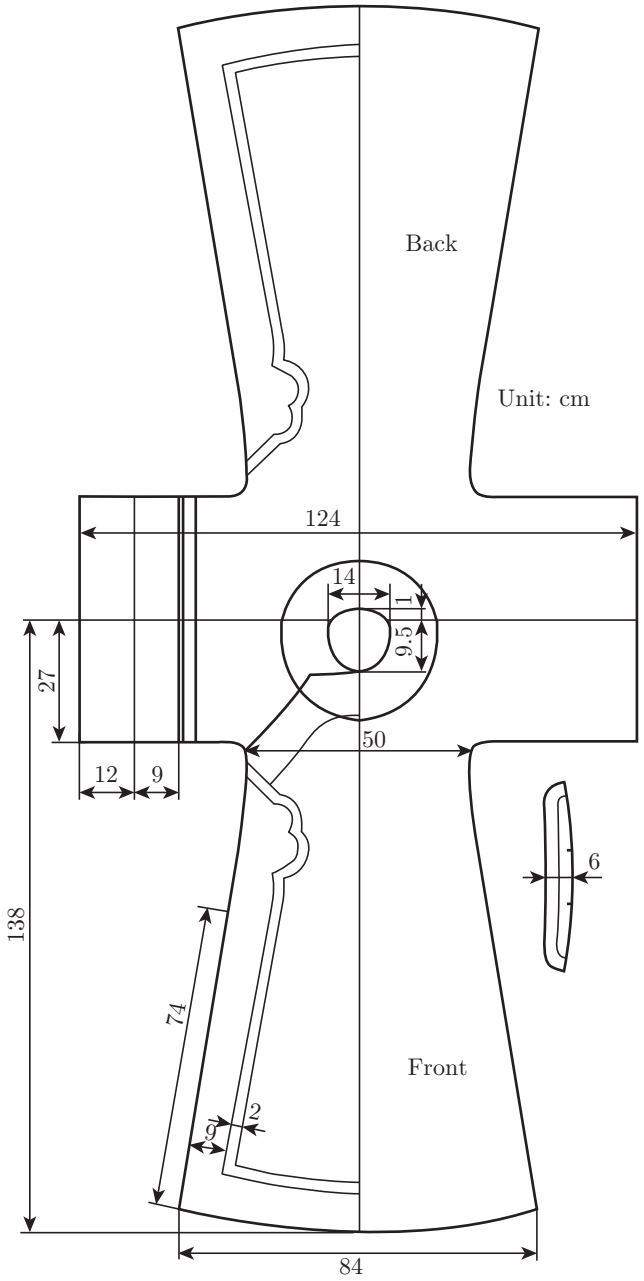


Fig. 2: Pattern drafting of the gown

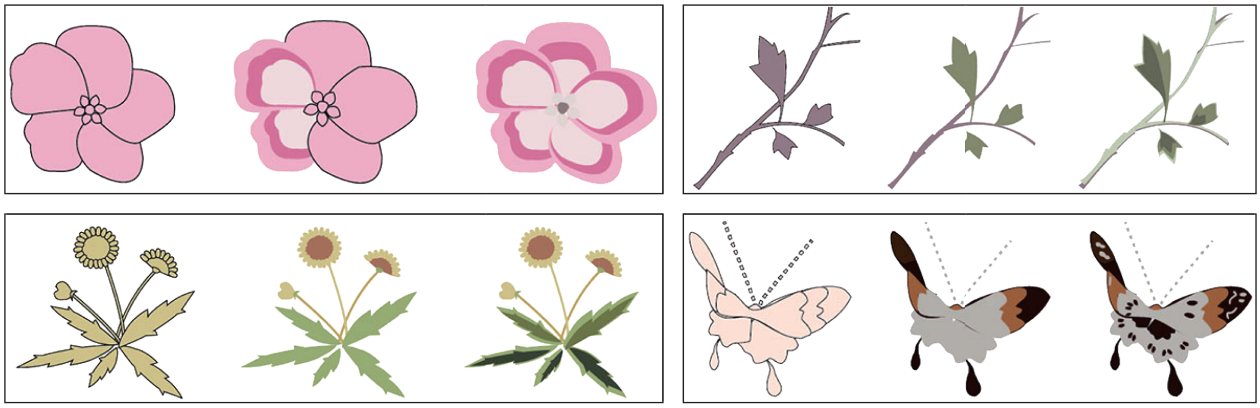

Fig. 3: Pattern unit drawing

Fig. 4: The overall design of pattern

plain stitches are divided into three types according to the directions of the compositional lines: vertical, horizontal, and diagonal twining [10]. Through trial and error, textured brushes of Painter software are adopted to simulate skin texture effect of embroidery. Adjustments on the motion of the brush strokes, the parameters, such as the size of the brush, brush diffusion and the flow, etc, are made according to the embroidery texture. Because flowers, leaves, butterflies and daisies are formed by multilayer superposition, effects of different layers should also be created through levels and shadows. Simulation effect of embroidery patterns is shown in Fig. 5.

Fig. 5: Simulation effect of embroidery patterns

## 3.3 Simulation Design of Edging Decorations

The collar, front piece, sleeves, and hem are decorated with edging, which requires a reference of garment pattern to locate and draw with precise size, and then printed on it the simulated

embroidery flowers. The direction of flowers needs to be arranged along the curved woven lace, which is of multi-level patterns and colors to form into two continuous patterns. Then similar graphics to lace edge are selected, their hues and color saturations are adjusted to match the color of the painted woven lace as so to put all parts into a whole. Simulation effect of edging decorations is shown in Fig. 6.

Fig. 6: Simulation effect of edging decorations

## 3.4 The Overall Layout and Post-processing

After the design of each part, integrate each local pattern of the front sheet, the back sheet and collar in Photoshop, try to reproduce every detail in accordance with the original Chi-pao. To emphasize the texture effect of a pattern, and make it visually similar to the real clothes, moderate adjustment and beautification to the edge of the embroidery texture, edge and other parts are necessary. Any adjustment is carried out in reference to the original photos and data, to make the simulation natural and real. Layout design of the gown is shown in Fig. 7.

Fig. 7: Layout design of the gown

### 3.5 3D Virtual Fitting

Prior to the final production, simulation results are tested to verify its effect. The layout pattern in the garment pieces are imported into a three-dimensional (3D) CAD system, and observed from different angles to evaluate the effect of color collocation and pattern layout. Problems can be found and corrected through virtual fitting.

First, the size of the fitting model is regulated in the 3D CAD system, then the clothing pieces of DXF format file are imported for virtual stitching. The model's pose needs adjustments to match the planar structure of traditional Chinese costumes, and then the model is put into the corresponding pattern file to complete 3D fitting for the final confirmation of simulation effect, as shown in Fig. 8.

Fig. 8: 3D virtual fitting

## 4 Digital Printing, Production and Display

Template design: Traditional Chinese costumes have the center line at the front and back clothing as the vertical axis of symmetry, shoulder sleeve line for the horizontal axis of symmetry, and the front, back, and sleeves are all in one piece. Rolled binding process is adopted during the production. Right front panel is disconnected, and the other side takes the under fly. As digital simulation has integrated the edge with the fabric and pattern, so that welt is not made separately, the shoulder line is disconnected to design the template. The colors of seam pieces should be the same to those of the fabric printed in making seam allowance, as shown in Fig. 9.

Samples should be printed before the official print to make sure the design of the color is correct. Calibrated printings can be printed directly on the transfer printing paper, and then thermal-transferred to simulation silk chemical fiber fabric. Fabric needs no processing, as shown in Fig. 10.

Product display: completed plane display and fitting display, as shown in Fig. 11.

Fig. 9: Template design with seam allowance

Fig. 10: The process of digital printing

Fig. 11: Plane display and fitting display of the finished product

# 5 Discussion

Since the dimension data and dermatoglyphic pattern are from the image of the tiled clothing, certain details of the simulated effects of the final product are still awaited to be improved. The

printed colors are relatively brighter than the original colors. Meanwhile, colors like gold and silver need to be printed separately with spot color ink. Although there are limitations to the method of digital simulation design, this technology has provided a distinctive way in the inheritance of traditional fashion cultures, which can be applied to the other costumes simulation.

Fig. 12 shows a daily gown for Manchu women in the Qing Dynasty [11]. It is a typical dress for noble women, with a round collar, a loose design, and straight lines. The front piece is the part from the collar to the hem. The sleeve cuffs have the exquisite pattern known as "Butterfly Loving the Flower". This costume is made of first-class material with bright colors and subdued Round Dragon patterns. Edging decorations are added to the collar, front piece, and sleeves.

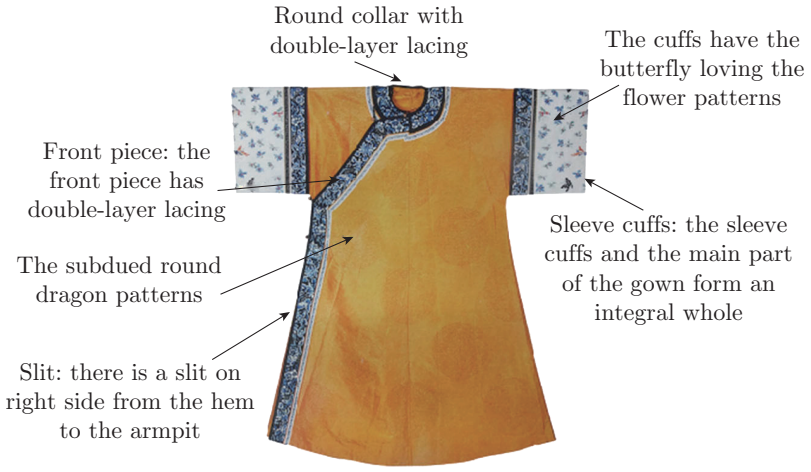


Fig. 12: A typical gown for noble women in the Qing Dynasty [11]

Simulation design of the dress in the structure, color, patterns, and decorated techniques has been finished using the same method to verify the effectiveness of the research method. Completed plane display and fitting display are shown in Fig. 13.

Fig. 13: Plane display and fitting display of the finished product

# 6 Conclusion

Through case study, this paper explores the technology of digital simulation on traditional costume design and digital printing. It has achieved the desired effect and obtained the preliminary experience by integrating the 2D garment CAD, 3D garment CAD, graphics software and digital printing technology. At its early stage, the research work faces a lot of practical problems yet to be explored and solved, such as the diversity in Chinese traditional embroidery crafts. This paper has simulated only one kind of embroidery stitches. Moreover, the application of this method has certain limitations. As the technology of digital simulation has broad prospects in application, the research and development in this area will help put forward the inheritance of traditional Chinese costumes to a new stage.

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