Research Article

Design of Three-Dimensional Pleated Clothing Pattern Based on Computer Animation Technology

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With the improvement of people’s living standards, people’s pursuit of clothing is becoming more and more diverse. As the main way to shape the external curve of the human body and reflect the texture of clothing materials, pleating technology is widely used in clothing. Different wrinkle expression techniques can often be seen in garment production and press conferences. Many designers are inseparable from the use of folding technology in their creation. The decoration of clothing is also constantly enriched. Diversified and multitype fabrics will bring great differences and influence to clothing and even affect the trend. Based on the computer animation technology, through the analysis of the principle of three-dimensional folds, this paper explores the formation of geometric patterns from two-dimensional plane fabric laying to three-dimensional, mainly through the techniques of pleating, kneading, lattice pleating, and pleating, so as to knead, stack or stack the fabrics orderly or randomly and naturally. The folded intersection area and nonfolded area are formed to form the basis of three-dimensional geometric folds. The simulation results show that the computer animation technology can effectively support the three-dimensional fold garment pattern design, select different materials for regional folding, present obvious three-dimensional geometric pattern folds, understand the expression forms of folds, and explain the application of folds in garment design, so as to provide some reference for fold garment design.

1. Introduction

The folds of clothing are decorated for the ripples of the fabric, and the appearance has a strong sense of three-dimensionality and simulation. Because folds are a diversified means of change, they can increase the aesthetics of clothing and show different styles of clothing [1, 2, 3]. In this way, for pleated fabric, the mutual conversion between the two-dimensional plane and three-dimensional is realized. The folds of clothing are the changes of curves and straight lines, assembling and combining them through the material of the clothing itself or other auxiliary materials to form a patterned and regular decoration. This decoration is to match the rhythm of the clothing through the understanding and design of the shape of the clothing. The usual production of folds includes the manual method, crimping method, and weaving method [4, 5, 6]. On the other hand, despite the ready-made patterns, the crimping method leads to high production efficiency, but it is prone to deformation. On the other hand, although the manual method has a good effect and is not easy to deform, it requires high labor cost. The woven method is to directly use raw materials to achieve the pleated effect. The three-dimensional effect of the fabric is relatively good, and it is not easy to deform, but it is worth noting that due to the single pattern of the fold effect, the three-dimensional geometric effect of the pleated fabric is extremely complicated. It is of forward-looking significance for the fabric design and development of clothing [7, 8, 9].

The deformation three-dimensional pleated garment pattern is mainly designed with the symmetrical features of computer animation technology to improve the data. By
constructing the three-dimensional pleated garment pattern design feature tree, the high-level feature diagrams can be used, and the computer intelligence is used to facilitate the interaction between humans and machines. Through the design of a three-dimensional pleated garment pattern, the essence of culture and users' awareness of culture are spread, and research is carried out from these two perspectives. The problem of three-dimensional pleated garment pattern design is described from the perspective of extracting cultural resource graphics, and then the design of a three-dimensional pleated garment pattern is carried out. The problem of homogenization of traditional three-dimensional pleated clothing pattern design is improved. Data analysis and development through computer animation technology can better establish influence for the design of three-dimensional pleated clothing patterns. This paper studies the space design technology of three-dimensional pleated garment pattern design analyzes the application of computer animation technology in three-dimensional pleated garment pattern design, which is of reference significance [10, 11]. Aiming at the problems of difficulty in feature extraction and no corresponding labels for patterns in the design of three-dimensional pleated garment patterns by computer animation technology, a design algorithm for three-dimensional pleated clothing patterns based on computer animation technology is discussed. First, the reflector layer pattern that can characterize the important features of the three-dimensional pleated garment pattern is obtained from the pattern; then, the foreground and background of the acquired reflective layer pattern are segmented to obtain the three-dimensional pleated garment pattern; finally, the recurrent generative adversarial network is used to conduct unsupervised learning of three-dimensional pleated garment pattern features to obtain a high-order representation of the three-dimensional pleated garment pattern feature space, realize the mapping of three-dimensional pleated garment pattern features, and can reference effectively obtain the three-dimensional pleated garment pattern features of the computer animation technology target, and express the three-dimensional pleated garment pattern; compared with similar algorithms, it has better subjective and objective effects.

In order to effectively solve the problems of unreasonable design and low evaluation level in the process of three-dimensional pleated garment pattern design, this paper proposes a three-dimensional pleated garment pattern design method based on computer animation technology. Through the analysis of the forming principle of folds to try to design the three-dimensional fold pattern of stretch yarns, it aims to realize the mutual conversion between two-dimensional and three-dimensional clothing.

2. The Forming of Three-Dimensional Geometric Pleated Fabric

2.1. Forms and Types of Folds. The regular folds can reflect the ability and experience of the clothing designer, fold variation and richness can fully show the artistic effect according to the clothing style, raw materials, reflect the user is fine, exquisite, delicate, regular three-dimensional folds can give people to enjoy, reflect the user size of the slender, increase a certain visual beauty; the neat parallel arrangement of wide folds can make obvious visual development, in the quantity, quality have a certain breakthrough and development [12, 13].

Compared with regular folds, irregular folds refer to folds with irregular texture, length, and effect, but this does not mean that irregular folds have no aesthetic feeling and cannot reflect body shape. It can be more reflected when combined with raw materials and clothing. The superiority of folds. Irregular folds reflect the designer's ideas and characteristics. They can express irregularities in a personalized and emotional way. Even though they are irregular folds, they are more effective in combining irregular and chaotic. Reflected in the sense of beauty and unique temperament, it can embody the characteristics of yearning for freedom and individuality [14, 15].

2.2. Folding Lines of Three-Dimensional Geometric Pleated Fabrics. For three-dimensional geometric pleated fabrics, the folding lines are the lines that act as a ruler, the mark left after folding. For two-dimensional planar materials, the folding line needs to be evaluated and preset before the fabric parameters are selected. Different folding lines of fabrics often produce different effects. For clothing, it will affect the overall effect, which is also the primary consideration in the design of three-dimensional geometric fold patterns. If the laying of the folding line has certain disadvantages, the subsequent pattern design will be affected by this, and it is difficult to meet the realization of clothing transformation.

The determination of the folding line is only the first step. Its determination does not mean that the garment can be directly converted from a two-dimensional plane to a 3D three-dimensional shape. It is necessary to reasonably set and match the raw materials to form a three-dimensional molding.

2.3. Principles of Computer Animation Technology. Three-dimensional pleated fabrics usually have problems with the distribution of folds due to the randomness of the introduced raw materials. These are the limitation and drawbacks of the raw materials. Therefore, the raw materials need to be selected at the beginning of the design of the fold pattern. Setting a certain regular fold line on a two-dimensional plane can be converted into a three-dimensional geometric pleated fabric pattern [15]. This article first tries to design the three-dimensional geometric pattern as a rhombus.

Folding lines can be divided into vertical and horizontal directions according to the folding position and are further distinguished according to whether the three-dimensional geometric fold pattern is horizontal or vertical. On this basis, folds can not only express the overall appearance of the clothing but also convey the design of the clothing. The main idea and connotation of the teacher, the plane visual effect of folds may change with the intensity of light, which is not
available in two-dimensional plane materials. Therefore, it is necessary to pay attention to a group gathering and combination effects.

In the design of the three-dimensional fold pattern, it is necessary to introduce a matrix separation model and perform image brightness equalization based on the Jacobian iterative algorithm. The coefficient of the Jacobian transformation is represented by \( \mathbf{A} \times n, b \times 1 \) is used to represent the adjacent element vector, and \( \varepsilon \) is used to represent the edge fusion error, according to the edge pixels, the theorem of the three-dimensional matching block can be calculated, and the coefficient equation is shown in the following formula:

\[
h(x, y) = \frac{\lambda}{2\pi\sigma^2} \exp \left[ -\frac{1}{2} \left( \frac{x^2}{\sigma^2} + \frac{y^2}{\sigma^2} \right) \right] \cdot \exp[2\pi jFx'].
\]

(1)

On the basis of formula (1), set the minimum error rate, determine the design effect of the wrinkle pattern by position, and calculate the corresponding bit rate. The quantitative calculation of the distribution of new edge pixels is shown in the following formula:

\[
\phi_n = \frac{n\kappa}{N}, \quad k = 0, 1, 2, \ldots, N - 1.
\]

(2)

Confidence analysis is performed using pixels to obtain the optimal result, that is, the best matching function of the image distribution, then the three-dimensional wrinkled priority coefficient to be designed can be quantitatively calculated by the following formula:

\[
\left[ \begin{array}{c} x' \\ y' \end{array} \right] = \begin{bmatrix} \cos(-\theta_1) & -\sin(-\theta_1) & 0 \\ \sin(-\theta_1) & \cos(-\theta_1) & 0 \\ 0 & 0 & 1 \end{bmatrix} \left[ \begin{array}{c} x \\ y \end{array} \right].
\]

(3)

Among them, the two-dimensional plane distribution coordinates of the three-dimensional pattern design are represented by \( x \) and \( y \), and the comprehensive update and iteration realizes the balanced restoration of the pattern brightness.

The technique is represented by a ternary array \((r_1, r_2, r_3)\), \( r_1 < r_2 < r_3 \) of zeroed numbers, and its subordinate function is

\[
\mu(x) = \begin{cases} 
\frac{x - r_2}{r_2 - r_1}, & r_1 \leq x < r_2, \\
\frac{x - r_3}{r_2 - r_3}, & r_2 \leq x < r_3, \\
0, & \text{otherwise}.
\end{cases}
\]

(4)

Let \( \lambda_i = (a_{1i}, a_{2i}, a_{3i}) \), \( i = 1, 2, \ldots, m \) be computer animation technology, and the non-negative linear combination of \( \lambda_i \) and computer animation technology planning are obtained:

\[
\sum_{i=1}^{m} \lambda_i a_i, \quad \lambda_i \geq 0,
\]

\[
\sum_{i=1}^{m} \lambda_i a_i = \left( \sum_{i=1}^{m} \lambda_i a_{1i}, \sum_{i=1}^{m} \lambda_i a_{13} \right).
\]

(5)

Computer animation technology is a stochastic plan, and the constraints include random parameters. Chance represents the probability of the constraint conditions being established. Under the computer animation technology, the possibility of taking the opportunity as a constraint condition is understood. Constraint Programming of Computer Animation technology is as follows: the stochastic computer animation technique control plan provides a powerful tool to solve planning problems with stochastic parameters and computer animation technique parameters. This model is in a general form.

\[
\begin{align*}
\max & f(x, \xi, \eta), \\
\text{s.t.} & g_j(x, \xi, \eta) \leq 0, \quad j = 1, 2, \ldots, m.
\end{align*}
\]

(6)

Among them, \( x \) is the decision vector, \( \xi \) is the random vector parameter, \( \eta \) is the computer animation technology parameter vector, \( f(x, \xi, \eta) \) is the objective function, \( g_j(x, \xi, \eta) \) is the constraint function. Due to the appearance of computer animation technical parameters \( \eta \) and random parameters \( \xi \), the symbols \( \max \) and constraints in the model lack clear meaning [10, 11]. To address this issue, computer animation technology and random elements that appear simultaneously in the model are considered here as the coexistence of computer animation technology and random chance and are further considered.

For the design of the three-dimensional geometric fold pattern, it can be classified according to whether it is folded or not. The folded area refers to the area with fold lines, and the nonfolded area refers to the area without fold lines. Under the complementary action of multi-scale illumination, the dice pattern and brightness characteristic pattern of each pixel of the three-dimensional pleated garment pattern design are calculated. The adaptive feature weighting is performed on patterns collected by digital graphic pattern processing methods, extract edge contour features, and define the constraint optimization solution vector of the pattern.

\[
\min f(\mathbf{x}), \quad \mathbf{x} = (x_1, x_2, \ldots, x_n) \in \mathbb{R}^n,
\]

(7)

s.t. \[
\begin{align*}
\sum_{i=1}^{m} \lambda_i a_i & \leq 0, \quad j = 1, 2, \ldots, l, \\
\mu_j(\mathbf{x}) & = 0, \quad j = l + 1, l + 2, \ldots, p.
\end{align*}
\]

In the formula, \( x \in \Omega \) represents the executable area of the uniform pixel parade of the three-dimensional pleated garment design. Under the condition of low light, the pattern grayscale pixel feature vector is constructed using the collected pattern output mathematical model \( g = \{g(i), i \in \Omega\} \), and the collected output pixel of the three-dimensional pleated garment pattern representation is obtained.
The patterns were fused using the constrained optimization evolution method, and the collected three-dimensional pleated garment pattern representations were scaled and stabilized in the wavelet region. In order to improve the beautification ability of the pattern, the pixel template \( m \) is obtained by template matching. The three-dimensional pleated garment pattern design is analyzed in \( n \) with \( x \), to collect the performance of pixel features as follows:

\[
L = f(w, e) - \sum_{j=1}^{N} a_i \left[ w^T \varphi(x_i) + b + e_i - y_i \right].
\] (8)

The pattern processing simulation experiment was carried out on the Matlab7 experimental platform. During the pattern acquisition, the light intensity threshold of the pattern was set for the JPEG pattern with the original pattern of \( 1280 \times 1024 \). The pattern collection resolution is \( 1280 \times 400 \). The pattern processing simulation experiment set for the JPEG pattern with the original pattern of \( 600 \times 400 \). The pattern collection resolution is \( 1280 \times 1024 \) pixel, and the characteristic ratio of pattern segmentation shadow area and luminance area is 12.

2.4. Three-Dimensional Geometric Pleated Fabric Pattern Design. According to the appearance characteristics of the garment design pattern for the three-dimensional geometric pleated fabric pattern design method, the relatively complete pleated garment is mainly divided into two parts: the flat area and the pleated area. The flat area is mainly the area that does not need to add auxiliary yarns, and the pleated area is the area that needs a redesign process to increase the stretch yarn, which can be divided into an upper pleat area and a lower pleat area. The three-dimensional geometric pleated fabric pattern design is shown in Figure 1. During the process of designing the three-dimensional geometric pleated fabric pattern, the yarn is laid under the upper pleat protrusion and the lower pleat concave in the pleated area. By making full use of the unique stretchability of stretch yarn, combined with the specific material used in garment design, the method of floating thread shrinkage is used in the garment design process to achieve the design fold effect. In order to effectively achieve the effect of a single pleat direction of the three-dimensional geometric pleated fabric pattern, this paper adds stretch yarn in the lower pleated area of the clothing design and uses the shrinkage of the stretch yarn in the lower pleat area to effectively make the upper pleat projection area slope down to the lower pleated area in the process of clothing design.

In order to better ensure that the stretch yarns used are under the action of the folds generated by the clothing design, and try to avoid the phenomenon of uneven clothing materials in the design area due to too long stretch yarns, the three-dimensional geometric pleated fabric used in this paper is used. The pattern design method can effectively control the number of the inter-lacing of the material, the shortest floating length, the plain weave, and the shrinkage rate. In order to further effectively complete the design of the upper pleated part of the fabric used in the clothing design to tilt the lower pleated area, the design principle used in this paper is shown in Figure 2.

In order to effectively avoid the clothing warp error caused by the upper and lower layers of the pleated area 2. And, ensure the design of high-elastic spandex yarn in the pleated area 4; then, it can be seen from the analysis of the design principle that the use of spandex yarn is not the main cause of wrinkles in the clothing design process, which can effectively reduce the difference in warp run-in as shown in Figure 3.

By analyzing the surface morphology and cross section of the three garment design samples and the pleated fabric respectively, as shown in Figure 4, the selected fabric cross-sectional shape and the pleated fabric can have a certain similarity, so that the degree of restoration of the appearance design of the clothing surface is also relatively high.

By dividing the pattern surface with the same design attributes of the three-dimensional pleated garment pattern into two parts, the nodes of the feature tree are extracted in the algorithm. According to the high-level design basic knowledge and evaluation method in the later stage of expression effect, computer animation technology is introduced into the process of modification of the original three-dimensional pleated garment pattern design. The technology shows that the three-dimensional pleated garment pattern design has excellent artistic expression ability, improves the aesthetics and visual performance of the pattern, and has high artistic application value.

3. Simulation and Result Analysis

The three-dimensional pleated garment pattern design is beautified by taking into account the computer animation technology, which is applied to the pattern art design. The pattern processing simulation experiment was carried out on the Matlab7 experimental platform. During the pattern acquisition, the light intensity threshold of the pattern was set for the JPEG pattern with the original pattern of \( 600 \times 400 \). The pattern collection resolution is \( 1280 \times 1024 \) pixel, and the characteristic ratio of pattern segmentation shadow area and luminance area is 12.
For this irregularly folded women’s frock, the waist parts and shoulder straps are used to fold, as shown in Figure 5. First, simulate the shoulders of the mannequin, and then shrink the fabric by setting the shoulder straps. During this process, it is necessary to pay attention to the length, ups and downs, and 3D three-dimensionality; secondly, make diagonal folds according to the left side, pay attention to the chest part of the mannequin, and fix a certain modification; furthermore, set a certain center line according to the fabric of the waist, and fix it with a pin; then, roughly cut the fabric according to the shape, and fix it with a pin, and at the same time, restitch according to the outline, and cut off the excess material. Finally, according to the sewn sample garments, the longitudinal uniformity of the fold analysis is carried out, and the overall appearance is noble and elegant.

For regular folds, the use of folds to shape is one of the common methods, which is to distinguish between regular materials and fully reflect the beauty of the human body. Firstly, fix the bust line, center line, and center line of the mannequin according to the body shape of the human body; secondly, according to the neck, carry out round picking reservation, fixation, and cutting to realize the side seams of the shoulders and chest; third, fix the waist according to the bust line downwards, and use pins to fix it. Also, pay attention to the rise and fall of the chest, perform simulations, and observe the effect of three-dimensional folds. If there are inappropriate places, mark them in real time and make adjustments to finally reflect the human body three-dimensional body shape and beauty.

Based on the pattern effect processed in Figure 5, the white balance optimization of the three-dimensional pleated garment pattern design is carried out using the illumination adaptive equalization technology to improve the beautification effect of the three-dimensional pleated garment pattern design. The final output result after beautifying the pattern is shown in Figure 6.

Compared with the original pattern in Figure 5, the pattern vision of three-dimensional pleated garment pattern design using this technology shows better artistic representation ability, improves the aesthetics and visual performance of the pattern, and has straps. During better design effect of three-dimensional pleated garment pattern. Table 1 shows the comparison of the output peak signal-to-noise
ratio and operation time of the visual representation of the design pattern in the same three-dimensional pleated garment pattern using different design pattern design methods. The method in this paper can be used for art setting. It can improve the effect of pattern quality, and shorten the operation time.

The current artistic design effect is poor, so a new art design method is developed for computer animation technology, and the analysis of the background of the current art is used to provide a good environmental foundation for the designed three-dimensional pleated garment pattern, so that it can be used for integration after the design, which shows multimedia multi-element design art in computer animation technology and control for representation. Computer animation technology reflects the improvement of superiority and efficiency in the design of three-dimensional pleated garment patterns; it makes the current artistic expression diverse and makes it a new development in the current new technology background.
4. Conclusions

Folds have been widely used in the current fashion art design process. The design method of three-dimensional folds is particularly important in the fashion design process, and it is also an indispensable key skill for fashion designers. The three-dimensional pleated garment pattern design technology can be used to make clothing design show better practical value and visual performance value. During the entire clothing design process, some of the folds that appear will serve as an important element. With the increasing demand for clothing design, three-dimensional pleated clothing design technology will become the mainstream technology in the clothing design industry. In this paper, computer animation technology is applied to the design process of three-dimensional pleated clothing pattern and based on the method of analyzing geometric pleats, the design and three-dimensional analysis of pleated pattern are realized, and the goal of three-dimensional pleated clothing pattern is realized so that the effect of clothing design is more beautiful. Finally, through the experimental analysis results, it can be concluded that the method used in this paper can effectively realize the change and interweaving of the three-dimensional pleats in the folded area and the nonfolded area of the three-dimensional pleated clothing pattern and can be continuously innovated and applied in the future clothing design industry, which occupies an irreplaceable position.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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