Development of outfitting and human body representation method Using Virtual/Augumented Reality -Interactive Clothes Modeling for Apparel Production System-

Takao Furukawa, Masayuki Takatera, Yoshio Shimizu, Masayoshi Kamijo,
Satoshi Hosoya, Akio Yuda, Xiaoqun Dai
Department of KANSEI Engineering, Faculty of Textile Science and Technology,
Shinshu University

1. Introduction

As the computer technology develops rapidly, CAD/CAM system is leaded into a lot of areas, of course the textiles and apparel industry. As we know well, the clothing function changes greatly from its original meanings: resisting cold, protecting body and so on. Today, people pay more attention to show one's individuality and sensibility when they choose clothes. Computer aided apparel design system which reflect customers' demand becomes necessary.

In this paper, we propose a hybrid method of these two kinds models. At first, we construct 3-D clothes models for apparel design and then fit them to human bodies by geometrical method; furthermore, in order to obtain a physical stable shape of the clothes, we apply the popular physically based model, particle system, to them. The rest of this paper is organized as follows. First, an interactive apparel design interface is introduced, an end-user can get a 3-D clothes model he wants, as well as the paper pattern for it. Then, the simulation of designed clothes fitted to a human body is carried out. Furthermore, particle system is applied to clothes geometric model, its physically stable state is investigated.

2. Interactive apparel design

In apparel design area, a kind of clothes are usually classified by their silhouette. Actually, with its silhouette line given, the general shape of clothes is determined. Therefore, we provide designers and customers an interface to design clothes by silhouette editing. Users can select a clothes model from the clothing database, then edit its silhouette line in the front and side projection planes by using a mouse to move the control vertex as they please. Simultaneously, they can get the 3-D results. Fig.1 shows a skirt under editing. Of course, silhouette editing is insufficient in real design, some more details editing is necessary. We can realize it by increasing patches. To show clothes made of various materials, we can change cloth texture patterns easily by texture mapping techniques.

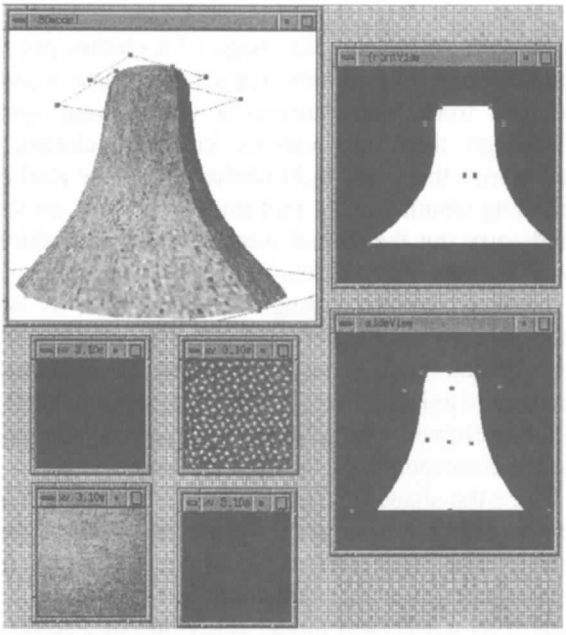

Fig.1 skirt under editing.

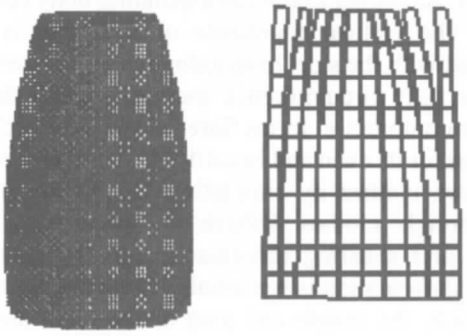

Fig.2 3-D skirt and its developed pattern.

3-D clothes is formed by cutting and sewing 2-D cloth. Conversely, by developing the 3-D clothes, we can obtain paper pattern for it. Actually, except a few surfaces such as conical surface and cylindrical surface, most surfaces are undevelopable and can only be developed approximately. Here, we develop the 3-D model by discrete methods.

Fig.2 shows a 3-D skirt and its developed pattern. The broken part can be regarded as darts. By merging some small darts properly, and with some necessary length calculation, we can obtain paper pattern for the skirt.

3. Virtual wearing

In order to get the 3D image of a clothes put on a human body soon and also reduce the waste in sample making trials, we construct a virtual wear system. Although there are various kinds of clothes, we categorize them into tight clothes and loose clothes in clothing simulation. In this study, we focus on skirts, and carry out the virtual wear of tight plain skirts as well as loose flared skirts.

Cloth is flexible, during its deformation, its length and area do not change so much, the preservation of length and area can be regarded as a geometric constraint existing in cloth. Based on the constraint, we fit the designed clothes to any a human body according to the corresponding paper pattern size.

Since the shape of tight clothes is similar to human body surface, the surface covering the underlying body can be used to describe it approximately. Usually, a plain skirt fits body well, there is no folds in it. We construct a 3-D skirt model consisting of a series 2-D cross section contours from the top to the bottom.

A skirt contour is formed with its length in 2-D pattern preserved according to the corresponding body contour shape. The vertical coordinate of a contour is also calculated with the skirt longitudinal length preserved.

As the skirt circumference increases, cloth drapes and inter-compresses, forms flared shape. A flared skirt is popular for its even and beautiful folds. We visualize such loose clothes by simulating the natural drape. Even though clothes behave complex stretching, bending and shearing deformation in its drape, the bending deformation is remarkably large among them. As a result, the length and area of the cloth are still approximately preserved while the cloth shape changes greatly.

There are many factors affecting the skirt shape, such as the cutting pattern, the cloth mechanical properties, body shape and posture, and so on. The contour of the skirt flared shape is called a hemline. We assume that the length of a hemline is preserved, simulate its bending, and construct flared skirt model consisting of a series of hemlines. Fig.3 shows a flared skirt put on a woman body, which is generated by the proposed method. The simulated skirt is generally same as the real one.

Furthermore, we apply the particle system method to the clothes modeling. If we simulate the clothes formation directly from 2-D cloth patterns to 3-D shape fitted to a body, the computational cost is very high. More seriously, there may occur divergence of numerical calculation. By using the geometrical model as initial shape, and performing the mechanical properties calculation with particle system, we can obtain the clothes model of relatively stable shape.

Fig.3 Flared skirt put on a woman body

4. Conclusion

In this study, an interactive clothes modeling system is constructed. With this system, designers as well as end-users can design various kinds of clothes as they please simply, at the same time, the paper pattern for such clothes can be obtained. Moreover, the sample making and fitting process are also replaced by virtual wear in computer, furthermore the physically based clothes model has also been discussed.

This system can reflect end-users' demands well and can also reduce waste and time in apparel production greatly, it will be very useful in fashion industry. It can also be used to make virtual fashion show and of course, it is useful in the electronic commerce based on computer network. During the particle system calculation, the collision between cloth and cloth, cloth and human body has not been considered. It remains as our future work. To apply the particle system method to all the clothes models we have constructed is also our work in the future.