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How to Get New Apparel Industry with Changing from Desire of Purchasing to Desire of *Kansei* Exchange : Part 1. An Interactive Body Model for Individual Pattern Making

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Abstract

In order to mass-customize clothes, it is essential to take into account individual body shape using computerized 3D body models. This paper describes the development of an interactive body model that can be altered to match individual body perimeter, postures and depth for the purpose of computerized pattern making. Construction of the body model requires the extraction of necessary points, adjustment of coordinate points, linking of points by spline curves, control of section lengths and selectability of various hip types. Front to back depth of the model is adjusted by scaling ratio. We had a great result for controlling perimeter, posture and depth of body shapes. The results support the adaptability and potential usefulness of the posture and depth adjustable body model.

Ⅰ. Introduction

With the flow of changing from mass production to mass customization, apparel manufacturers have been struggling to solve difficulty of customers in finding stylish and comfortable-fitting garments. Therefore the development of techniques for better fitting clothing for individual body shapes is essential.

In order to establish interactive body model, it is able to alter individual perimeter, postures and depth.

Variations in individual postures are a major obstacle in pattern making. In this paper, 'individual posture' means back shape and hip shape. Therefore, many women have difficulty in finding stylish and comfortable-fitting garments that accommodate their proportions. They are dissatisfied with the fit around the neckline and shoulders, unbalanced hemlines of jackets and

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skirts, and size problems relating to waist and hip girths. These problems relate to traditional grading method and posture differences.

Another of obstacle in pattern making is variation in individual depth of the body. Even though cross sectional shape have similar perimeter, some people are wide from side to side and narrow front to back, while others are thin from side to side and thicker in depth. It is essential to take into account individual body shape using computerized three dimensional body models in order to solve these fitting problems.

This paper describes the development of an interactive body model that can be altered to match individual body perimeter, postures and depth for the purpose of computerized pattern making.

Ⅱ. Method

The interactive body model is divided into three parts. One part is for controlling the perimeters and height, another part is for controlling individual postures, and the other part is for controlling individual depths.

1. 3D Measurement of Body Shape

We used a three dimensional shape scanner (VOXELAN) to measure three dimensional body shapes. Scans from different sides were combined to generate a three-dimensional body model. The three dimensional model thus generated could then be used interactively.

2. Cross Sectional Line Modeling

In order to alter dimensions for contouring individual body shapes, we propose a cross sectional line model. It is easy to control the body shape and also easy to calculate length and perimeters because the model consists of cross sectional lines arranged at regular intervals. In this research, the body models consist of cross sectional lines arranged at 10mm intervals.

3 Assigning Shape Control Lines

In constructing the interactive body model, we assigned certain Shape Control Lines (SCL) that were used to modify the shape of the model representing different body shapes. We have the three main factors, which influence body shape (height, bust, and hip) and add six other SCL; underbust, waist, stomach, thigh, calf and ankle to fine tune the model to specific body shapes.

4. Scaling Method

Scaling methods and spline curves were used to construct the interactive body model. Perimeter of cross sectional line of basic model(r_n) and perimeter of cross sectional line of modified body model(s_n) is expressed as scaling ratio($P_2=(s_n-r_n)/r_n$).

Modifying the whole body by a scaling ratio with same centroid is not suitable to represent real body shapes accurately. Therefore, centroid(G_x, G_z) is moved as center position(G_x, G_z+Z) and the horizontal scaling ratio is different for each of the nine SCL. Perimeters, center positions, and proportions of SCL can be independently modified using this scaling method. Another four lines (highest line of body, lowest line, shoulder and neck) were added to the original nine SCL and were linked by spline curve. When the perimeter of one part is altered, other parts would influenced smoothly by the spline curve.

5. Process of Body Modeling for Posture

1) Extraction of Posture Constructed Points

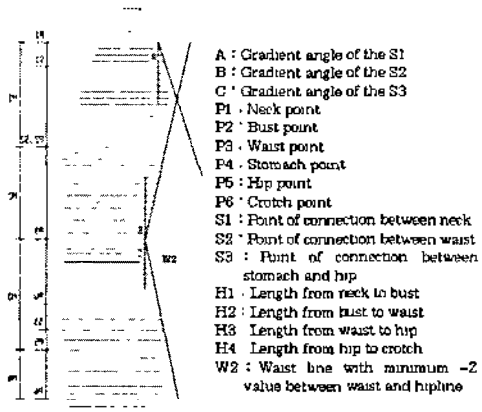
To represent the individual body posture, we use the spline curve. It is essential that ten points are extracted from the side view of the body silhouette. The ten points include seven position control points of neck point, bust point, waist point, stomach point, hip point, crotch point of body (P1~P6) and new waist point (W2), and three points of connection between, waist and the middle of point between stomach and hip (S1~S3). Especially points of P1, S1, S2, S3 and W2 are added for establishing of body posture. P1 is extracted by line with minimum + Z value above crotch line. W2 is extracted by line with minimum – Z value between waist and hip line. 〈Fig. 1〉 shows the necessary points and positions for constructing different postures.

2) Altering Gradient Angles of the Back and Hip Parts

Gradient angles at the neck point, waist point and hip point (A, B, C) can be altered depending on the individual back shapes.

3) Moving of Coordinates Points

Even similar body shapes which have similar gradient angles can be assigned different



〈Fig 1〉 Necessary points for constructing individual posture.

coordinate points (P1, P5, P6). Therefore the neck point, hip point and the bottom of the body model can be moved independently depending on body shape.

4) Linking Points by Spline Curves

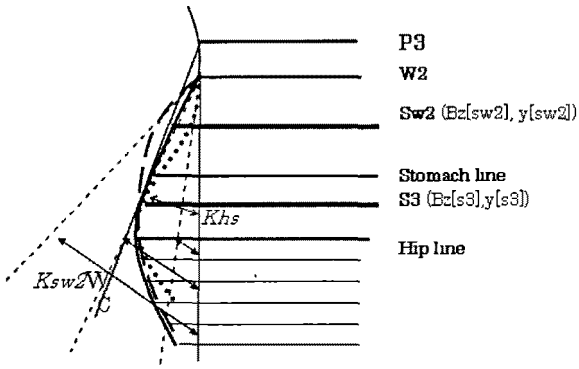
In the upper part of the body, four points (P1, S1, P2, P3) are linked by spline curves. The cross sectional lines are moved along these spline curves. Eight points (P1, S1, P2, P3, P4, S3, P5, P6) are described using spline curves in the button part of the body.

5) Controlling Section Heights

Control over distance from neck to bust(H1), bust to waist(H2), waist to hip(H3) and hip to bottom(H4) allows construction of a more exact body model. 〈Fig. 1〉 shows necessary point and positions for constructing different postures.

6) Defining of Hip Types

Even though two bodies may have the same C angle their curves between waist and hip can still be different as shown in 〈Fig. 2〉. Therefore in this paper, hip shapes can be divided into three types (H1, H2, H3) by the ratio of angles *Khs*, *Ksw2*, calculated from W2. C angle is calculated from P3. *Khs* is the angle at the connection point between middle of stomach and hip. *Ksw2* is the angel at the connection point between middle of waist and stomach. *SK* is the ratio of *Ksw2* to *Khs*. To adjust individual hip types, K_{sw2}' is calculated by multiplying *C* angle by *SK*. K_{sw2}' is converted to the new *Z* value which replaces the existing *Z* value (Bz[sw2]). As moving Bz[sw2], H1, H2 and H3 type is provided.

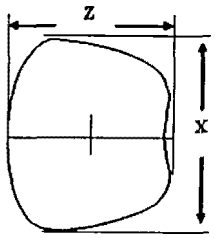


〈Fig 2〉 Method to define of hip types

6. Controlling Depth of Body Model

For controlling the depth of body, we calculated lengths from side to side and from front to back of cross sectional lines of bust, waist and hip. The widths are expressed as *X* coordinates

and the depth as Z coordinates (Fig. 3). Scaling ratio of depth($Dsclx$, $Dsclz$) is described as the length of the cross-sectional line of the basic model ($D[bust]$, $D[waist]$, $D[hip]$) and the length of the cross-sectional line of the modified body model ($SD[bust]$, $SD[waist]$, $SD[hip]$), as described in equation (1, 2).



$(x, z)=(Dscl_x[bust], Dscl_z[bust])$

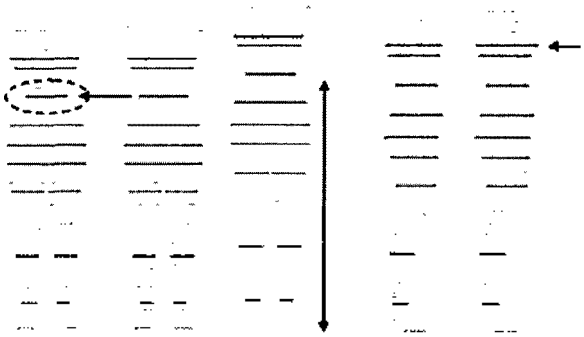
〈Fig 3〉 The information for controlling depth of body.

$$Dsclz[g]=\frac{SD[g]}{D[g]} \quad (1) \qquad Dsclx[g]=1+\left(1-\frac{SD[g]}{D[g]}\right) \quad (2)$$

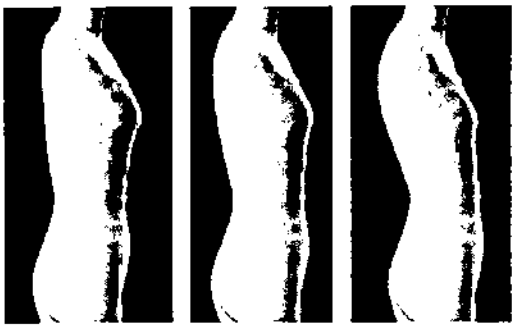
Ⅲ. Results

〈Fig. 4〉 Shows the results for controlling perimeters and heights in certain control positions. 〈Fig. 5〉 Show the results for controlling back shape such as stoop, average shape and flat shape. 〈Fig. 6〉 Show the results for controlling hip shapes of flat shape, average shape and protruding shape. Using the constructed body model, accurate modeling of the body size and posture is achieved.

The results of controlling depth of bust, waist and hip part with same perimeter is shown in 〈Fig. 7〉 ~ 〈Fig. 9〉. By controlling the front to back depth of certain body parts independently, it is possible to model bodies having different front to back depth in upper and lower halves of the body. Therefore the interactive body model could be used in the design of well-fitting clothes for women, accurately accommodating their proportions.



〈Fig. 4〉 Results for controlling perimeters and length in certain control positions.



Flat shape | Average back shape | Stoop shape

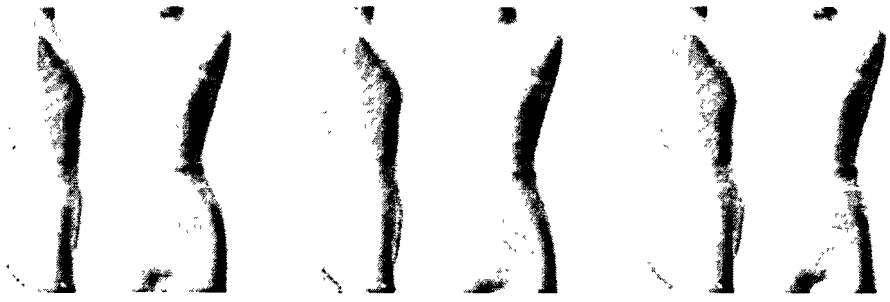
〈Fig 5〉 Results for controlling back shape.

Flat shape | Average shape | Protruding shape

〈Fig 6〉 Results for controlling hip shape.

〈Fig 7〉 The result of controlling depth of bust.

〈Fig 8〉 The result of controlling depth of waist.



〈Fig. 9〉 The result of controlling depth of hip.

Ⅳ. Conclusion

This paper describes the development of an interactive body model that can be altered to match individual body perimeter, postures including depth for the purpose of computerized pattern making.

Construction of the body model requires the extraction of necessary points, adjustment of coordinate points, linking of points by spline curves, control of section lengths and selectability of various hip types. Front to back depth of the model is adjusted by scaling ratio.

The results support the adaptability and potential usefulness of the posture and depth adjustable body model. Also we are developing a primary dialog for altering perimeter, length and depth, and a posture dialog for controlling back and hip shapes.

By making fine adjustments whose effects are instantly viewable therefore, it is possible to make pattern which result in clothing that not only fits well, but also exhibits other desirable properties. These other desirable properties, such as drape style, dart amount and optimum use, are possible to be viewable on screen before any fabric has even been cut. This system could, therefore, be seen as a major step forward in pattern making.

Ⅴ. Acknowledgement

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