

## Autobiographical note

### Computerized pattern making focus on fitting to 3D human body shapes

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## Computerized pattern making focus on fitting to 3D human body shapes

### **Abstract**

**Purpose-** This paper aims to describe the development a method of constructing 3D human body shapes that include a degree of ease for purpose of computerized pattern making.

**Design/methodology/approach-** We could make the body shape with ease allowance to an individual's unique body shape using sweep method and a convex method. And then generates tight skirt patterns for the reconstructed virtual body shape using a computerized pattern making system.

**Findings-** We obtained individual patterns using individually reconstructed 3D body shapes by computerized pattern development. In our patterns, complex curved lines such as waist lines and dart lines are created automatically using the developed method. We successfully used our method to make variations of a tight skirt to fit different size women. We also used our method to make other skirts of various designs.

**Originality/value-** Our method is useful for making patterns and then garments, without the need for the garments to be later adjusted for the

subject.

**Keywords** Individual pattern making, Ease allowance, 3D human body shape

## **Introduction**

Traditional pattern making systems use two dimensional perimeter element information, which is not enough to correspond to individual variations in the shape of the human body.

By using three dimensional (3D) data measured by 3D scanning devices, it is possible to express individual unique characteristic of body shape for pattern making. There are number of current research efforts in the field of 3D body modeling and computerized pattern making systems using 3D data (Cho et al., 2005; Bigliani et al., 2000; Watanabe, 1999). However, almost all of them use scanned 3D dummy shapes, not 3D human body shapes (Heisey et al., 1990a,b; Kim and Park, 2007; Miyoshi and Hirokawa, 2001).

When making patterns using traditional techniques, pattern makers used dummies(Miyoshi,2002). These dummies are shaped to include a degree of ease. Ease allowance (looseness in certain areas) in pattern making allows

for body movement and unrestricted fit. Too much ease can be sloppy and unattractive.

When making individually personalized clothing patterns, it is difficult to map the pattern to actual 3D representations of the body, because ease allowance must be given. Therefore pattern makers (dummy used) using traditional techniques need not allow any additional ease. However it is necessary to confirm that they actually fit well on real people body shape. Adjustments to garments are often required.

Because we are using scanned 3D real human body data as opposed to pattern makers' dummies, our system must generate patterns that include a degree of ease. Our method first constructs a virtual body shape which includes ease, and then generates tight skirt patterns for the constructed virtual body shape using a computerized pattern making system. By using 3D real human body shape directly, it is not necessary to confirm actually fit well on real people body shape. This system has the potential to be much more efficient than traditional pattern making techniques. It also generates patterns which are much more suitable for each unique human body.

## **Methods**

The lower body, waist, stomach and hip shape express unique characteristics of an individual's shape. Thus these factors need to be considered when reconstructing 3D body shapes with ease allowance during the pattern making process.

In our research, we develop a method of reconstructing 3D individual body shapes which retain individuals' unique characteristics.

### **Take in Figure 1**

#### **Method of reconstruction of real human body shape**

In the reconstruction process, it is necessary to divide the body in three parts, from waist to stomach, from stomach to hip, and from hip to hemline.

The following steps describe our method;

- a) First, we construct a line model using 3D scanned body data.
- b) We extract waist line having maximum Z value of back shape line in the side view of 3D body model. Stomach line is extracted by line having maximum Z value in front shape line under waist. Hip line is extracted by line having minimum Z value in back shape line under stomach.

Figure 2 shows waist line(WL), stomach line(SL) and hip line(HL) on lower body so that it is possible to divide into three parts, from WL to SL(I), from SL to HL (II)and from HL to hemline(III).

**Take in Figure 2**

c) Extracted stomach line is arranged and copied to hip line at regular intervals using sweep method.

As a result, there are existing two lines on the same Y coordinates in the II area.

**Take in Figure 3**

These two lines are connected using convex hull method for gaining the besieging lines at each position in II area. The convex hull of a set of points is the smallest convex set that includes the points. For a two dimensional finite set the convex hull is a convex polygon.

When creating the besieging lines, it is possible to give ease allowance retaining an individuals' shape in areas such as stomach and hip line's shapes.

**Take in Figure 4**

d) Using sweep method, the besieging line is copied from hip line to hem line as III area.

**Take in Figure 5**

e) Uneven lines from waist to stomach back shape line on I area are smoothed using a convex method. As shown in figure 6, we can make the body shape with ease allowance for making patterns unique to an individual's unique body shape.

**Take in Figure 6**

## **Experiments**

### **3D Measurement of human body shape**

We used scanned ten subjects' body data to examine the effectiveness of our reconstruction method. Table 1(a) shows size information of the ten subjects based on JIS size indication. For example, number three subject had difficulty choosing skirts because an M size, which is suitable for her waist is

too loose around her hips. Six other subjects in the Table 1(b) had similar problems with size choice.

We try to reconstruct their body shape for individual pattern making and make unique skirts for each subject. We then examine how well they fit.

### **Take in Table 1**

#### **Individual Pattern development process**

Our development method is presented simply here (Cho et al., 2006).

Firstly, we make the 3D reconstructed body surface of the clothes using triangular patches and sets grainlines for weft and warp on 3D body surface.

We arrange twelve cross sectional grainlines at 15° intervals to make fourteen sections. After we set grainlines accurately for weft and warp, we fit the fabric lattice to the contour surface. We form a fabric lattice with a mesh structure in weft and warp direction. We cut three-dimensional surfaces using plane. We create patterns by making angle of fabric lattices at right angles from three dimensionally contoured panels into two dimensions. Panels can then be described using curved lines in this process, three-dimensional cutting line is flattened on the two dimensional pattern.

Finally we can achieve the pattern.

**Take in Figure 7**

## **Results**

### **Results of reconstructed 3D human body shapes**

Figures 8 show the results of reconstructions for subjects 5 and 8. As shown, our reconstructed body shapes include ease allowance. These reconstructed body shapes which include ease allowance are used as body shapes for pattern development.

**Take in Figure 8**

### **Results of individual pattern development**

We obtained individual patterns using individually reconstructed 3D body shapes by computerized pattern development.

Figure 9 shows the completed pattern of four subjects with four dart lines. In individual patterns, complex curved lines such as waistlines and dart lines are created automatically using our developed method. Even though subjects 3 and 5 have same size as shown Table 1, their shape, amounts and length of

waist and dart lines are different depending on individual body shapes.

These lines are one of individual characters in pattern making.

**Take in Figure 9**

### **Result of making skirts using personalized patterns**

We made tight skirts using patterns created using our method and then examined fitness on each individual subject's body. Figure 10 shows tight skirts for four subjects made using our pattern making system. Subjects indicated that the fit of our skirt. It shows how our method works for making patterns for different body sizes and shapes.

**Take in Figure 10**

### **Application for various designs**

There are various designs based on a basic skirt pattern. In this research, we tried to apply our method to make various design skirts with patterns unique to a given subject. Two subjects used our method to create various design.

Figure 11 shows the results for the two subjects.

**Take in Figure 11**

## **Conclusions**

We developed a method of reconstructing 3D individual body shapes which retain an individual's unique characteristics. It is part of a computerized pattern making system which we developed. We could make the body shape with ease allowance for making patterns unique to an individual's unique body shape using sweep method and a convex method.

We obtained individual patterns using individually reconstructed 3D body shapes by computerized pattern development. In our patterns, complex curved lines such as waist lines and dart lines are created automatically using the developed method. We successfully used our method to make variations of a tight skirt to fit different size women. We also used our method to make other skirts of various designs. Our method is useful for making patterns and then garments, without the need for the garments to be later adjusted for the subject.

## **Acknowledgement**

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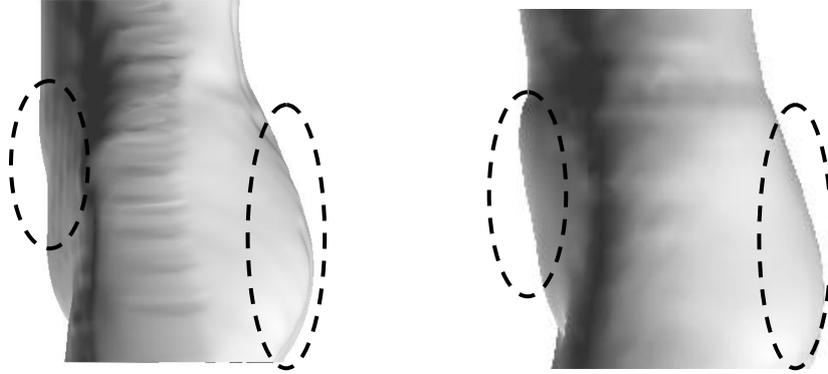


Figure 1. Individual shape of stomach and hips

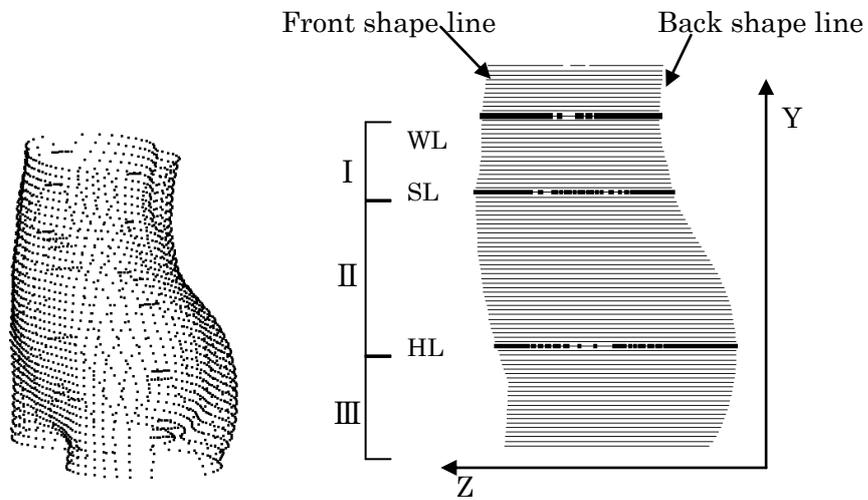


Figure 2. 3D body shape and Line model extracted WL, SL and HL

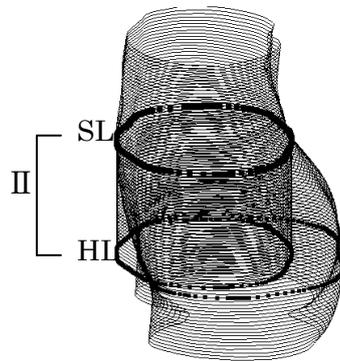


Figure 3. The result of II area using sweep method

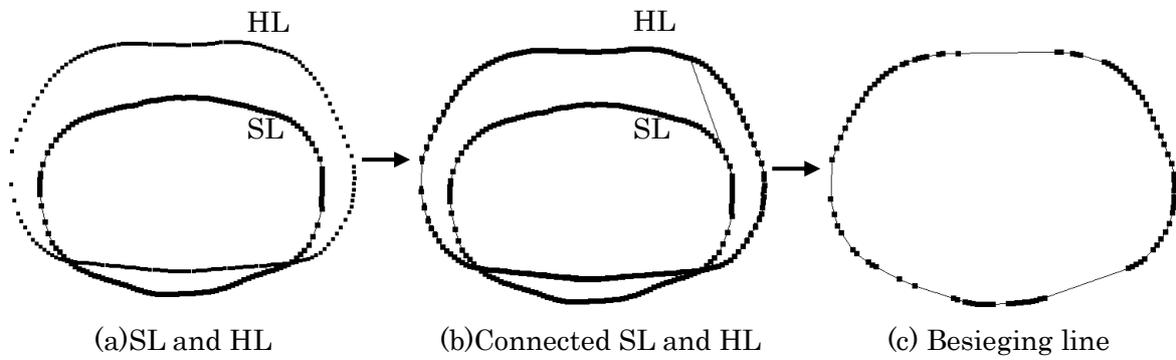


Figure 4. The convex method for creating the besieging lines of SL and HL

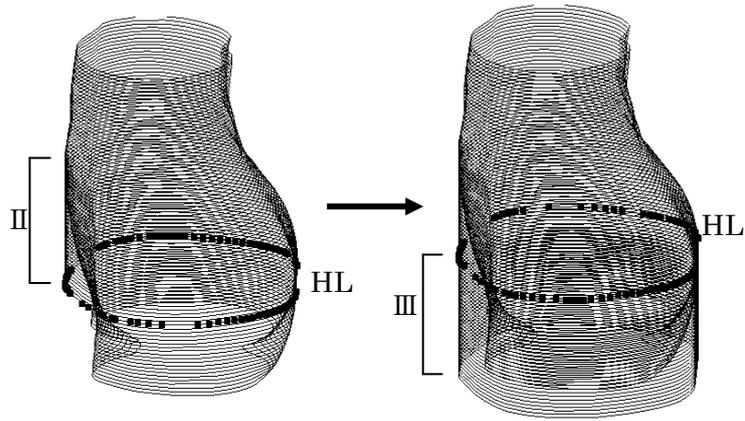


Figure 5. The result of swept HL on III area

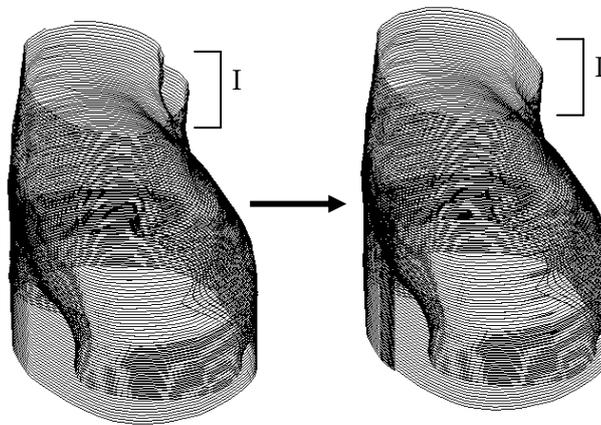


Figure 6. The results of smoothed waist and stomach back lines on I area

Table 1. JIS size indication(a) and size information of subjects(b)

(a)

( cm)

|            |       |       |        |        |
|------------|-------|-------|--------|--------|
|            | S     | M     | L      | LL     |
| Waist size | 58-64 | 64-70 | 69-77  | 77-85  |
| Hip size   | 82-90 | 87-95 | 92-100 | 97-105 |

(b)

( cm)

| Subject number | Waist size | Hip size |
|----------------|------------|----------|
| 1              | M          | S        |
| 2              | L          | L        |
| 3              | M          | S        |
| 4              | LL         | L        |
| 5              | M          | S        |
| 6              | L          | L        |
| 7              | LL         | L        |
| 8              | L          | L        |
| 9              | L          | L        |
| 10             | L          | M        |

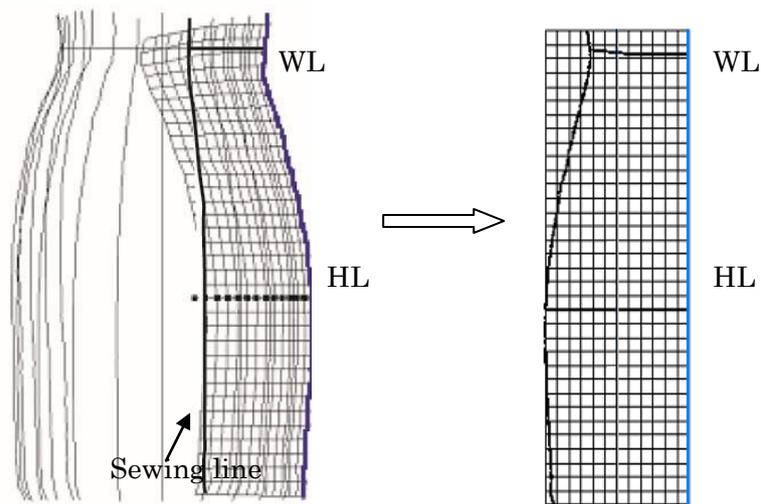


Figure 7. Individual pattern development process

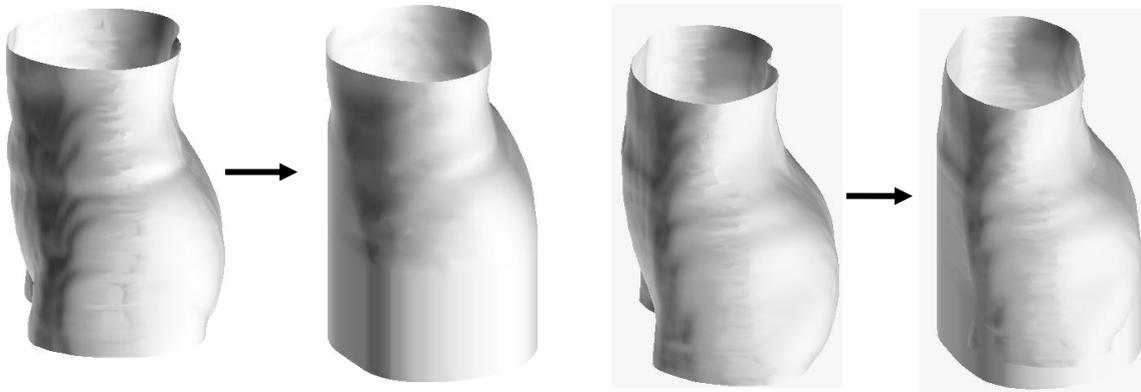


Figure 8. The reconstructions for subjects 5 and 8.

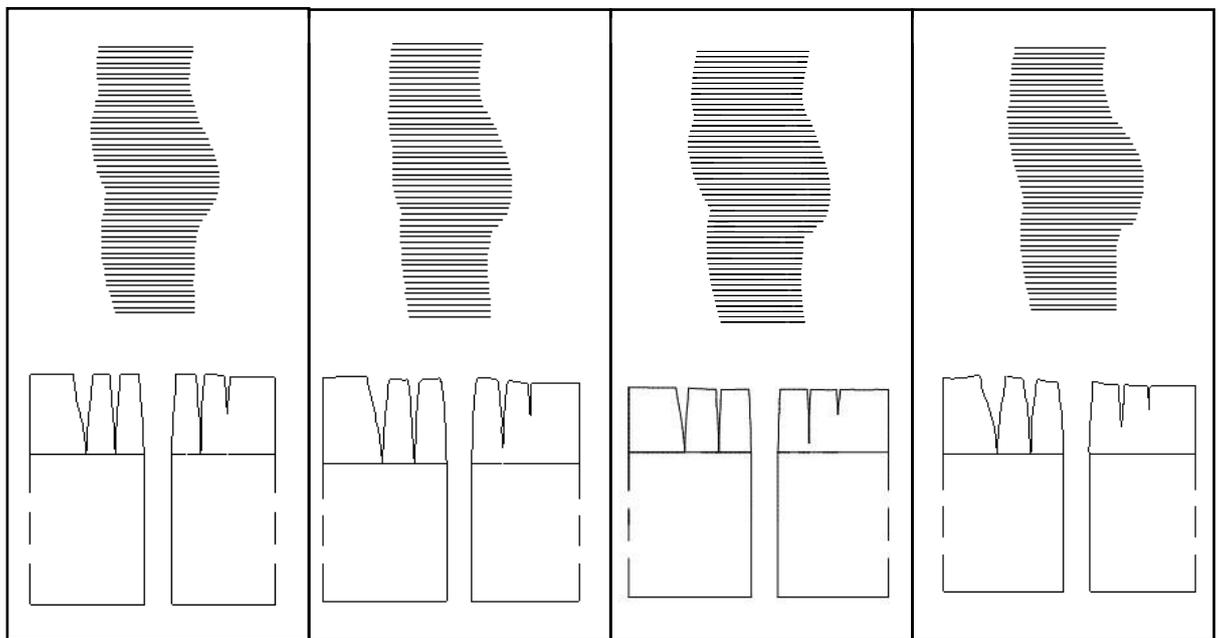


Figure 9. The results of individual pattern (subjects of 3, 5, 7, 8)



Figure 10. The result of making skirts using unique created patterns (subjects of 3, 5, 7, 8)

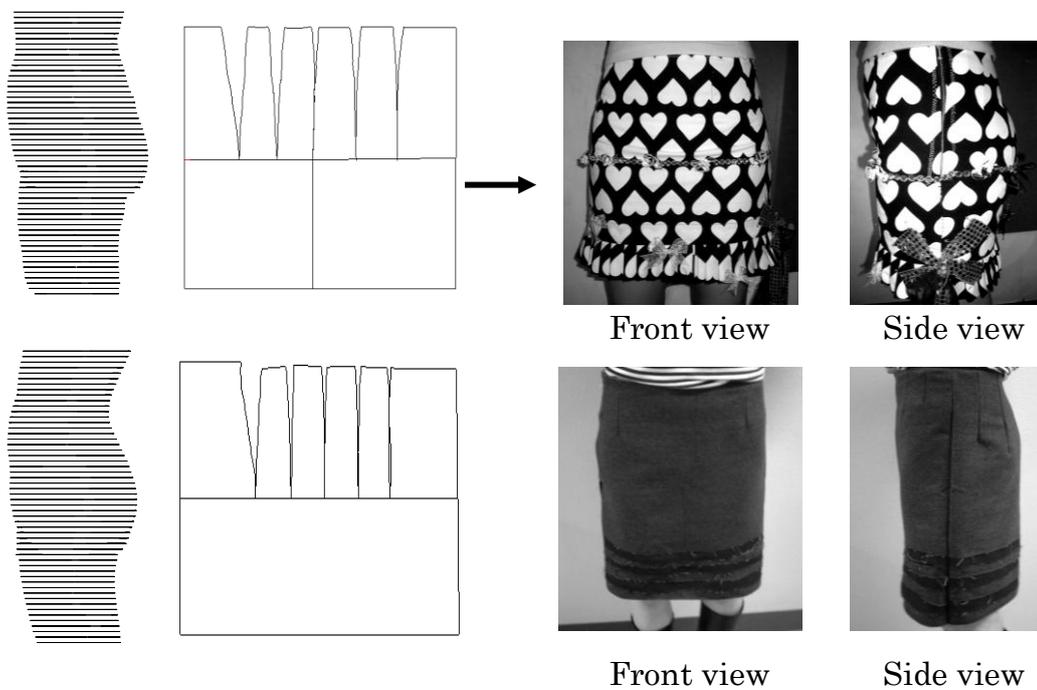


Figure 11. The results of application for various designs (subjects of 9,10)