

## **Garment construction with a 3 dimension designing system**

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*The computerized design and visualization of garments is still a subject of continuous research because of the diversity of the human body and the special characteristics of textiles. The associates of the Department of Polymer Engineering (Budapest University of Technology and Economics) and the Department of Information Engineering – sponsored by Tét SLO-7103 and the OM ALK-0025712002 and the OTKA T-42775 as well as by the GVOP-3. 1.1.-2004-05-0182/3.0 – along with associates of Budapest Polytechnic Institute of Leather, Textile and Garment Technology are presently developing a 3D designing system for apparel industry.*

*This 3D designing system being presently developed optically establishes the individual measures of the human body in full details in digital form, and on the basis of this the computer automatically generates the body model of the customer as a virtual mannequin. The garment constructions are made to individual measure on the basis of the body model. In our article we are going to show the achievements we have reached so far in the pattern construction.*

## 1. Introduction

Nowadays computer technique makes it possible to make construction, grading modelling and laying-up works in the garment-trade with the help of computers. At the Budapest University of Technology and Economics it has been dealt with computerised clothing systems for many years, at present they are developing a 3D (**Sylvie® 3 Dimensional Dress Design System**) garment designing system. In this system – that is being developed – the measures and the shape of the human body are fixed by digital photos and on the basis of these the computer shows the body model of the costumer as a virtual mannequin. In the course of this project we approach the construction of dress patterns based on individual measures from two directions. One of them is the 3D 'clothing' of the body and the laying out of the cloth, the other one is the development of a special construct with 3D opportunities based on some traditional constructions. In our article we deal with women body build, measuring methods and the construction of women skirts. The aim of our work is to evolve a construction method, which is applicable for making basic clothes that perfectly suites each people with different body shapes without trying on while we use the traditional construction methods and routines, as well as the photos and the help of the virtual mannequin.

## 2. Body model and taking body measurements in Sylvie® system

### 2.1. Body modell

In the Sylvie® system the 3D virtual body model that is the mannequin, is built up according to the parts of human bodies and their original sizes while using anthropometrical principles. The frame of one part of the body- similar to skeleton- is represented by a bar that is characterized by the furthest points of its coordinates whilst the part of the body is demonstrated by the surface made around the bar. (See figure 1. that shows a surface model of a leg).



*Figure 1. Surface model of a leg*

Each body part depends on 2-3 body parameters. The connection of body parts to each other are defined by tortuous curves. If we give all the parameters of body, we get the surface model of the complete body. This program provides the possibility for creating the from the garment industrial point of view exact body model of the studied person after giving his/her measures and thus insures the cutting for the body of further clothes.

## 2.2. Methods of taking body measurements

### 2.1.1. Taking body measurements from digital photos

To determine the parameters of the bodies, front and side-view photos are taken of the selected person. The digital photos will come into the body measurement taking program, in which after calibration we can determine the distance between any two points in the plane of the photo, thus any measures of the body shape in the plane of the photo can interactively be determined [3]. (2. figure). In order to determine other measures, back and right side photo loadings are also possible.



Figure 2. Taking body measurements from digital photos

The Sylvie® dress designing program uses all the parameter values needed to create the virtual body model of the examined person and 'copying' the contour of the visualised body in the picture it automatically determines the form of the human body.

### 2.1.2. Taking body measurements from the 3D body

In the Sylvie® system it is possible to define different body sizes from the 3D body model of the examined person. This program gives the spatial distance between two points on the body surface (3. figure). [1]



Figure 3. Measurements of the distance of spatial points with the help of the 3D body

### 2.2.3. Measurement of the horizontal plane section curves in the envelop area

Constituting the envelop area of the virtual body model and its horizontal plane section curves we get to such important data concerning dressmaking for individual sizes – comparing arc lengths and forms of the curves to each other – which can be defined just this way. [1]. The figure 4 shows curves which are necessary to the skirt construction.

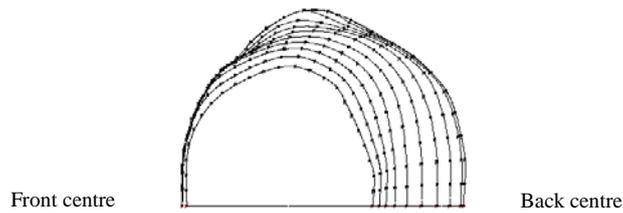


Figure 4. Plane section curves of envelop area from hip line to waist line

### 3. Dress design to individual measure in the Sylvie® system

In the Sylvie® system we can attain dress patterns of individual sized dresses in two ways:

- With laying out
- With construction

In our article we present the completion of the straight cut skirt construction.

#### 3.1. Dress design with laying out

The laying out is based on the 3D mannequin. On the basis of the 3D mannequin surface the program automatically generates the surface of the skirt (figure 5.). [11] The skirt suits the body between the waist and hip line, from the hip line it hangs freely. The form and cutting lines of the skirt can be designed by the skirt designing program, then according to the cutting lines this program defines- 'lays out'-the 2D parts of the skirt with numeral methods. (figure 6.).

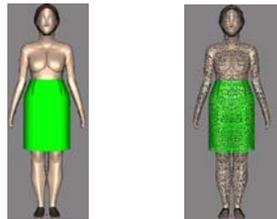


Figure 5. A skirt in a mannequin



Figure 6. A laid out skirt

#### 3.2. Dress design with construction

The form of the skirt depends above all on the side line as well as on the place, length and depth of dart formation.

### 3.2.1 Plane section curves to the skirt formation

We use the plane section curves of envelop area to place the darts. The figure 4. presents the half envelop area from the hip to the waist and its curves located at the same vertical distance from each other. We choose from those the four most significant curves of the human body: the waist I, waist II, hip, and hip II lines. (figure 7.). We define the so-called external envelope curve out of the above point-of-view curves. We use the hip I. and waist I. curves to define the side line of the skirt and the place of the darts.

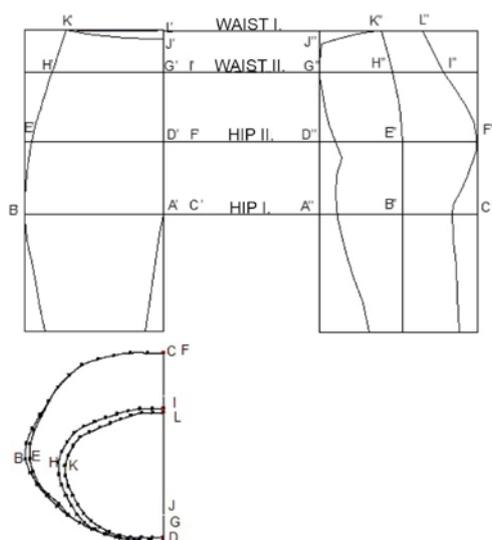


Figure 7. Front, side and view from above curves of the body and the skirt

### 3.2.2 Determining the place of the skirt's side line

The place of the skirt's side line can be defined with the help of the side view picture (Figure 7.). The side line starts from the midpoint of the skirt's bottom line and it goes parallel to the skirt's line up to the hip line. However, above the hip line – mainly in case of slim women who have no big stomach – this line a little differing from the vertical line follows the body line. In the figure 8. we defined two possible side lines with the help of two selected curves. One of them is straight (red), the other one is slanting (black).



Figure 8. Determining the side line of the skirt on the body shape

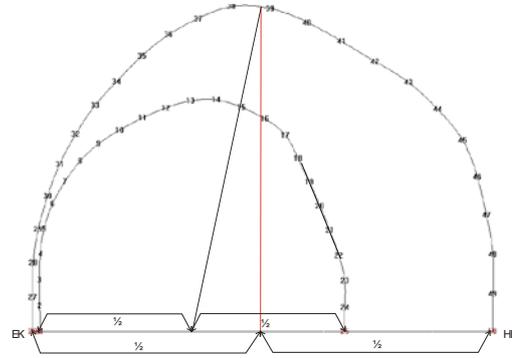


Figure 9. Determining the side line of the skirt on the most characteristic envelope curves

It can be seen in the figure 9, that if we let the side line of the skirt straight the side line will slip to the back site, this way the aspect of the skirt's side view will become aesthetically worst. It can be also noticed in the figure 10 that the application of the slanting line the fit of the skirt is better, yet the side line on the sewn skirt still slips a bit to the back side, thus it needs further correction.



Figure 10. Side line constructed with the straight perpendicular bisector



Figure 11. Side line constructed with the slanting bisecting line

### 3.2.3. Determination of the back's darts place

The potential place of the back's dart can be determined with the help of the form of the waist envelope curve. On each models' waist curve there is a relative straight section whose place – in the case of one dart – is in the ca. same distance like in the traditional construction. This can be found on every models' curve. The place of the dart can be determined with a perpendicular line which is drawn to the middle of the straight section (Figure 12,).

### 3.2.4. Determining the place of front's dart

The place of the front dart is marked by the line that is drawn between the intersection of the side and back lines and the point at the quarter of hip's perimeter (Figure 11.)

### 3.2.5. Determination of the dart's depth

In the figure 12. there is a help line between the front dart and the side line as well as the side line and the back dart. these give the dart's depth.

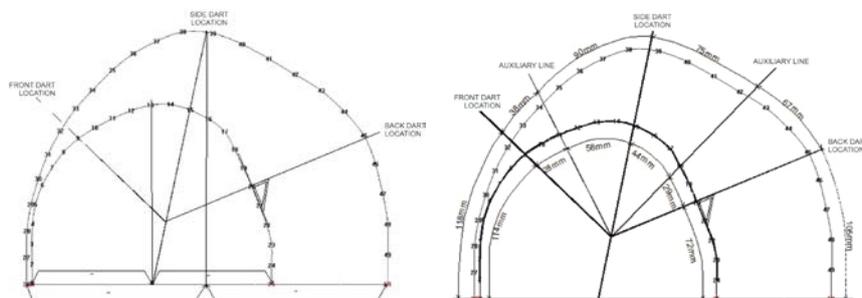


Figure 12. Definition of the darts' place and depth on side line, front and back

We define the length of darts sewing on the grounds of construction experience. There are some connections between the length and depth of darts and the qualities and ironing of the textile. In general, it can be written what length should belong to what depth value. The depth of dart in the front skirt can be min. 10 mm, max 25 mm. If the depth is bigger, two darts must be used in such a way that a distance of 30-40 mm must be kept between the midlines of the darts. The depth of the dart at the back of the skirt can be min. 15 mm and max. 45 mm. If this number is exceeded two darts must be used like on the front of the skirt.

### 3.3. Method of skirt construction

The method of skirt construction is slightly different from the traditional methods. The starting points and appellations can be seen in the 7. figure. First the base lines must be drawn, these are determined on the basis of the dates on the plane section curves and digital photos. The main steps of construction are presented in table 1. The construction of the skirt can be seen in the figure 12.

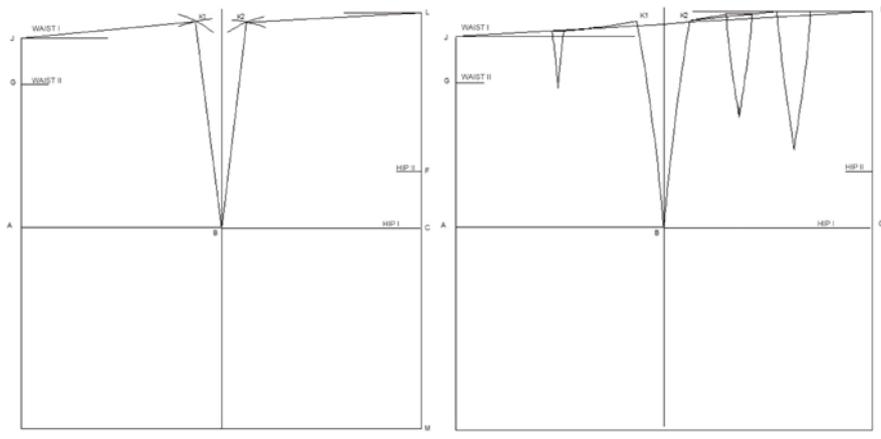


Figure 12. Construction of the skirt's base lines

Table 1. Main steps of skirt construction

1. Draw middle of back line	
2. Draw Hip I line perpendicular to back line, intersection: C	
3. C-A skirt wideness: length of hip's envelope curve, draw front centre line perpendicular to hip line, intersection: A	
4. C-M Skirt length: from Hip I line on back line	
5. Determination of the skirt's side line: Back: C-B Front: B-A	
6. A-G The distance between the Hip I and the most prominent part of the stomach measured on the basis of the profile photo	
7. G-J The distance between the most prominent part of the stomach and the waist line measured in a diagonal way on the basis of the profile photo	
8. The diagonal distance between the Hip I and the side waist line: the distance is defined with the help of a compass. <b>B-K1, B-K2</b>	
9. <b>J-K1</b> Length of the front waist line: front waist perimeter measured on the curve + dart's depth	
10. <b>L-K2</b> Length of back waist line: back waist perimeter measured on the curve + dart's depth	
11. Hip I- Hip II distance: measured on the profile photo <b>C-F</b>	
12. <b>F-L</b> Distance between the Hip II and the waistline measured on the profile photo	

#### 4. Summary, the supervision of the design method and assessment of the results

The supervision of the dress patterns made with the two methods occurred the following way: We sewed skirts that we made with the two methods and for more women with different sizes and differing from the geometrical mean.

The figure 13 shows two kinds of skirts made for one of the models. One of them is made by laying out method, the other one is made by construction.



*Figure 13. Skirts made by lay out and construction*

It can be seen very well in the photos whether the form of the skirt fits the body shape. On the basis of the photos it can be stated that the skirt made by both methods fits the model's body shape well apart from small mistakes. Looking at the wrinklins we can allocate some errors of the skirts. In the profile photo of the laid out skirt it can be seen that it is not straight in the front, thus the side line slips to the back. In the case of the constructed skirt the waist and hip lines are good, and the skirt fits the woman's build. However, its error is that it has a long back that's why it rumples on the back waist line. Based on the results of the error analysis the dress-pattern of a perfectly fitting skirt can be produced, however, the computer program must be improved.

We can say on the ground of the results that in the Sylvie® 3 Dimensional Dress Design System we can make skirts to individual sizes with laying out and construction method as well. When and which methods is worth using depends on the decision of the designer.

## 5. Reference list

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