Applicability of 3D Garment Prototyping in Assessment of Garment Fit

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http://dx.doi.org/10.15221/14.066

Abstract

The aim of the study is assessment of CAD software implementing a virtual simulation of the garment, its prototyping and fit. The study is an attempt to compare the numerical model of dress: "stitched virtually" on a digital avatar issued from the body scanner and its “scanned” real form made for the same user in order to prove a proper design and garment fit to the given user morphology.

Keywords: 3d body scanning, proceedings, format

1. Introduction

Design and modeling of forms of clothing is a tedious process and requires the designer experience and years of practice. Manual exercise and gradation of clothing, sewing prototypes to validate the modeling in order to match the product to the figure, as part of the preparation process of production, occupy a significant part of the time it takes to process the production of clothing. This means that the process of preparing production carried out traditionally it generates large losses both financial and time.
The current trend influenced by dynamic changes in fashion requires manufacturers to quickly adapt new models or colours. The use of CAD/CAM software in garment industry reduces and streamlines the process of garment production preparation. Computerization of this industry is also reflected in the increasingly wider use of 3D scanners [1, 2] for non-contact measurement of the human body. Avatar retrieved from the scanning process can be used in the virtual simulation of garment, Internet, and ultimately on the purchasing of tailored garment. The current trend towards dynamic changes of fashion requires the manufacturer to quickly adapt new models or colors.

2. Methodology

The aim of the study was to evaluate the applicability of 3D garment prototyping in implementing a virtual simulation of the garment to garment production process on the example of Lectra software. Our assumptions take into account that the use of CAD software implementing virtual garment simulation to the process of preparing garment manufacturing at the present stage of advancement of technology cannot replace, in some cases, these traditional prototypes sewn to validate the design and modeling, the accuracy of the selection of materials and accessories, as well as the quality of the process. However, it represents a useful tool to assess the correctness of the design or selection of the size of the garment to the body.
The work attempts a visual comparison of the product " virtually stitched " for scanned avatar of wearer and the garment prototype sewn and tried-on by the same wearer in reality.

2.1. Scope of work

Our study included several stages where we makes a prototyping process in the virtual environment employing 3D body scanner and software solutions of CAD system, as well as the part of industrial prototyping process usually realized in manufactory, mentioned below:

- Dress model designed in Kaledo software,
- Numerical avatar generated in 3D scanning process by TC2 scanner,
- Fabric parameters of chosen fabrics: cotton and polyester analyzed by simple metrological tests,
- Patterns of dress designed and modelled, based on the basic method of woman blouse employing Modaris software,

- Dress patterns transformed to a virtual simulation,
- Virtual simulations iterated according to the required alterations of the patterns
- Dress pattern printed for cutting,
- Two prototypes of dresses sewn,
- Comparison of virtual dresses to real products
- Data of the user wearing the prototypes re-scaned ,
- Dresses scans and their virtual simulations analyzed in the point of view of fabrics drape and the garment fit.

2.1.1. Design of dress model

Design of sketch and model of dress was performed using CAD system of Lectra solutions – KALEDO STYLE. Front of the dress is matched by a breast darts and tucks at the waist line. The front neck line was deeper and was properly modeled. On the back, the dress was fitted at the waist line with tucks and darts shoulder. Bottom of the dress has been constructed on the basis of the pitch circle. The lower edge was finished with a single one-quilted hem. Dress with zipper, which was located in the left side. The edges of the neck and armpits finished with bands (figure 1).

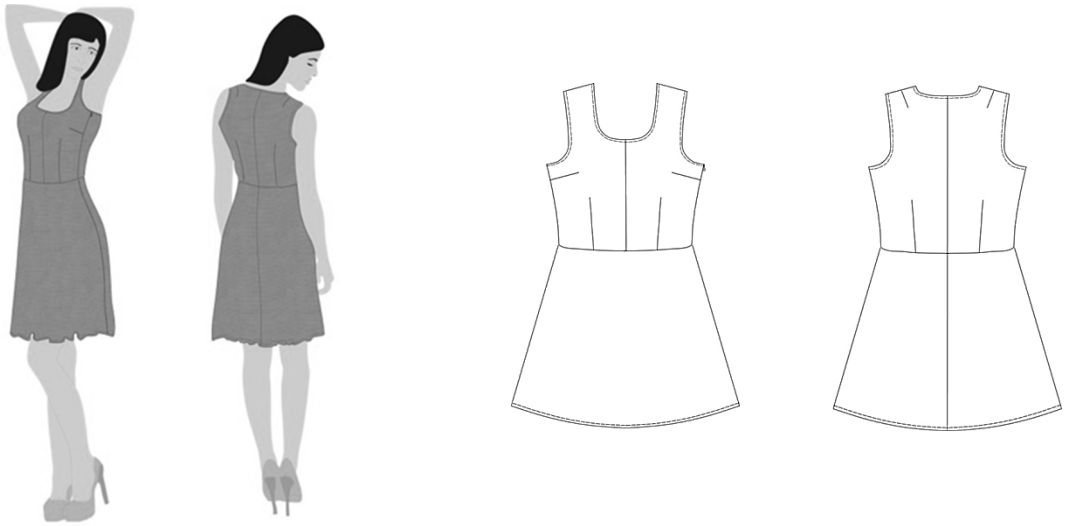

Figure 1. Dress design and its technological sketch performed using KALEDO STYLE (Lectra)

2.1.2. Numerical avatar issued 3D scanning process

In order to make a precise definition of human body NX16 Body scanner was used. 3D image of the silhouette was converted into a numerical avatar according to used 3D CAD module. Body measurement data's issued from the scanner were employed to make standard woman blouse and then to make a dress patterns.

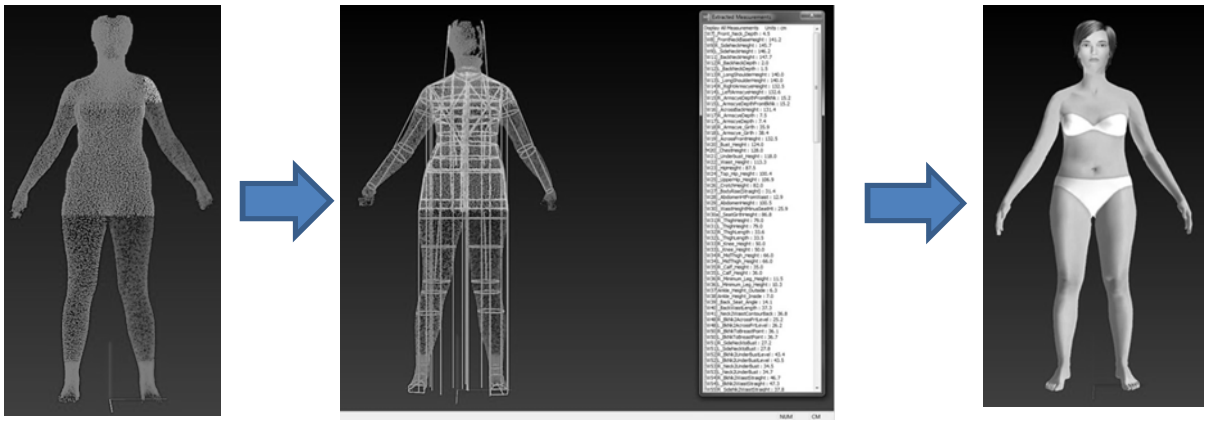

Figure 2. Numerical avatar of wearer issued from 3D scanning process

2.1.3. Metrological analysis of fabrics

To adjust the virtual fabric with 3D cube Fit and fabric selected to sew dresses prototypes (polyester and cotton), conducted a simple analysis of the metrological research including thickness, weight and drape surface (number of folds) of selected fabrics. The idea behind this approach was to simulate the actual conditions in the average factory clothing, for which access to the KES system is very difficult.
Examination of fabric thickness according to Standards: BS EN ISO 5084, as well the survey study of fabric drape performed on a Cusick Fabric Drape Tester, according to the manufacturer standard, were done to determine the parameters of numerical fabrics.
Software's fabric selector allows to indicate the several parameters, such as : composition, density – mass per square meter , thickness, weave's type, flexibility and elasticity.
Due to the limited number of available fabrics, the chosen fabrics were characterized by the same weave and composition, and the closest mass per square meter and the same or similar number of folds (figure 3).

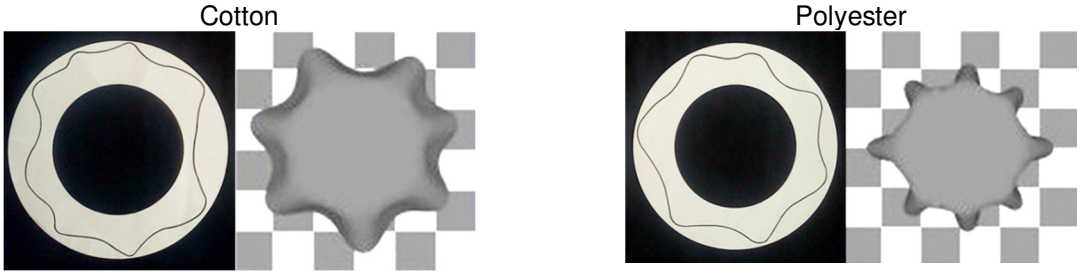

Figure 3. Fabric drape performed on a Cusick Fabric DrapeTester

2.1.4. Design *and modelling of dress patterns*

The design and modeling of the dresses were made by construction method mentioned in [4] for basic women's fitted blouse and skirt formed on the basis of the circle's pitch.

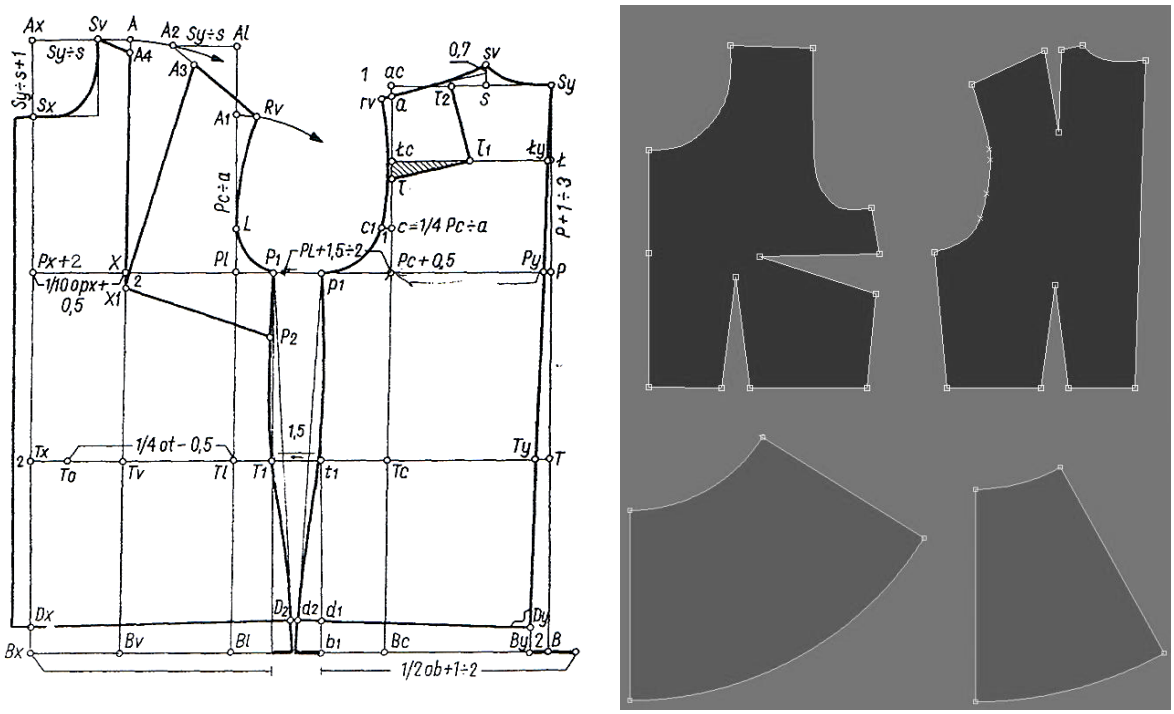

Figure 4. Design and modelling of dress patterns

2.1.5. Dress patterns transformed to a virtual simulation

In order to verify the matching the dress to the given silhouette, a virtual "stitching" of its elements was made. The sewing was carried out in six stages, wherein each of the stitched seams, such as:

- sewing of back elements, ea. pleat stitching, shoulder darts at the waist line and the seam on the back center line
- sewing of front elements ea. sewing chest darts , pleats at the waist line and the seam on the front center line
- sewing of side seams
- sewing of shoulder seams
- sewing of bottom dress
- sewing the upper part and the lower part of the dress

The result of the virtual “stitching” of dress shown below on the figure 5.

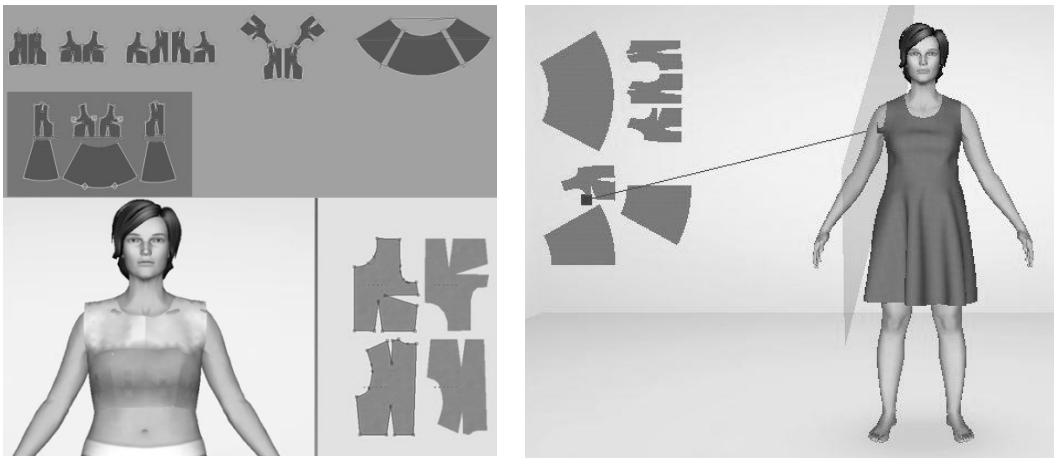

Figure 5. Process of virtual sewing of the dress

2.1.6. Dress patterns alterations whilst the dress virtual simulation

To take into account the wearer's silhouette shape the pattern of dress had to be modified. The modification process of the dress pattern shapes proceeded in two stages, in which considered the upper part of the dress, divided into front and back.

In order to fit a template to fit the front, the following adjustments were made (figure 6) such as:

- Adjustment of the center line
- Rounded shape of the pleat at the waist line
- Decreased breast darts
- Changed the angle of the shoulder seam line
- Shortened the seam line of the shoulder
- Deepened armpits line
- Modeled side line
- Deepened neckline.

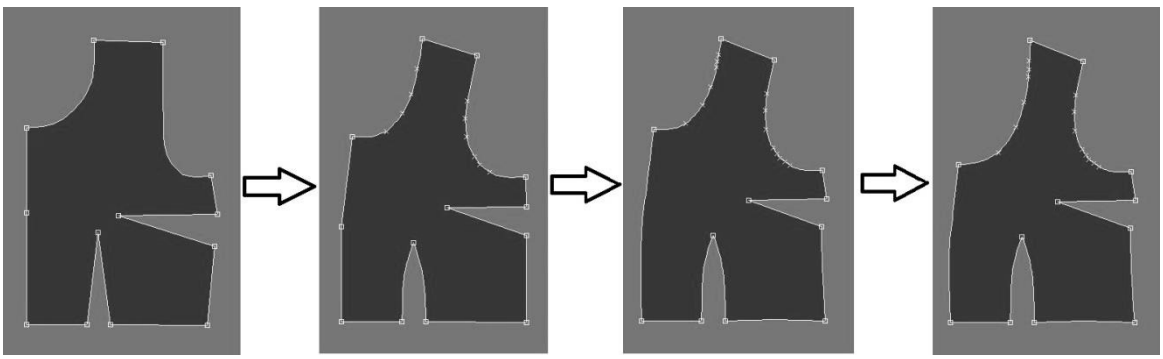

Figure 6. Process of alterations of the front dress

Then, an adjustment to the back, the steps shown in Figure 7

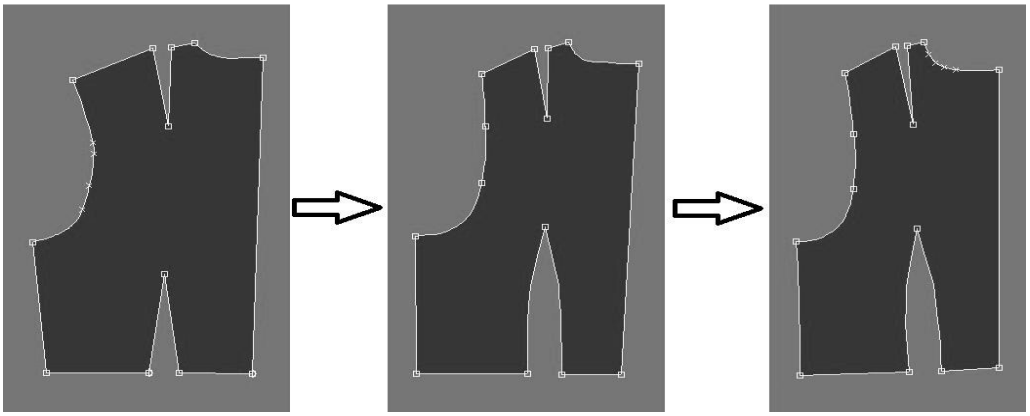

Figure 7. Process of alterations of the front dress

In order to correct the back shape, the following amendments were introduced, such as :
• Shortened the seam line of the shoulder
• Increased and rounded darts at the waist line
• Modeled the side line
• Deepened the back of the neckline
• Narrowed the center line

On the basis of the corrected shapes of patterns dress, the final simulation for the two variants of the fabric was carried-out as presented on the figure 8.

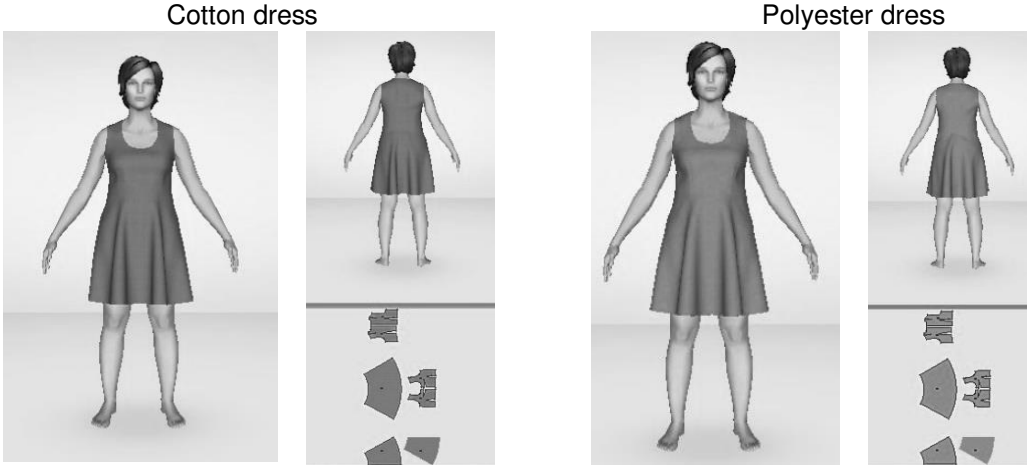

Figure 8. Final virtual simulation of dresses

Modified as a result of virtual simulation the patterns of dress were then used for the implementation of the markers (the pattern garment arrangement on the given fabric) for cutting cotton and polyester fabrics. Finally two prototypes of dress made of: cotton and polyester were sewn.

2.1.7. Comparison of virtual dresses to real products

The following figure (figure 9) is an example of the scoreboard dresses drape on the body, viewed from the front. At the front of the dresses (real), visible wrinkling on the line armpits and on the side line. It can also be noted that drape of the front of the real dress is convergent this drape of the virtual one.

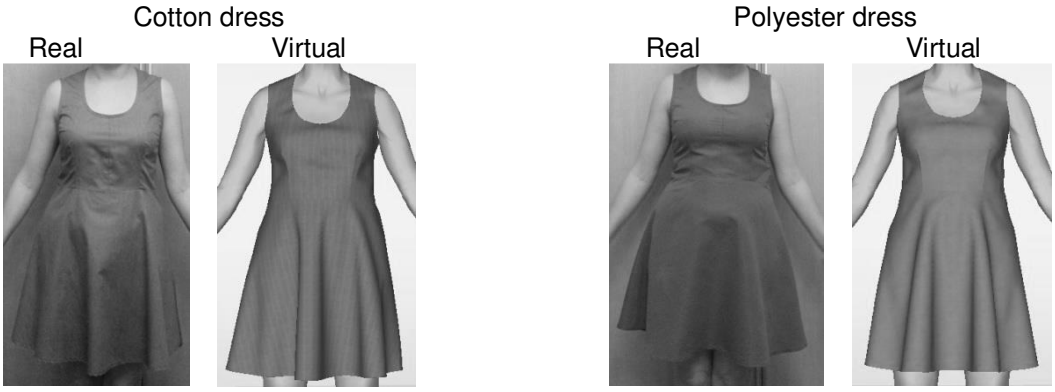

Figure 10. Comparison of virtual dresses to real products

2.1.8. Re-scanning process of the user wearing the prototypes

In order to ensure appropriate conditions with possibility to give an objective assessment of the actual draped dresses and their 3D virtual images, the scanning process was carried out with the prototypes of dresses worn by the same user. This operation allowed us to convert the results of the process of the creation of prototype garments to virtual reality to be able to give a report and compare them with the results of virtual simulation. The scanning process of the user wearing a dress, carried out for the two prototypes using the same 3D scanner NX 16. On the three-dimensional scan data the locations of cross-sections to be analyzed at a later stage were selected. Taking into account the fact that the upper part of the dress was very tight, our considerations on the result of dresses draped were subjected to the lower part of the dress - in the area between the waist and bottom-line of dress, the occurrence of places of characteristic lines of the body, such as:

• Line of hip - 87.5 cm
• Line of thigh - 79 cm
• Line of mid-thigh - 69 cm

2.1.9. Analysis of the drape of dresses scans and their virtual simulations

Analysis of the dress draping is consisted of test of the geometrical parameters of selected cross-sections of the dress in the virtual space, such as the shape of cross-section, which is associated with a number of folds which forms the product situated on a given height of human body. Second parameter analyzed takes into account the length of the studied cross-sections and obtained for a given height of the user. In our study we are taken into account the place where the folds of dress were appeared. Such analysis was done for selected cross-sections of both fabrics. The results are summarized in Table 1 for cotton and in Table 2 for polyester fabric.

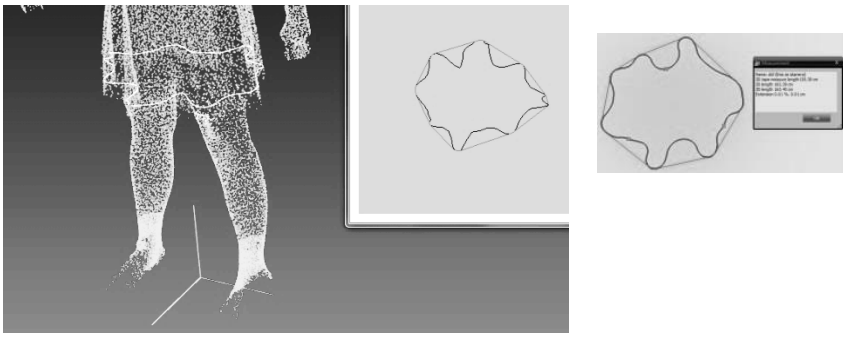

Figure 9. The example of cross-sections of cotton dress scanned at the at the thigh line

Table 1. Cotton dress parameters

Cross-section	Cross-section perimeter of cotton dress		Fold number of cotton dress	
	RD	VD	**RD**	**VD**
Hip	128,65	127,37	**8**	**7**
Thigh	142,30	143,49		
Mid-Thigh	166,60	165,40		

Table 2. Polyester dress parameters

Cross-section	Cross-section perimeter of PES		Fold number of PES	
	RD	**VD**	**RD**	**VD**
Hip	128,90	127,45	8	8
Thigh	**143,40**	**142,89**		
Mid-Thigh	163,60	163,41		

Conclusions

Our studies show that the drape for both realization, as compared to their virtual images is convergent, and the comparative analysis of the results obtained are satisfactory.
CAD systems streamlines the process of preparing a production of clothing and increases the accuracy of structural forms
Sensibility of the software proves that changes in the drape of clothing are seen in the application of structural alterations in the garment patterns as well as whilst the changes of dress materials
The use of such a program allow to evaluate faster and easier the drape and fit of the product to the human body and to find the places where the alterations should apply. However, due to the limited size of the base materials, it should not be the only tool to assess correctness of the fit and drape of the garment, it's only a tool to facilitate the work, the knowledge and the experience of the pattern maker are still required

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