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A STUDY ON USING 3D VISUALIZATION AND SIMULATION PROGRAM (OPTITEX 3D) ON LEATHER APPAREL

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Abstract: *Leather is a luxury garment. Design, material, labor, fitting and time costs are very effective on the production cost of the consumer leather good. 3D visualization and simulation programs which are getting popular in textile industry can be used for material, labor and time saving in leather apparel. However these programs have a very limited use in leather industry because leather material databases are not sufficient as in textile industry. In this research, firstly material properties of leather and textile fabric were determined by using both textile and leather physical test methods, and interpreted and introduced in the program. Detailed measures of an experimental human body were measured from a 3D body scanner. An avatar was designed according to these measurements. Then a prototype dress was made by using Computer Aided Design-CAD program for designing the patterns. After the pattern making, OptiTex 3D visualization and simulation program was used to visualize and simulate the dresses. Additionally the leather and cotton fabric dresses were sewn in real life. Then the visual and real life dresses were compared and discussed. 3D virtual prototyping seems a promising potential in future manufacturing technologies by evaluating the fitting of garments in a simple and quick way, filling the gap between 3D pattern design and manufacturing, providing virtual demonstrations to customers.*

Key words: *Leather, Leather apparel, 3D, Simulation, Physical properties*

1. INTRODUCTION

Virtual prototyping is a technique used in the process of garment development that involves application of computer aided design intended for garments development and virtual prototyping of them. Its aim is to integrate all specific characteristics of the garment into the virtual prototype that fits the virtual human body model [1].

The application of computer aided design (CAD) intended for garments development and their virtual prototyping has become an obvious trend in many of industries recently. Nowadays, the virtual prototyping allows us an accurate and rapid development of garments, as well as adaptable and quickly changeable garments [2-3].

Virtual garment simulation is the result of a large combination of techniques that have also dramatically evolved during the last decade. The cloth is by nature highly deformable, therefore the mechanical representation should be accurate enough to deal with the nonlinearities and large deformations occurring at any place on the cloth, such as folds and wrinkles [4]. With application of the 3D virtual garment prototyping the garment's patterns can be placed and draped on the virtual human body. When the virtual prototyping is accurate the garment fitted to the body model reflects and combines characteristics of the garment style, garment pattern design, virtual body model and mechanical properties of textiles [5]. The success of 3D virtual garment prototyping programs closely depends on definition of the used material properties to the program. Present softwares contain selection of many fabric types within the program. However lack of detailed leather types in the software hinders usability of these programs in leather garment manufacturing.

3D virtual garment prototyping programs have advantage of time, labor and material saving by fitting designed garment models and patterns on virtual mannequins. Leather jacket production requires numerous inputs. The major cost of a jacket, which is more than 74%, is the leather cost followed by the labor cost which accounts for about 21% [6]. These figures show the importance of material and labor cost.

In this study, a dress was designed and produced by using textile and leather materials both virtually and in real. The first one was a leather dress, where individual mechanical and physical properties of the leather were defined to the program. The second was a cotton fabric dress, where fabric properties of the material were selected from the OptiTex database. Similarities and differences were compared between virtual model and real production.

2. MATERIAL AND METHOD

2.1. Material

9 chromium tanned leathers, Cotton fabric (97% Cotton / 3% Spandex), Polyester lining, Gauge for thickness measurement Sylvac S229 (textile) and Pellizzato (leather), Hounsfield H10 dynamometer and Louis Schopper tensile strength testing instruments, Analytical balance Acculab 302, 3D Scanning VITUS Smart XXL (Human Solutions GmbH, Germany), 3D visualization and simulation program OptiTex 3D, LECTRA cutting machine VECTOR FASHION FP, Industrial sewing machine, Brother S 7200B-403/EFL one needle direct drive with thread trimmer, Polyester close-end zipper, No.50 polyester thread, Adhesive for leather apparel

2.1. Method

Samplings of all leathers for the tests were done according to TS EN ISO 2418. The test samples were conditioned according to SR EN ISO 2419:2003 [7]. Thicknesses of test samples were measured according to SR EN ISO 2589:2004 [8]. Physical properties of samples were determined following standards: SR EN ISO 3376: 2012, ISO 13934-1, SR 5045:2008, IRS SR 6144-86(A) and TS EN ISO 17235 [9-13]. The surfaces of leather and cotton fabric were scanned by a scanner. 3D body scanning of selected person was performed using the Human Solutions 3D body scanner at National Research and Development Institute for Textile and Leather (INCDTP) Bucharest, Romania. The scanner consists of 4 laser sensor and 8 photo cameras with CCD sensor. The 3D scan object has a density of points of 300 points/cm^2. After that, the body measures were taken using the program package VITUS Smart XXL. 151 different body measurements were obtained as one example: body height is shown in Fig. 1.

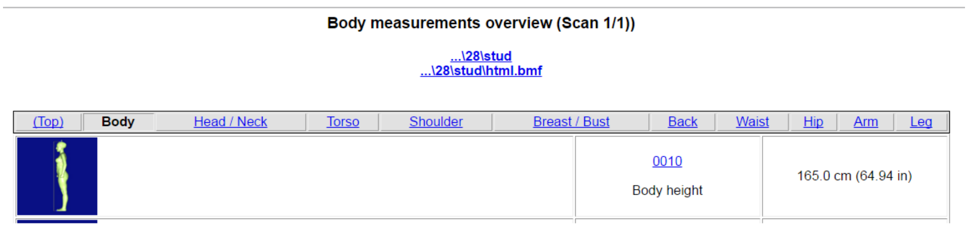

***Fig. 1**: Body height 3D scanning*

The 3D body scanning system used is a mobile system efficient in serial measurements, which consists in a very precise body scanner and powerful software, Anthroscan. The VITUS Smart XXL scanner is based on the most precise optical triangular method with laser, for the 3D image capture, in conformity with EN ISO 20685:2005 [14]. The system combines the efficiency and flexibility of an automate capture of the body sizes, providing the user the possibility to define individual measuring rules perfectly fit to his/her own requests. The parametric 3D body model of selected female was built by using OptiTex PDS program and the body measures obtained from the scanner. These body measures were: body height, neck, bust, over-bust and under-bust, waist, hips, upper arm, wrist, thigh and high thigh, knee, neck, arms, waist to hips, waist to floor and many others with the aim to achieve more realistic appearance of the virtual body model (Fig. 2).

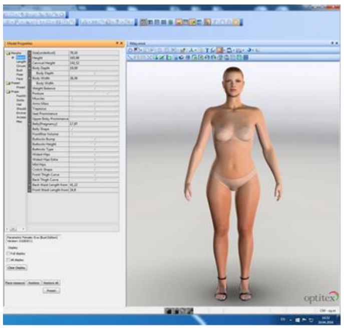

***Fig. 2**: 3D body model on OptiTex PDS*

A dress model was designed as shown in Fig. 3. Many different pattern making systems are used in the apparel industry, developed according to the nation's anatomy and changes in the pattern preparation steps with respect to different systems [15]. In this study, the dress patterns were designed by using OptiTex 2D system in conformity with German pattern drafting system M. Müller & Sohn (Fig. 4). The carton drawing and cutting of patterns were made by Lectra cutting machine.

***Fig. 3**: Design of dress model*

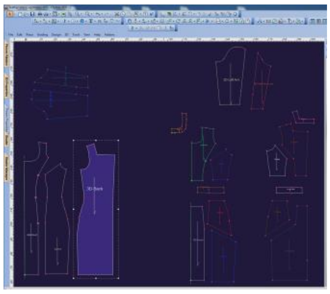

***Fig. 4**: Screenshot of patterns on OptiTex 2D*

The leathers and fabric were cut by placing dress patterns on them and the pieces were laid on a table individually (Fig. 5-6). Linings were cut by placing dress patterns on them and the pieces were laid on a table individually (Fig. 7).

***Fig. 5**: Leather pieces*

***Fig. 6:** Cotton Fabric pieces*

***Fig. 7**: Lining pieces*

The leather and fabric pieces of the dresses were sewn by using BROTHER S 7200B-403/EFL sewing machine. The dresses were finished and fittings were done. For the leather dress some adjustments were done in order to improve the fitting because the leather was flexible and 1 cm on the hip line was cut to tight the dress around hip line (Fig. 8). Then, last fittings were done.

***Fig. 8**: Fitting of leather and cotton fabric dress*

3. RESULTS

The surface images of leather and cotton fabric are shown in Fig.9-10. These images were transferred to the program to observe the details of material texture in the 3D simulation.

***Fig. 9**: Surface of leather*

***Fig. 10**: Surface of cotton fabric*

Physical tests were applied to both leather and fabric samples according to leather and textile official test methods. The obtained test results are given in Table 1. Acceptable quality standards recommended by UNIDO for chromium tanned garment leathers are 10 N/mm2 for tensile strength and 15 N/mm for double edge tear load [16]. BASF Leather Pocket Book has a recommendation of less than 60 % elongation at break value for chromium tanned clothing leathers [18]. When the data given in Table 1 are considered in terms of strength and elongation; and compared with the recommended standards; it is seen that the leather has met the standards for tensile strength and elongation % for tests done according to leather standards. Single edge tear, is getting importance in last years, thus there is no recommendation in old standards. Additionally it was observed that the tensile properties of fabric were higher than the leather when tested within the same standards; however textile fabric had less elasticity and percentage elongation.

Similar tests were done again to same samples by using textile testing standards. Again tensile strength of fabric was found higher than leather; and percentage of elongation was found lower than the leather sample. Another finding is that although the names and principle of the physical tests used in leather and textile are similar, they have different methods, patterns, sample measures which leads to obtain differences in results as seen in Table 1. So it is advised to measure the properties of materials either only by using leather methods or only textile methods, but not to compare results of separate methods.

Table 1: *Physical test results*

Test	Leather Standards		Leather	Fabric
Tensile	Thickness (Mean) (mm)		0.48	0.30
	Strength(N/mm²)	Mean	15.53	37.70
	Elongation (%)	Mean	49.33	27.66
Single Edge Tear	Thickness (Mean) (mm)		0.61	0.31
	Strength (N/mm)	Mean	5.66	48.10

Test	Textile Standards		Leather	Fabric
Tensile	Thickness (Mean) (mm)		0.56	0.43
	Strength (N/mm²)	Mean	22.55	26.33
	Elongation (%)	Mean	86.53	21.40
Single Edge Tear	Thickness (Mean) (mm)		0.56	0.43
	Strength (N/mm)	Mean	7.48	36.16
Weight	Mean (g/m2)		302.44	177.36

OptiTex 3D software demands some properties as bending, stretch, shear, friction, thickness and weight. The results obtained from physical analyses were interpreted to the 3D program considering physical and organoleptic tests, and then the data were entered in the 3D program and after, the dresses were simulated. The real and virtual dresses are shown on the Fig. 11-12.

Fig. 11*: Real and visual leather dress*

Fig. 12*: Real and visual cotton fabric dress*

In 3D program clothes are virtually sewn on the avatars, but clothes should be physically worn by human in real life after sewing. That's why 3D programs sometimes couldn't simulate wearing comfort in the reality. In this study, the dress was not designed with long sleeves because leather and cotton fabric are not elastic like some fabrics. Thus, this dress can be worn comfortably by human. And for the same comfort reasons, the dress was designed with a zipper from back of the neck to the hip. Then the virtual and the manufactured dresses were compared and done critics by experts. It was concluded that the virtual and real appearances were very similar. But the most important thing is defining the material properties right. Leather is an anisotropic material, the strength and stretch properties change directionally and locational over the area of the leather [18] and one to the other even from the same batch. The parameters of the program in which are available for standard textile fabrics should be adjusted in accordance with the leather type and properties.

5. CONCLUSIONS

In this study, which we presented the process of 3D virtual prototyping of dress based on a 3D body scan model and then the real and virtual models were compared to each other, the following conclusions were came out as outputs:

- The success of apparel begins with right body measurements. Using a 3D body scanning system provides possibility to obtain individual measures perfectly to match with dress measures.
- 3D body scanning systems make it possible to create realistic avatars in short time with precision.
  - 3D Visualization and Simulation programs need and have a rich material database. However the variety of leather material is not defined enough.

- It is possible to interpret new material properties to 3D programs by using some data as bending, stretch, shear, friction, thickness and weight. Some physical tests can provide related information.
- Although the names and principle of the physical tests used in leather and textile are similar, they have different methods, patterns, sample measures which leads to obtain differences in results.
- It is possible to obtain realistic simulations comparable to in real world examples by interpreting the right material data.

As a final conclusion 3D virtual prototyping seems a promising potential in future manufacturing technologies by evaluating the fitting of garments in a simple and quick way, filling the gap between 3D pattern design and manufacturing, providing virtual demonstrations to customers and maybe for e-tailoring chains, but material properties and interpreting to software should be studied in detail.

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