DESCRIBING THE QUALITY OF FIT ON A 3D VIRTUAL MANNEQUIN USING AN ALGORITHM TO SIMULATE REAL FABRIC DRAPING BASE ON VARIOUS MATERIAL PROPERTIES

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ABSTRACT

The objective of research is to accurately simulate the virtual cloth draping by comparing real fabric draping on a physical mannequin with the virtual draping on a virtual mannequin. This research will aid the development of an algorithm, which will accurately describe draping for various fabric types by taking into account the mechanical properties of the fabric. Material behaviour depends on many factors including the fibre, yarn, manufacturing process, fabric weight, textile finish etc. For this study, five different fabric types with very different mechanical properties were selected and evaluated for all of the above fabric characteristics. Bending, shear and roughness properties were calculated using the KES system (Kawabata). This study will consider current research using the KES system to understand and simulate fabric folding on the virtual body. Testing will help to determine, which material properties have the largest impact on the fit of the garment. By developing an algorithm, which factors of the body type, material type and clothing function, it will be possible to determine how a specific type of clothing made from a particular type of material will fit on a specific body shape and size. A fit indicator will display areas of stress on the garment such as shoulders, chest, waist and hips. Using these data, CAD/CAM software can be used to develop garments that fit with a very high degree of accuracy. Therefore, research aims at providing an innovative solution for garment fitting, which will aid in the manufacture of clothing. Presented research will help the clothing industry by cutting the cost of the clothing manufacturing process and also reduce the cost spent on fitting. The manufacturing process can be made more efficient by virtual fitting of the garment, before the real clothing sample is made. Fitting software could be integrated into clothing retailer websites allowing customers to enter their biometric data and determine how the particular garment and material type would fit to their body.

Key Words: (VIRTUAL AVATAR, FABRIC PROPERTIES, CLOTHING BODY GAP)

1. RESEARCH BACKGROUND

In recent times, a lot of research into human body shapes has been done in an effort to improve garment fitting. However, current garment technologists do not have the necessary knowledge and experience of human anthropometry to take advantage of this new research. The clothing industry is moving very quickly ‘fast fashion’ and due to this much of the fitting is done using 3D virtual avatars. However, these avatars are a basic approximation of the human form and do not take into account true body fat distribution. Therefore, the use of such avatars can result in poorly fitting clothing. Many factors such as the type of material, the type of fibre and the finish of the fabric can affect the fit of clothing. Ethnic diversity is another factor which should be considered in the fitting of clothing. Clothing retailers based in countries which have a significant ethnic diversity, such as the United Kingdom, Germany, France and Spain, often have difficulty with proper and satisfactory fitting of clothing due to variance in body shapes between ethnicities. Every garment technologist has their own interpretation of how clothes should look and fit to the body which leads to a lot of variation [1-3].

This study also draws attention to the fact that the industrial process is very time-consuming and expensive, which is indirectly influenced by the high costs associated with renting professional models.
Hitherto virtual fitting does not take into account the real characteristics of materials and so it is difficult to carry out proper analysis of the suitability of the cloth for use in clothing. Parameters that characterize fabrics are usually the surface weight, fabric thickness, coefficient of friction, bending stiffness, form rigidity and fabric strength. All the above properties are included in fabric parameters in various CAD / CAM systems. The material's parameters are very important features for textile products as they affect cloth draping.
One of the methods used to determine the fabric's draping characteristic is to determine the amount of folds on a given cloth, the gravitational force on the folds and the bending angle of the folds. Therefore, the mutual interaction of the product's mass and it's bending stiffness determines how the fabric will form on the human figure. This property of flat textiles allows them to bend in different directions at the same time, allowing for a variety of spatial forms. This drapability allows for the cloth to be formed into desirable shapes.

The multidirectional drapability of the fabric is expressed by the formula

$$K = \frac{\pi r^2 - S}{\pi r^2 - r_1^2} . 100\% \quad (1),$$

where: S - sample shadow surface,
r - radius of the support disc,
r1 - sample radius.

Determining the correct multidirectional drapability is important as it affects the draping of the fabric. Literature review indicates that many CAD / CAM companies struggle to find the correct multidirectional drapability or the method used to determine this factor [4-5].

2. EXPERYMENTAL PART

The scope of this work is to develop a new algorithm which simulates real draping in the virtual world. The following stages will be used to help develop a new algorithm
1. Testing mechanical properties of materials using KES and FAST systems, and introduction of parameters to the CAD system [6-8].
2. A mannequin will be scanned firstly without clothes and then again when dressed in a sewn sample of clothing, e.g. blouse. These two scans can then be used to determine the space between the body and the clothing, in particular the areas of the arms, waist and hips [9-10].
3. The material's real drapability will be compared against a virtual simulation using the Lectra system. Cross-sections of a real mannequin both with and without blouse will be

compared against the same cross sections for the virtual mannequin with and without blouse. The front, back and side of the blouse will be considered. The upper body will be divided into three sections: arms, bust/waist and hips [9-10].

In order to better understand the importance of the mechanical properties of flat textile products, fabrics with different parameters will be used for testing. For this research, five different fabrics will be used with different characteristics in terms of the surface, weight, fibre composition, the finish and the weave of the fabric. All mechanical parameters of the fabrics will be determined using the Kawabata Evaluation System and FAST. Fabric analysis will be carried out very carefully [11-12].

In the next stage, the virtual drapability of the fabric will be compared with the real drapability. The multidirectional drapability formula will be amended to take into account the gap between the body and clothing. The gap between the body and garment is one of the physical parameters which discribes the comfort of a garment. This area of study will focus on the fabric thickness and also its mechanical properties. Virtual fitting is unable to determine how the fabric thickness interacts with the body, not only on the drape and fit but how the body reacts to the garment in different climates. The study will aim to derive an algorithm to determine the physical effect of the enviroment on the body if the fabric is too thick or too thin. Unfortunately, virtual fitting does not show how much space there is between the body and fabric, whereas this can be calculated with real life fitting. In this study only one layer of fabric will be considered, however it is important to note that a garment with several layers will have a different drape and also a different gap
For this research, the author has deliberately chosen to study the female upper body because the body-clothing gap will be greater below the breasts and the fabric will have various draping angles [13].

3. GENERAL QUALITY INDICATOR

The general quality indicator known as the numerical indicator represents the global value of a product from the perspective of the quality. The general usability index determines the usability of the product for a particular purpose or usefulness of the product for a specific purpose.
In addition to these general indicators, there are also indicators that characterize the product from the point of view of a certain group of features, such as the general indicators of durability, aesthetic qualities, and physiological properties.
The general indicator increases as the quality increases. The quality of the product increases with the increase of the intensity of the characteristic, for example, as the intensity of the analyzed feature increases, the quality of the product increases as well as the indicator of its quality increases.
The general indicator is derived from the individual output indications of such characteristics, which indicate a certain quality optimum occurring at the specific strength of a given feature, while the quality indicators grow continuously without indicating any maximum or minimum, for example, the fabric stiffness.

Fig 1. Drapeability vs stiffnes

In order to achieve the correct drapeability of the fabric on the body, the highest stiffness of the fabric is determined according the purpose, and the usefulness for a specific purpose is indicated by the fabrics whose stiffness approaches as closely as possible to the optimum stiffness of this product.

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