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Session Abstracts

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Flexible Piezoresistive Pressure Sensors for Smart Textiles

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Introduction

The development of smart textiles relies in many applications on the development of textile-integrated sensors. Flexible piezoresistive pressure sensors have many potential applications especially in sports science. In the applications for martial arts, flexible pressure sensors are mostly used to measure the impact of the contact [1-3]. Moreover, in order to monitor the performance of muscles during exercise, flexible pressure sensors integrated garments are researched [4]. The purpose of the present study is to build flexible pressure sensors for integration in smart textile products.

Materials and methods

For the sensors silver plated conductive fabric was used as electrodes, HDPE film (Linqstat) or conductive silicone were used as piezoresistive material. In order to obtain a piezoresistive material based pressure sensor, conductive material as electrode is placed on both sides of piezoresistive material [5]. Two bonding materials based on polyolefine provide the adhesion between piezoresistive material and electrodes. In hot press, the materials are put between two plates at specific temperature, pressure and time. Another bonding method is using and oven, with a minimum of pressure provided by a glass plate. In order to determine the temperature to be applied in the hot press, the melting point of Linqstat film was analysed with the Differential Scanning Calorimetry (DSC) technique.

Afterwards, the sensors were built according to the layout shown in Figure 1 with different temperatures, 10 seconds time and a pressure of 5 bar in the hot press method, 10 minutes in the method using the oven.

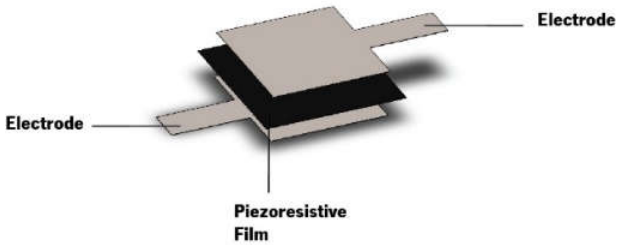

Figure 1. The construction of pressure sensors [6]

Results

With the hot press technique using one of the bonding materials, the conductive fabric and Linqstat layers were well bonded. However, when the sensor was tested, it was determined that the sample does not behave as pressure sensor. It might be due to modification in Linqstat's structure because of the high temperature (110 ºC) and pressure, producing the cancellation of the piezoresistive behaviour. The other bonding material fuses at a lower temperature. With this one , the piezoelectric effect was observed, but in a very unstable way, and with a very small response (small variation in electrical resistance).

Using the oven both materials provided well-bonded, functional and stable sensors.

Conclusions

It was found that both types of bonding materials can be used, but only using the oven with minimal pressure provides functional sensors. The paper will describe the results in more detail.

Acknowledgments

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Gait analysis by using smart textile socks

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Abstract
Human gate monitoring by means of foot plantar pressure measurements -could have numerous applications, such as post-operation rehabilitation and recovery assessment, abnormal gait condition detection, foot surface pressure monitoring for diabetic patients, and many more [1, 2]. Pressure plates, being typical plantar pressure monitoring systems, used in clinics, cannot be used for continuous patient monitoring due to the limited surface area. Pressure – sensitive insoles are, generally, suitable for out-of-lab measurements, but such devices are sensitive to folds and thus could not be used with orthopedic insoles or shoes. On top of that, both of these systems are rather expensive; due to this patients often have to use such devices under the direct supervision of medical staff. In recent years, smart textile based plantar pressure measurement systems have been studied worldwide as a possible alternative [3]. Such smart textile socks are rather inexpensive, they can be made to fit any foot size, can be used for a prolonged period, are washable and do not require a sophisticated data acquisition hardware [4]. Despite the above advantages, smart socks still are not widely used for gait analysis, as there is no well-established framework on how to use the limited number of sensors to detect differences in a step pattern.

This research proposes a new method for gait pattern evaluation and step type detection. For each step, a high dimension vector is constructed, which contains 44 extracted parameters, such as sensors on/off time, integrals of the individual sensor signal, ratios of different sensor signals, and so forth. This vector is then compared with reference vectors that were obtained from a set of recordings, corresponding to particular step patterns. The comparison was performed by sum of Manhattan distances, which allow evaluating the difference between two high dimension vectors [5]. Such approach allows evaluating how close a step is to a predefined gait pattern.

The proposed method for step analysis was verified by performing test-walks by three volunteers, wearing smart textile socks (cotton with elastane, silver-coated thread for wires, and Shieldex 117/17 thread for sensors) while walking normally or simulating excessive pronation, excessive supination or limping (1039 steps in total). Figure 1 demonstrates the Manhattan distances to the normal gait reference for each step of a single volunteer, for normal gait, gait with excessive pronation and gait with excessive supination. In the demonstrated case, the mean sum of Manhattan distances for a normal gait was 2.05 (std 0.95), for gait with pronation 4.64 (std 1.22), and for gait with supination 5.51 (std 0.93).

The preliminary results demonstrated that the proposed smart textile based method could be used for gait type analysis. A significant difference was observed between the reference and the steps of an abnormal gait.

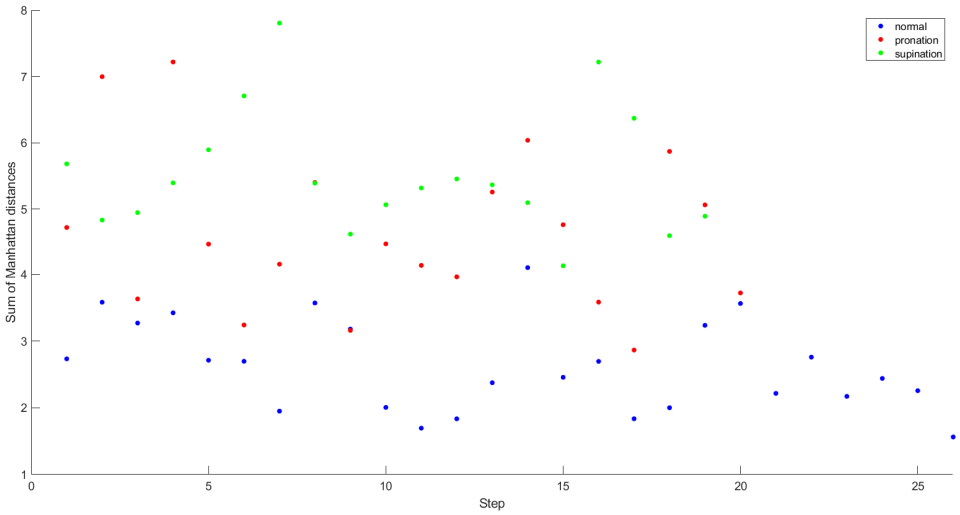

Figure 1. Sum of Manhattan distances between reference and normal step (blue), step with excessive pronation (red) and step with excessive supination (green)

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1. Presentation: **Oral**
2. Topic: **Textile Engineering**

Market readiness of smart textile structures – reliability and washability

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Abstract

Even if smart textiles gained a certain level of maturity, they are not yet ready for the market at large scale. The main issues explaining this are related to problems of reliability and difficulties to launder smart textile structures.

Smart textiles are also facing problems for launching in market due to lack of standardizations. This paper is focused on washability standards of smart textiles. The idea is to co relate some available mechanical tests with the washing of smart textiles and observe the change in their performance. First different washing functions and washing factors acting in washing machines are analyzed and discussed. Then Martindale abrasion test and pilling box tests were performed in order to detect damages similar to those provoked by washing process. In the first time, two different types of silver coated conductive threads sewn on cotton plain weave fabric are used. Changes in resistance during these tests are analyzed and correlated with conductivity after washing of the similar samples. Therefore, the mechanical stresses underwent by conductive threads during washing cycle have been identified and reproduced by standardized testing equipment.

More generally, this paper emphasizes all the problems, encompassing efforts that industry and research labs have to realize to make smart textile structures more robust and able to be cleaned or washed similarly to everyday textile products such as underwear, clothing, home textiles and even technical textiles. It gives indications on how the issues related to reliability and washability of smart textile structures have to be addressed in order to make them reliable and robust enough to be put on the market.

Sensory analysis: approach for total handle evaluation of wool-type fabrics

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For a long time, the fabric handle concept has been used in the textile and clothing supply chain as a description of fabric quality for a potential end-use. Nowadays, the interaction with the human senses is considered an essential performance property; so, the quality and sensorial characteristics of apparel fabrics are frequently evaluated by handle, leading to their subjective assessment [1]. Usually, the subjective assessment of fabric handle can be set up with trained panelists' experts and/or non-experts, and the applied methods are referred to as a descriptive analysis consisting of analytical method that describes attribute intensities. However, without minimizing the reliability assured mainly within the panel of experts, it is important not to forget the issue of consumers' perceptions regarding the fabric suitability for the end use. Therefore, it makes sense to develop a descriptive analysis including non-experts (with different backgrounds) as panelists for sensory analysis, pursuing the practical aspects of understanding the material and the impact of their perceptions within the supply chain [2, 3, 4, 5].
Taking into account the well-known definitions for fabric handle, the approach of fabric quality by means of sensory analysis is a common practice, due to the physical interaction with the textile product. Frequently, it was pointed out that sensory analysis method uses the human senses as "measurement device of tactile perceptions", mono-sense approaches being preferred [2, 3, 6]. Regarding the total handle, this is not a property in itself but it was defined as a summary of all the feelings of a person when handling the fabric, so obviously we cannot talk about mono-sense approach anymore. Therefore, the total handle subjective evaluated could be assessed because the overall sensory analysis allows emphasizing the overall perceptions of the fabrics properties linked to the sensorial comfort as handle attributes. Consequently, an overall fabric quality measure associated with fabric sensory properties, used by panelist as subjective judgment criterion, can be defined as Total Handle Value subjective evaluated (THVs) [6] .
A previous work approached the subject of wool-type fabrics selection for ensuring sensorial comfort in women's clothing, using the multi-criteria decision analysis based on a rating scale delivered by customers with knowledge in the textile field, but non-experts in the fabrics hand evaluation topic. The analysis criteria were three fabrics properties (flexibility, thickness and heaviness) tested by means of objective measurement techniques, linked to the sensorial comfort defined by three groups of bipolar attributes (flexible/stiff, thin/thick and light/heavy). The criteria grading was carried out according to the ranking of feelings when fabrics are virtually handled (just as the personal conduct). This ranking was achieved from a survey conducted on a sample of 187 women, regarding the preferences manifested when purchasing clothes and the importance of various sensory perceptions through handling materials used in clothing products. By means of multi-criteria decision analysis, the most adequate fabric to the worst choice fabric for manufacturing comfortable women office trousers wool-type designed for the cold season were ranked based on the assessment scale customized according to the survey results, without a real handling [7].

In this paper, sensory analysis techniques were applied for the same collection of wool-type fabrics, considering just the subjective assessment of Total Handle Value (THVs) by both, "handling" and "visualization-and-handling". To be consistent with the reality when it comes to the consumer niche demands, was considered that a reliable sensory analysis of the THVs could have a primary position in the process of fabrics' selection for the specific end-use, which is women office trousers for cold season.

The current study was aimed to analyze the results of subjective evaluation sessions for THVs, the sensory analysis being applied by a panel of master students, facilitated by professors and conducted in two successive stages: first by "handling" (as blind individual evaluation of each panelist) and afterwards, by "visualization-and-handling" (as visualization and consensus evaluation from the entire panel). Two interactive ICT-based learning tools previously developed have supported the sensory analysis of fabrics hand by means of THVs : STAT-Hand and STAT-ConCor. STAT-Hand (Statistical Analysis for Hand) useful to optimize the subjective evaluation in terms of the time spent for trials and a quicker processing of the results. STAT-ConCor (Statistical Analysis for Concordance and Correlation) is a software application with two facilities helpful to emphasize the agreement among evaluators within the panel, and the level of correlation between the individual and consensus evaluations.

The obtained results highlighted the sensitive aspects of the textile supply chain, which can turn from strengths to weaknesses due to the influence of the potential buyers' real preferences. Therefore, when developing marketing strategies it should take into account the subjective perception of the consumer niche on the sensorial comfort properties expectations.

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Options: *Oral*; *Topic 10: Textile Engineering*

Fabric physical properties and clothing comfort

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Aim of the research
Clothing comfort is one of the most important attributes of textile materials – importance as it and in terms of measurement of the comfort. Clothing comfort is understanding of interrelationship between fibre material, yarn structure, fabric structure, transmission characteristics (air, heat and moisture) and tactile aspects of textile materials on thermo-psychological and neurophysiological processes [1]. Fabric performance in terms of better skin comfort ought to be an essential requirement of materials which are used in contact with skin. Wear comfort has been listed as the most important property of clothing demanded by users and consumers according to recent studies [2]. Especially when discussion is about clothing worn in contact with skin – lingerie, sportswear and bed clothing. The aim of this research is to set fabric physical properties to predict skin comfort – search for appropriate testing methods and find shortcomings of existent methods.

Materials and methods
Comfort properties of lingerie fabrics for active load performance workers made of polyester, cellulosic fibers and their blends were studied by hotplate test according to ISO 110921 [3] providing water vapor transmission resistance (Ret) and thermal insulation (Rct), as well as moisture buffering capacity (Fi) as an additional measure of comfort and skin-friendliness. . Additionally, drying rate was measured gravimetrically. Moisture transportation property was measured by Absorbency Testing System (ATS) [4]. Skin-sensorial aspects were investigated using Tissue Softness Analyzer (TSA) [5] as well as an expert handfeel panel. The results were discussed in the light of workwear-specific technical and comfort requirements.

Results
Ret measurements showed higher vapor transfer resistance in fabric with vapor absorbing properties. If considered isolated from other properties, a polyester fabric would be misleadingly expected to provide more comfort than a cellulosic (Fig. 7). Thermal insulation values mostly depend on fabric construction and the existence of air gaps therein. Therefore, moisture buffering capacity (Fi) was also considered as a relevant criterion expressing the ability of the fabric material to absorb vapor off skin surface and hence supporting skin cooling mechanism. A similar observation was made in sensorial assessments. While pure physical measurement attribute to polyester high “softness” values, human hand recognize synthetic as such and test persons state more “softness” feeling with cellulosic. Under normal working conditions, vapor uptake is more relevant a property than the wicking of liquid. Under sweating conditions, wicking properties become more important. Polyester surface with some hydrophilicity can provide faster liquid transport than the swelling cellulosic fibers. Nevertheless, a combination of both fibers could provide synergy effects leading to faster transportation than the 100% fabrics.

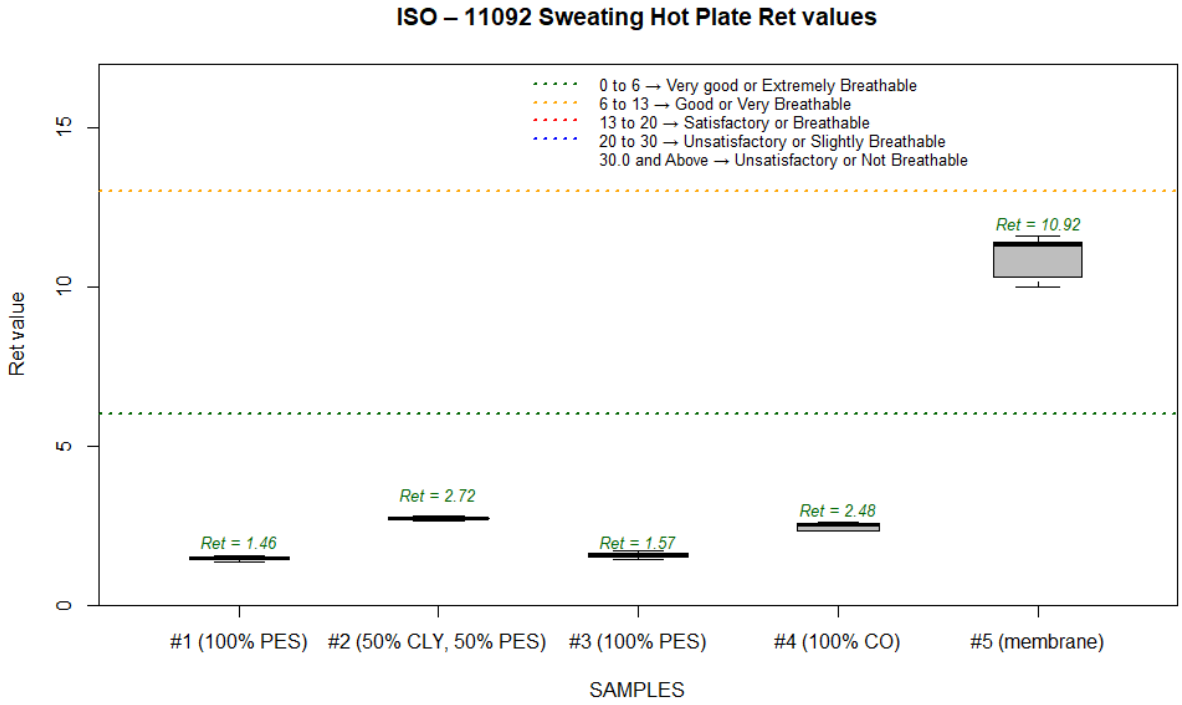

Figure 1. Ret values of different fabrics

Discussion and conclusions

To determine the level of comfort, objective and subjective methods must be used to determine the correct psychological, physiological and physical factors. It is not possible to obtain a complete quantitative assessment of comfort using isolated test methods. The effects of all five senses, the environment and textiles can have a significant effect on individual perception of clothing comfort. However, the characteristics of textiles that are useful to delimit those textile materials that are definitely affecting the comfort negatively can be determined with sufficient accuracy.

Acknowledgments

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Options indication
1. Indicate your option for the presentation: ***Oral****.*
2. Indicate the option for the topic: ***Textile Engineering***

Evaluating the Thermal Comfort Properties of Different Fabric Constructions in order to Develop New Shirts for Outdoor Sports

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Humans are endothermic organisms; they are less dependent on the external environmental temperature. In the body core (cranial, thoracic, abdominal cavities), the human body temperature is around 37 °C. In the extremities, it is lower and exhibits regional differences (28-36°C) [1]. In order to prevent heat stress during active sports, human body needs to lose a considerable amount of heat. Sweating is an important mechanism used by human body to provide heat dissipation. In order to contribute for thermoregulation of human body in active sports, the sportswear should support heat dissipation and promote an efficient transfer of the sweat from skin to atmosphere. In the designing process of active sports garments, not only the physical and comfort properties of fabric but also the human physiology during active sport should be considered. The sweating and thermal response of human body is an important research topic thoroughly analysed by different researchers [2-7].

The aim of the present research was the evaluation of the thermal comfort properties of different fabric constructions in terms of body parts in order to develop new shirts for outdoor sports in different climatic conditions. Within this scope, one fibre composition and six different knitting structures were chosen. The details of the compositions and knitting structures were given in Table 1.

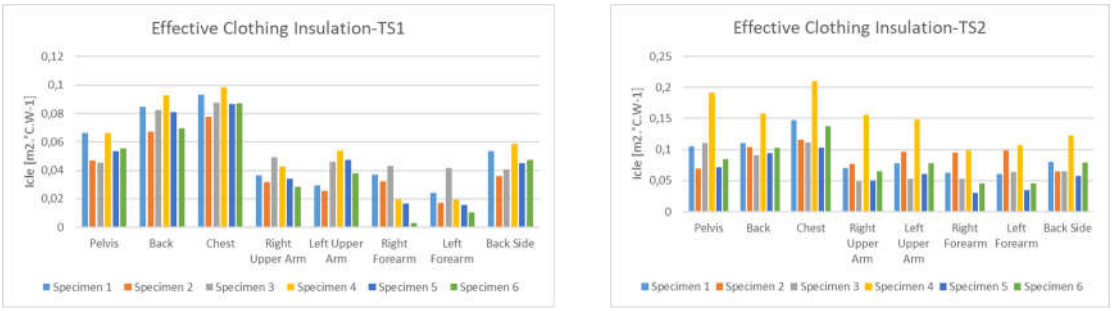
Table 1. The compositions, knitting structures and the codes of shirts

Specimens	Composition	Knitting Structures
Specimen 1	60% Polyamide	False Rib 1
Specimen 2	35% Polyester	False Rib 2
Specimen 3	5% Elastane	Single Jersey jacquard 1
Specimen 4	60% Polyamide	Single Jersey jacquard 2
Specimen 5	35% Polypropylene	Single Jersey jacquard 3
Specimen 6	5% Elastane	False Rib 3

In order to analyse the thermal properties of these fabrics, the thermal resistance (Rct) and the evaporative resistance (Ret) were measured using PERMETEST, and the air permeability was measured on a Textest FX 3300 instrument. Afterwards, six rounded-neck raglan sleeve tight-fitting shirts were manufactured from these fabrics. Due to the active sports garments evaluated in this research were chosen for outdoor sports, a water-repellent finishing treatment was applied to all specimens.

The shirts were tested by using a thermal manikin. A female model thermal manikin (PT-Teknik made in Denmark) was used in this study in order to develop heat in a homogeneous distribution. The tests were carried out according to "ISO 15831- Clothing - Physiological effects - Measurement of thermal insulation by means of a thermal manikin" standard. The trials were performed in constant skin temperature mode and the skin temperature of thermal manikin was set at 33 ±0,2°C.

Two climatic conditions were chosen in order to simulate the conditions for outdoor sports. The "Test Series 1" were performed in a climatic chamber at constant ambient temperature of 24,5±1°C and relative humidity of 60±5%. "Test series 2" were conducted also in a climatic chamber at constant ambient temperature of 19±1°C and relative humidity of 77±2%.



(a) (b)

Figure 1. Effective clothing insulation results according to body parts for all specimens (a) in Test Series 1 and (b) in Test Series 2

The results obtained from the fabric tests and thermal manikin tests were evaluated and compared graphically and statistically. Moreover, the effective clothing insulation results were calculated for eight body parts (Figure 1). The results indicated the optimum fabric construction for each body part involved in the shirt in different climatic conditions.

Key words: Thermal comfort, shirts for outdoor sports, thermal manikin, the air permeability, the thermal resistance, the evaporative resistance.

Acknowledgments
This work was supported by FEDER funds through the Competitivity Factors Operational Program - COMPETE and by national funds through FCT – Foundation for Science and Technology within the scope of the project POCI-01-0145-FEDER-007136.

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1. ***Oral presentation***
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Thermal Comfort Properties of Nonwoven Fabrics Used in Surgical Gowns

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Nonwoven fabrics are used for surgical gown applications due to their low cost, lightweight, durability, breathability, low hairiness and disposability. Multilayered nonwovens with membranes are used in disposable surgical gowns to enhance protection against fluids, aerosol, toxins and microorganisms to meet the needs of surgical applications. Clothing comfort is another aspect that need to be considered besides protection.

There is limited number of studies in the state of the art concerning the thermal comfort properties of nonwoven surgical gowns [1-5]. In this study, we have analysed thermal comfort properties of SMS (spunbond-meltblown-spunbond) fabrics with three different weights (35 g/m^2 , 50 g/m^2 and 80 g/m^2) and also evaluated the layered nonwoven structures with a breathable and water impermeable membrane. Alambeta was used to test thermal conductivity, thermal absorptivity, thermal resistance of the fabrics [6]. Permetest instrument was used to measure water vapour resistance and water vapour permeability according to the ISO 11092:2014 (sweating guarded-hotplate test) standard [7]. The air permeability of the samples was measured by using Prowhite test apparatus according to standard EN ISO 9237:199519 by applying 100 Pa constant air pressure and 20 cm^2 sample size[8]. As a result of the study, fabric weight and layered structure had been found to have an important effect on the comfort properties of nonwoven fabrics.

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The Importance of a Comparative thermophysiological study in female jeans

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Abstract
The comfort of clothing is essential as to performance relative to the wearer and is considered a quality factor in the choice of a particular garment. That is why the science of comfort is used to evaluate jeans, a symbol of popular fashion and the consumption of the poor classes of Brazil [1].
Therefore, the present paper consists of the presentation of the experimental phase of a PhD research on the study of the comfort of Brazilian female jeans, specifically referring to thermal comfort tests through the use of equipment such as Permetest, Alambeta and Thermal Manikin for measuring thermophysiological comfort properties.
The popular jeans in question refers to jeans created, produced and consumed by the popular poor class of the Northeast region of Brazil, with the main focus being the items sold at fairs and popular markets in Fortaleza, Ceará state, where fashion popular jeans have stood out due to economic incomes, job creation and income for the poor populations of the peripheral and rural urban areas of the cities of Ceará [2].
The aim of this research is to compare five different models of jeans used by consumers in order to carry out an analysis of the products offered in popular markets, taking into account thermo-physiological aspects, such as air permeability, thermal resistance and moisture behavior, in order to establish an understanding of the comfort characteristics that the female target population using this specific product choose.
The relevance of this research lies in the analysis of this type of jeans that are being offered in the popular markets, determining the most demanded jeans regarding comfort conditions in the scope of combine the study of science of comfort and fashion concepts in the Brazilian popular fashion market and even worldwide.

Materials and methods
The study is based on the methodology of ISO 11092: 2014 [3]. The methodology of evaluation of the physiological evaluation of clothing is organized in five levels. For this stage of research, we applied the techniques level 1, the physical-mechanical analysis of the materials (using testing equipment) and level 2, the biophysical analysis of the garment (using thermal manikin).
Five models of women's jeans were purchased in the popular shopping centers of Fortaleza, Buraco da Gia and Beco da Poeira in Forteleza/Brazil.
In order to analyse the thermal properties of these fabrics, the thermal resistance (Rct) and the evaporative resistance (Ret) were measured using PERMETEST, and the air permeability was measured on a Textest FX 3300 instrument. [4] and the measurement of thermal resistance with the use of Thermal Manikin[5].

Results and conclusions
The results show that the raw material, the structures, the construction of the fabrics, as well as the type of industrial washing influence the thermophysiological properties of the different tested models of jeans (table1).

Table 1 – Jeans description

Jeans Models	Jeans1	Jeans 2	Jeans 3	Jeans 4	Jeans 5
Image					
Composition	98%contton 2%spandex	77%contton 21%polyester 2% spandex	98%contton 2% spandex	96,5%contton 3,5% spandex	77%contton 21%polyester 2% spandex
Structure	Twill(2/1 1)	Twill (2/1 1)	Twill (3/1 1)	Twill (3/1 1)	Twill (3/1 1)

By means of the evaluations of the parameters described above the jeans presented the following data:
Jeans 1 showed lower air permeability, lower heat absorption and higher thermal insulation.
Jeans 3 presented higher air permeability, higher heat absorption and lower thermal insulation.
Jeans 1 and jeans 2 showed very close data in all parameters analysed. It can be said that they are statistically the same.
It was possible to conclude that the objective evaluation of the comfort of popular clothing and specifically of jeans designed, produced and sold in Brazilian popular markets is unprecedented and that there is much to research, study and to learn from the popular fashion universe of the Brazilian Northeast.

Future perspectives

In further studies we will compare the results obtained through objective evaluation with data obtained through subjective evaluation using a inquiry and scales. This study is also important for the producers and traders of Fortaleza of this type of product in order to contribute to the development of this huge market.

Acknowledgments

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The influence of human body posture on the determination of total dimensions (morphological characteristics)

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Aim of the research

Size labelling rules [1] support satisfaction ability of multiform anthropometric demand of clothes for different consumers allowing various height, girth and drop interval combinations if suppliers would comprehend complexity of the applicable demand. For sizing and ensurance of uniformity and fit of uniforms and work wear most important body measurements (primary and secondary dimensions) are used. Anthropometry studies the total dimensions of the body - total morphological characteristics which comprise the major anthropometric indicators: body height, chest circumference, and body mass. They reflect the external form of a human body and are the most significant indicators of physical development, therefore, their interrelationships are investigated.

Among the end users of garment standardized to the fit range, no one would have encountered the disproportion between the actual values of his unique body measurements and the average value of the standard intervals in proportion to the standardized dimensions of the designed apparel. If the measurement is made inaccurate or inappropriate to the patternmaker's method and/or practice, it may turn out to be in another fit range and the end product is inappropriate for the recipient (end-user), thus wearing comfort would not be provided [2].

The aim of this research is investigation of chest circumference – factors affecting the precision of measurements and differences between contact (manual methods) and noncontact/optical (3D scanning) anthropometrical methods.

Materials and methods

The target group or the subjects of the performed research is Latvian National Armed Force soldiers - a group of 171 men. Measurements of subjects were obtained using both methods, for the contact method using measuring tape and anthropometer, but for the noncontact method using 3D anthropometrical scanner Vitus Smart XXL® (©Human Solutions GmbH and VITRONIC GmbH) with data processing system AnthroScan.

Results

The research deals with the comparison of the 3D and manual chest girths by calculating and analysing measurement differences. In order to identify any regularities between the measurement differences, the posture of the subjects was analysed, by determining stature indicators. For testing inclinations of standing posture and therefore appeared differences of chest circumference, different standing postures are measured for a separate group comprised of 22 men.

In the given example ('Figure 1'), the differences between measurements are small: 2-3 cm, however, patternmakers are used to use an axially perpendicular chest perimeter measure, mistakenly referred to as chest horizontal circumference which leads to untrue sizing.

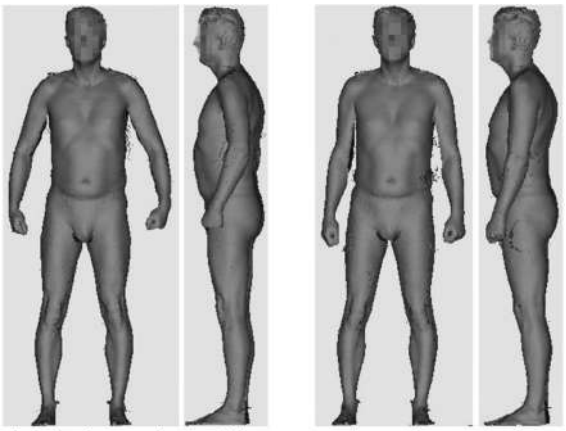

Figure 1. Different measurement positions – their affect to stand position.

Discussion and conclusions

As by manual anthropometric methods is hard (nearly impossible) to measure precise transversal measurement. By usage of human body laser scanning method, the transversal measurement is obtained precisely, therefore it is larger than manually measured. In the cases of the unique body measurement value is close to the boundary of the range of measurements, it causes problems with appropriate size picking for individual wearer.

The comparison of the 3D and manual chest girths, as well as the analysis of the results within the particular group confirm the assumption that the manual chest girth would be closer to the chest girth perpendicular to the axis of the torso, rather than the horizontal chest girth.

The occurrence of chest girth differences as a result of the change of the position may be influenced by many different factors - the posture indicators, the amount of soft tissue and development of muscles, the breathing features, the precision of measuring tools and skills of the measurer, the individual behavior of the person to be measured, etc.

Acknowledgments

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Options indication

1. Indicate your option for the presentation: ***Oral****.*

2. Indicate the option for the ***topic:*** *5. Garment Engineering.*

An Investigation of Design of Twist Knot Drape Clothes

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Introduction
The twist knot is one of drapery types which are used in design and pattern making of ladies' clothing. A study about geometrical systems of pattern making this type draperies show that in the constructional systems there aren't any mathematically founded dependence between the diameter of the knot (Figure 1, top right) and the widths of the draped pieces in the place of twist (Figure 1, bottom right).

Aim
The paper presents and investigation of connection between the knot diameter and the widths of the draped pieces in the place of twist in design of patterns with twist knot draperies. The investigation has been made only for woven fabrics.

Investigation
The dependence between the knot diameter and the widths of the draped pieces in the place of twist is searched because it will made the design of patterns with twist knot draperies full systematized.
The systemized system has to be suitable for different fabrics with good drapability. By this reason four fabrics with good drapability but in different structures are chosen. From the four fabrics double rectangles in skew direction are cut in the sizes by width: 30, 25, 20 and 16.5 cm (at first the width of 15 cm was chosen, but the investigation has shown that for this type of draperies the minimal width has to be 16.5 cm). The pieces are twisted and the diameters of the knot are measured. For every combination five twist and measurements are made.
After the measurements the dependence the knot diameter and the widths of the draped pieces in the place of twist has been obtained on the base of a linear regression made with STATISTICA 7.0.

Application
Fashion designs of ladies' dresses with different position and sizes of the twist knot are presented in the paper. Some designs combine the twist knot with other types of 3D elements.

Conclusion
The obtained dependence between the knot diameter and the widths of the draped pieces in the place of twist has made the design of patterns with twist knot draperies full systematized. The systematized pattern making system gives possibility for easy and correct pattern making of twist knot drape clothes. The system facilitates the process of fashion design and pattern making and gives possibility of variety of new designs twist knot drape clothes of especially on ready-to-wear industry.

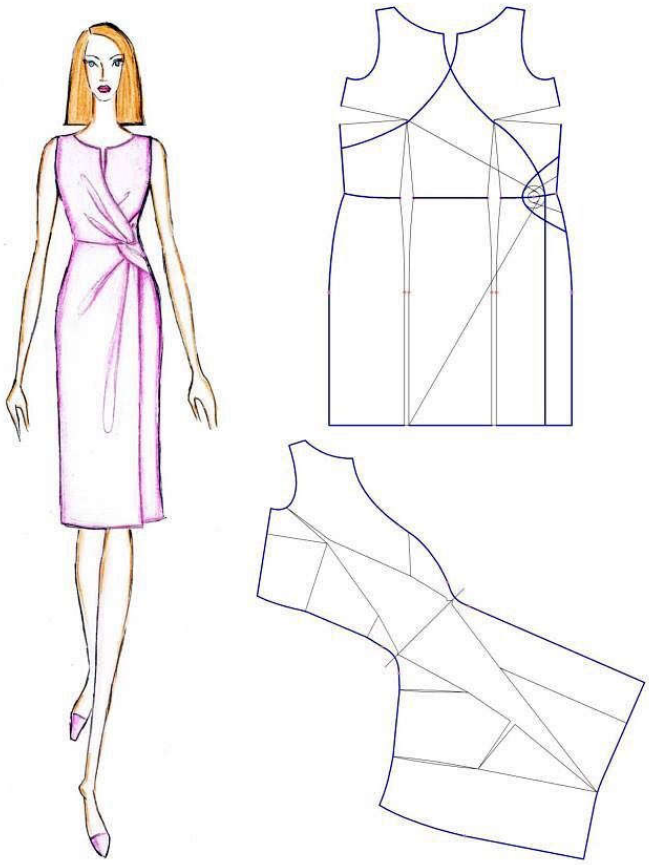

Figure 1. Design and pattern making of a twist knot drape dress.

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Options indication

1. ***Oral*** *presentation.*

2. ***Conference topic: Garment Engineering***

Integrating modern virtual engineering tools in footwear design and development

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Footwear products are assemblies of multi-material parts with very extended supply chains. Formulating effective product strategies dictates extensive analysis of a complex global operating macro-environment [1]. Aligning with fashion demands and understanding socio-cultural aspects of purchasing decisions is key to footwear development, however, there are more challenges to address: standardisation, performance, durability, comfort, consumer safety, environmental and sustainability issues, political and economic effects on material substitution and management of a very diverse human resources pool often extending across continents. The ability to effectively and efficiently develop products has become a competitive advantage [2]. Although the contribution of several business functions cannot be ignored, design is the heart of product development. It is a business process with inputs, outputs and performance metrics [3] (Figure 1). There are five stages in the design process: conceptualisation, concept screening, preliminary design, evaluation and improvement, prototyping and final design [3]. The modern view of Information and Communication Technology assisted Concurrent Engineering [4] has been considered in this paper.

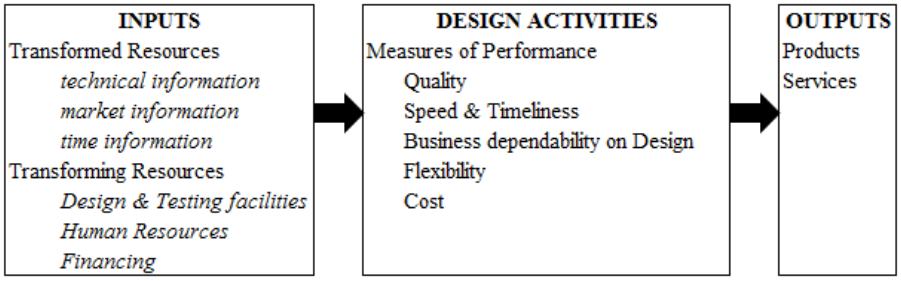

Figure 1. The Design Process (adjusted from Slack et al, 2016).

Prototyping (known as "sampling" in fashion) is key element in footwear design. However, it is constrained through significant volume of "sampling", time to market pressures, cost implications and the failure of the industry to attract and develop high quality product development professionals who master modern computer-aided product development. Given this situation and considering the advances in engineering, the question is how to best integrate computer-aided product development into the footwear design function. Relevant frameworks range from managing incremental improvement to radical re-establishment of processes [5]. A brief presentation of the capabilities and

limitations of modern ICT solutions that support footwear design is presented, while the failure of the footwear industry to integrate Computer-Aided Engineering (CAE) and Computer-Aided Material Selection into their processes is recognised. In this paper, modern footwear design is revisited in the light of material selection and CAE advances and alternative practices that will facilitate increased effectiveness and efficiency of the process are identified. The role of the other two transforming resources, which are human resources and financing, is also considered. Innovative approaches to harness the processing power of modern CAE tools at low or no cost are discussed along with proposals for changes in existing business practices.

Following the problem definition for the different sectors of the footwear industry and the scope of modern CAE and material selection, a review of the relevant key tools at commercial and research level is presented along with their limitations [6], [7], [8]. Then, proposed interventions to the design process, as modelled in this paper, for exploiting modern CAE and material selection tools are discussed, taking into account the Value Chain Model [9] and modern Cloud Service approaches [10]. The paper concludes with an overall assessment of the impact that the proposed changes may have on the footwear industry, as well as recommendations for policy making and future research and development work by academic, training, software developers and industrial establishments and organisations.

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Options indication

1. Oral

2. Topic 5. Garment Engineering

Hierarchical fit criteria of Made-to-measure men shirt with virtual technology

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Introduction

As the prevalent trends in fashion market, the mass customization with peculiarity to individuals has been developed[1], facilitated with new technologies such as 3D body scanning, 3D virtual try-on, artificial intelligent, etc. Even though, precisely predicting the fit and appearance of Made-to-measure (MtM) garments before production is still tough problem for designers and pattern makers. To improve the fit of personalized garments in a comparatively shortened duration, this research is aimed to propose a fit criteria and corresponding pattern block drafting methods concerning the men shirts styles and male body shapes with virtual try-on technology. Figure 1 shows the framework of investigating hierarchical fit criteria of virtual system "body-shirt".

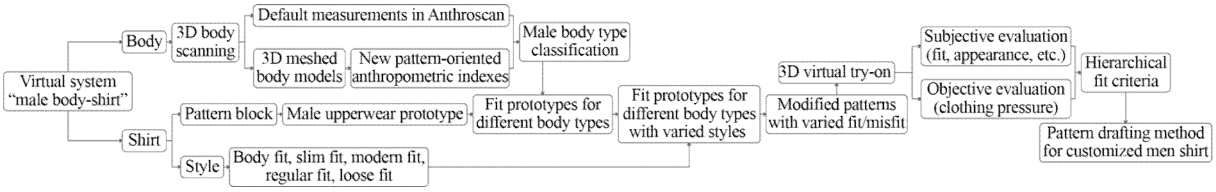

Figure 1. The framework of investigating the hierarchical fit criteria

Methods

In the virtual environment, the "male body-shirt" is employed as a system considering that the fit and the clothing appearance is revealed under the synergy effects of body morphology, pattern blocks, shirt styles, etc. In this research, the following primary materials are leveraged: 3D body scanner VITUS Smart XXL for capturing 3D body data, Anthroscan for generating default body measurements and 3D meshed body models, ET CAD 2012 for drafting 2D patterns, Rhinoceros for marking the feature points and measuring complementary indexes, CLO 3D for 3D virtual simulation.

Male body type classification based on new anthropometric indexes

According to the Chinese standard sizing systems for garments (GB/T 1335.1-2008)[2], the essential body measurements utilized for men's wear are height, bust girth, waist girth, hip girth, arm length, neck girth, etc, which is far from adequacy for MtM garments. Thus, 119 male bodies without physiological defects at the age of 18 to 30 were recruited to accomplish the 3D body scanning. New pattern-oriented anthropometric indexes were acquired partially from the default measurements in Anthroscan, and partially from manual measurements with 3D meshed body models in Rhinoceros.

Additionally, the indexes subordinate to different body segments (neck, shoulder, torso, arm, etc) were classified into various clusters with unsupervised machine learning technologies.

Shirt styles with hierarchical ease parameters

On account of that varied clothing styles have various acceptable ease ranges[3], shirts in five styles were investigated synchronously to comprehensively reflect the fit and the appearance variants. Hierarchical ease values of different body locations contribute to various shirt styles, the eases to half waist girth (EWG) of five styles were shown in Figure 2 as an example.

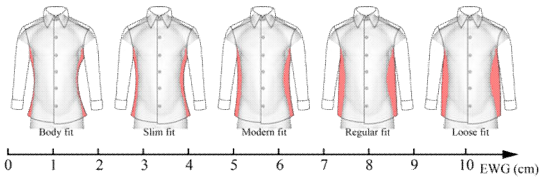

Figure 2. Five shirt styles with different eases to half waist girth (EWG).

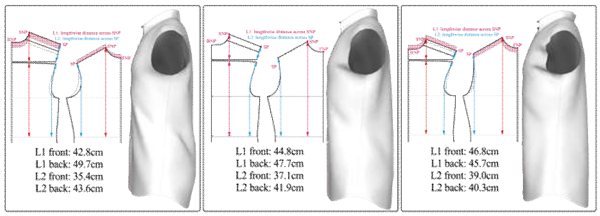

Figure 3. Patterns and profile appearances of shirt with stagewise proportion of front and back lengthwise distance

Shirt pattern blocks

In consideration of the new anthropometric indexes, five pattern prototypes of hierarchical eases were sketched, with which patterns fit different body types and sizes were obtained after corrections and virtual simulations. Based on these fitting patterns, the ease values were modified gradually with the interval (0.5 cm) by increasing and decreasing the values. Thus the database of patterns of varied fit was established.

Subjective and objective evaluations based on virtual try-on results

With patterns of varied fit, the virtual simulated shirts were dressed on the 3D scanned body models pertaining to different range of body types and sizes. Accompanied by the subjective evaluations of numerical clothing pressure, the objective evaluations were conducted simultaneously by scoring the fit of the shirt appearances by experts. The fit indicator includes the evaluation of fold, proportion, verticality of seams, etc. Hereby, the hierarchical fit schedule with the acceptable variants for certain body types and shirt styles was proposed.

Results and discussion

Through competitive neural networks, the shapes of neck, shoulder, armhole were classified into 4, 3, 2 categories respectively, and the proportion of front and back length, and of front girth and back girth were classified into 3 and 4 categories respectively.

Moreover, the fit pattern prototypes for varied body types and shirt styles and modified patterns with misfit features were drafted and imported into CLO 3D to attain the virtual shirt. When modifying the ease indicators, the fit or misfit features will appear particularly. Figure 3 shows the varied appearance of shirts with stagewise proportions of front and back lengthwise distances.

Conclusion

This research proposes the hierarchical fit criteria of MtM men shirt in consideration of the male body types and shirt styles. With these criteria, pattern maker or intellectual CAD will be able to draft the customized patterns accurately in desired style and fit for a certain consumer. The new classification of male body parts will be helpful to design other kind of individualized clothes.

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Options indication

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Analysis of bodily differences to design children's clothing

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Introduction

It is very recent in the history of garment the perception of its construction as a design project. As soon as clothing started to be perceived in these terms, other concepts were being introduced in, incorporating new knowledge such as anthropometry and ergonomics combined with comfort science and safety. When it comes to children's clothing, the process requires more attention from the designer, due the body of these users, not only having access to a table of consistent measures, but also being aware of their shapes. Many authors have been dedicated to analyze the body, its shape and scaling, but few bother to study the children's body targeted for clothing design. The characteristics of the user must be observed and evaluated, studied to meet the requirements of functionality, usability and comfort combined with the aesthetics of the product [1].

The purpose of this article is to identify the body shapes of Portuguese children at the 6-7 years-old and investigate what steps can be taken into consideration for the identification of those such shapes as published studies use to deal only with adult clothing. In addition, this paper aims to identify whether it is advisable to set a medium size for a measurement table that meets the 6-7 years-old body shape.

Material and methods

The data were obtained through an anthropometric survey of children from the northern region of Portugal of both genders, using the technological capability of 3D body scanner. About 700 children were measured in between 2 to 10 years-old, and such data is part of a doctoral thesis in fashion design in course, although the cut-off for this study are children of 6 and 7 years of age.

Hence, the final sample in this age group is of 138 children being 70 with six years and 67 with seven years of age. We do not take into account the gender issue because the measures tables published make no differentiation of boys and girls until the age of nine [2].

Existing studies for the analysis of biotypes of adults consider the following measures: height, circumferences of bust, waist and hips [3] [4]. For our analysis we consider the weight, in addition to these measures, to try to figure out how much the weight may influence the definition of the biotypes of the children.

Anthropometric data through the Body Scanner 3D technology

The systems that provide the measures necessary for clothing design have a software for acquisition and processing anthropometric data collected, as well as all volumetric data within a few seconds,

making the process efficient, effective, and quite fast. The creation of a database with statistical sampling of body segmentation enables the standardization of tables with real measures of the human body and thus offers to cater to a larger number of children, allowing optimization of production and the development of specific patternmakings.

The image-capturing system may display an error of 2 to 3 mm in depth, if the distance between the individual and the scanner is not in accordance with the parameters, or the infrared camera is not properly calibrated on the Kinect sensor. The calibration of the system is critical to the accuracy of the measurement, and should be performed whenever you start a study or there is an inadequate moviment of sensors. The calibration process goes through the use of a Target positioned in the middle of each pair of sensors, according to the instructions of the supplier. (KBI-Kinect Body Imaging-User's Manual) [5]. The child must be positioned between the Kinect capture sensors, on the center of an indicated carpet.

Statistical analysis consisted in the calculation of descriptive measures of children by age range and in checking, by means of non parametric test, if there was significant difference between the two age groups. The non parametric test was used since the variables considered did not follow normal distribution.

Significant difference was identified among children from 6 and 7 years-old for all measures, and in this way, the groups were treated on an individual basis. There was a clearly difference in measurements of children's bodies of 6 and 7 years, information that might be relevant for the clothing industry. However, it was found that there is na intersection between points, i.e. children from 6 years more developed, with the equivalent measures of 7 years, as well as children of 7 years with measures equivalent to the children of 6 years. For a description of the measures of children by age, cluster analysis was performed, considering two groups of children.

Conclusions

Through the measures of height, bust, waist, abdomen and hips circumferences, combined with the shapes registered from the body 3D scanner, we can define the proportions and shapes of the body of children between 6 and 7 years-old residents in the northern region of Portugal. With this infomation we can trace templates compatible with the anthropometric measurements of the Portuguese children and contribute to the clothing industry of Portugal. The proposition of tables of measures adapted to an specific target built in with a great coverage of consumers may generate a less number of pieces returned and may meet the expectations of its users. This fact contributes to enhance the satisfaction of the industry and the consumers and helps to protect the environment.

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Garment sizing appropriate for overweight and obese children: methodology stages and the preliminary results

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Introduction

This paper describes the methodology stages and the preliminary results of the garment sizing appropriate for overweight and obese children. It is part of an ongoing Ph.D. research in Textile Engineering at University of Minho, Portugal, which main goal is to develop appropriate clothing for this growing niche of the population, taking into consideration their ergonomic needs.
A limited offer of appropriate clothes leads this population to wear clothing for other age groups and body shapes. However, children's clothing manufacturers are not prepared to offer products to overweight and obese children. Although there is a need for designing adequate clothing for such children, few studies are being conducted. To develop appropriate garment sizing to support such industries, anthropometric studies should be carried out.

Methodology

The anthropometric data collection lasted 6 months, starting in June 2016 and ending in November 2016. It involved 816 children between 2 to 12 years old (434 boys and 381 girls). It is important to note that not all of these children belong to the target population of the study. Data from children that are not in the target group (overweight and obese) were excluded, and children from 2 to 4 were not considered, bad pictures. A final sample comprised of 205 overweight and obese children, located in 3 cities in the north of Portugal, aged from 5 to 12 years old, of both genders, was performed.
A 3D body scanning technology (KBI – Kinect Body Imaging system developed by researchers from University of North Texas at Denton) was used, providing quantitative data (body measurements) and qualitative data (body images), both of paramount relevance for this study. In addition to body measurements and images, weight and height data was collected.
Subsequently to data collection, for the purposes of this research, from the 110 body measurements provided by the KBI, 25 measures were used for statistical analysis. The following were selected 13 circumference measure: bust, waist, abdomen, hip, upper thigh, knee, calf, ankle, biceps, elbows, wrist, high-hip; 12 Height measure: bust, waist, abdomen, hip, thigh, calf, knee, shoulder width, shoulder depth, shirt sleeve, front neck to bust, front full length (neck-bust-waist).

Final considerations

Although 3D scanning system have been contributing to clothing industries, anthropometric studies are time-consuming, and adjustments for obtaining a valid and representative sample are needed. In this study, from an initial sample comprised of 816 children, only 205 were considered. However, such difficulties must be viewed as part of the learning process for conducting anthropometric studies. Such studies are of paramount relevance to the clothing industry, in order to support the design of appropriate clothing to specific populations.

Acknowledgments

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CONFERENCE HALL OF NORTH AEGEAN REGION

Multifunctional textiles by nanotechnology: Challenges and future prospects

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Introduction

With the advancement of science, textiles also have become innovative and high-tech. Traditionally, textiles are used as apparel to protect our body from the harmful effects of the external environment, and also to give warmth and comfort. Modern textiles provide performance and function, and can also be 'smart' in that they may be able to sense, react and adapt to the surrounding conditions [1, 2]. Future textiles will play a major role in maintaining our health and well-being by protecting us from infectious diseases, by sensing our activities and health conditions, providing us warmth by converting sunlight to heated energy and store the converted energy for the on-demand supply. Clearly, a huge opportunity exists for the development of innovative multifunctional textiles for high-value applications.

Textiles are made multi-functionalised textiles by various chemical treatments, for example, antimicrobial, fire retardant, antistatic, heat conductive, and also to protect us from UV, gamma, electromagnetic and X-ray radiations [3-7]. Even textile can harvest energy and can supply it on demand [8]. A single treatment that makes textiles multifunctional would be very attractive to the textile chemical processors, and nanotechnology plays an important role in this respect in the development of multifunctional textiles. A range of metallic nanoparticles, such as SiO_2, TiO_2, Ag, Cu, and Au, has been investigated to make wool, cotton and synthetic textiles multifunctional [9, 10]. Of them, silica (SiO_2) and silver (Ag) nanoparticles are particularly attractive. Various dye-doped silica nanoparticles not only make textiles hydrophobic but also multi-coloured. Similarly, Ag nanoparticles not only kill harmful pathogens, absorb UV and make the textiles antistatic, but also make them multicolored. However, there are many challenges that will need to be overcome to make them commercially feasible. This paper present critical review of the application of nanotechnology for the development of various multifunctional textiles, the key challenges, and future prospects.

Multi-functionalisation with silica nanoparticles

Silica nanoparticles have been extensively investigated to make textiles superhydrophobic, superhydrophilic and wrinkle resist [11]. Fan et al., reported that cotton fabric coated with silica nanoparticles modified with N-trimethoxysilylpropyl-N,N,N-trimethylammonium chloride not only made the fabric superhydrophilic but also increased its wrinkle recovery [12]. Textiles can be made multi-coloured by treating the fabric with various dye-doped silica nanoparticles [13]. Multi-coloured textiles can be produced using these fluorescent and non-fluorescent silica nanoparticles that may enhance the photo-stability of the treated fabrics. Fluorinated silica nanoparticles not only make textiles superhydrophobic but also provide antibacterial properties [14]. When applied on cellulosic

fabrics, silica nanoparticles-based treatments show strong durability to washing but their durability diminishes when applied on wool and polyester fabrics. Fig. 1 shows few examples of silica nanoparticle-coated multi-functionalised textiles.

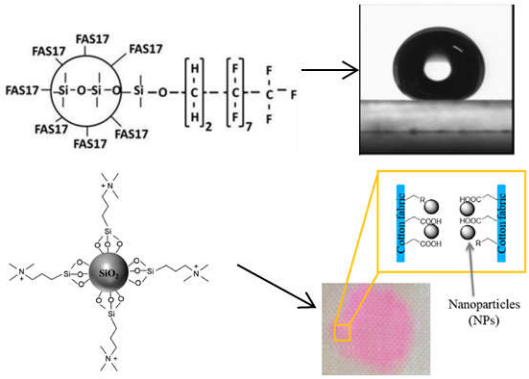

Fig. 1. Superhydrophobic (top) and superhydrophilic (bottom) textiles made with fluorinated and quaternary ammonium modified silica nanoparticles respectively [12].

Multifunctionalization with silver nanoparticles

Silver nanoparticle-treatments have been extensively investigated to make textiles multifunctional, such as multi-coloured, antibacterial, antistatic, and UV protective. Shrink-resist treated wool fabric coated with thioglycolic acid-capped silver nanoparticles not only showed excellent antibacterial properties but also made the fabric superhydrophilic and showed some levels of antifungal activity [15]. Textile fibres treated with silver nanoparticle not only makes them antibacterial but also multi-coloured, antistatic, UV-protective and antifungal. Fig 2 shows that multi-coloured textiles can be produced by treating them with silver nanoparticles with various shapes and sizes [16, 17].

Fig. 2. Different coloured textile made by treating silver nanoparticles of various shapes [16, 17].

Fig. 3 show the UV transmission through the fabric treated with the same weight (%) of silver and copper nanoparticles. It can be seen that silver (Ag)-treated fabric showed considerably lower UV transmission through the fabric compared to the fabric treated with copper (Cu) nanoparticles [17].

Multi-functionalisation with other nanomaterials

TiO_2 and ZnO_2 nanoparticles have been investigated to make textiles self-cleaning as TiO2 can produce hydroxyl radicals by the activation of solar irradiation, which can degrade the chromophore of dyes making them colourless [18]. On the other hand, silica nanoparticle-coated superhydrophobic textiles also can clean themselves through the so-called 'Lotus effect'. Recently graphene and reduced graphene oxide-based coatings draw attention. A reduced graphene oxide-coated cotton fabric showed

excellent electrical conductivity but the durability of the treatment considerably reduced after multiple washing [19].

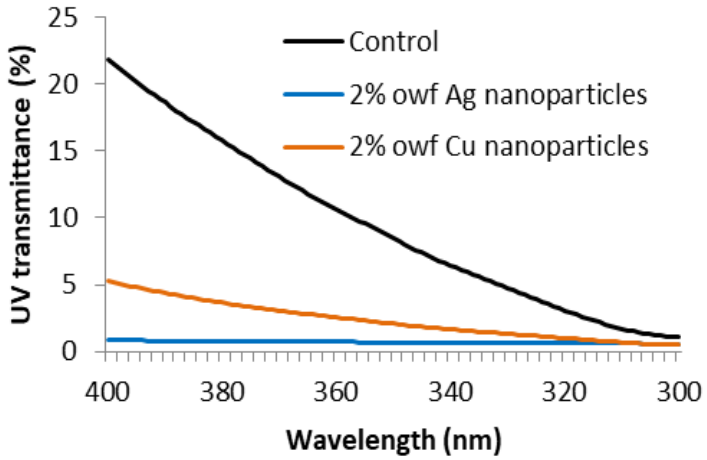

Fig. 3. UV transmittance through wool and cotton fabric treated with various metallic nanoparticles [17].

Key challenges

There are many key challenges for the successful industrial production and commercialization of these technologies. One of the most important factors is the production cost; some of them are prohibitively expensive. The colouration of textiles with nanogold or nanosilver could be one example and also the depth of the shade these nanoparticles can produce can be reproduced using traditional dyes at a fraction of the cost. Another challenge is the durability of the treatment as these nanoparticles mostly stay on the surface of the fibres or inside the fibres but near to the surface. Some of these nanostructured materials are moderately toxic and therefore they may pollute the environment.

Conclusions

Textiles can be made multi-functional by using nanotechnology by a single treatment but there are challenges that will need to be overcome to successfully commercialise them.

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CNTs incorporated textile materials & products

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Carbon nanotubes (CNTs) exhibit interesting properties such as temperature stability, mechanical strength and chemical inertness which render them important additives for both polymer nano-composites and fibers. The tubular structure of CNTs also provides structurally perfect and stable nano-channels with size at molecular dimensions. In this context, tailoring channel size at the nanoscale level allows tuning the interaction between diffusing molecules and CNT pore walls. Such physical and chemical properties of the nanocarbon filler material could enable tailoring of the gas and water vapor permeability leading to its applicability as selective membrane for a multitude of industrial applications, like filter systems, packaging and waterproof breathable fabrics. From the other side, it should be pointed out that despite the significant amount of scientific publications made towards producing high-performance fibers from polymer materials with the incorporation of CNTs, the mechanical properties still remain only a fraction of the expected theoretical values for these materials. The amount of end-use commercial or consumer products available in the market are very small comparing to the huge number of bibliography dealing with CNT/polymer fibers.

Since 2000, we have been involved in the development and characterization of innovative textile materials and products, such as specialty antimicrobial textiles [1], bioactive surgical sutures [2], single stage scalable tinctorial capacity on chemically modified cotton yarns/fabrics and particularly breathable non-woven synthetic products [3] & protective textiles for high risk professions [4].

In the 1st part, in the field of breathable polymeric films, we will present the water vapor transport through melt mixed polyolefin membranes containing CNTs of varying filler concentration and filler-matrix compatibility correlating their transport properties with the filler dispersion level.

In the 2nd part, in the field of protective textiles, the challenge is the use of new materials that improve the overall properties of the fabric while decreasing the overall weight. Fabrics based on CNTs reinforced PET fibers is an option that possesses the potential of fulfilling the challenges stated as they use low density materials which in principle exhibit striking mechanical properties taking into account both flexibility and toughness. In particular multifilament CNT reinforced PET fibers may be an excellent choice as: (i) multifilament fibers have in general superior macroscopic mechanical properties with respect to monofilament ones and (ii) despite the fact that a number of research studies indicate the enhanced monofilament CNT reinforced PET properties polymeric fibers [4], there is no known studies and/or commercial products based on similar weaved multifilament fabrics.

Specific competences and methods, already developed, will be also suggested how they could be assessed being applied to manufactured articles. We refer to the evaluation of the weight fraction CNTs in polymer composites [5], the estimation of the molecular orientation of drawn polymers & CNTs [6] as well as the characterization of CNTs at quite low concentration range by SERS in water purification applications, where there are chances of product water getting contaminated with CNTs [7].

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Thiocarbazole-based gold nanoparticles: synthesis, characterization and anti-proliferative activity evalutation.

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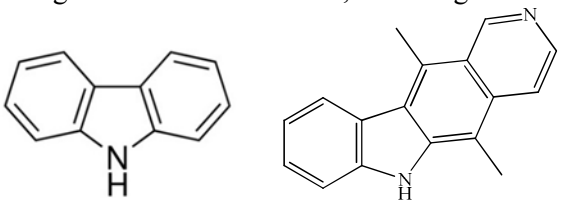
Abstract
Carbazoles are aromatic heterocyclic compounds derived from the fusion of a benzene ring with an indole nucleus in position 2,3 (Figure 1a). Today, many carbazole derivatives are widely used as antioxidants, anti-fungal, photoconductor, anti-bacterial, antimalarials, anti-tuberculosis, anti-HIV agents and for obesity's treatment. Some of them, differently substituted, have been synthetized and their biological activity have been evaluated.[1] Ellipticine, a vegetable alkaloid with a carbazole backbone (figure 1b), isolated from the leaves of Elliptica Ochrosia, is well-known for its marked antitumor activity, exerted through different mechanisms, including inhibition of the topoisomerases.



(a) (b)

Figure 2. (a) General structure of carbazoles. (b) Chemical structure of Ellipticine.

However, the presence of side effects limits its use, as well as for some of its derivatives, in clinic therapy.[2] Thus, over the years new carbazole derivatives were synthesized with the aim to cut down side effects and improving their biologic activities.
This work is focused on the creation of new N-thioalkylcarbazoles bearing on the nitrogen of the carbazolic core long alkyl chains up to seven, eight and nine carbon atoms, linked to a terminal thiol group, and various substituents on the carbons in position 1, 4 and 6 (figure 2).
Some of the synthesized compounds have shown anti-proliferative activity, due to the induction of the intrinsic apoptotic pathway, also known as mitochondrial pathway, in mammary MCF-7 and MDA and, to a greater extent, in uterine HeLa and Ishikawa tumor cell lines. The main advantage of these compounds may be ascribed to the absence of cytotoxic effect on non-tumoral cell lines MCF-10a and 3T3-L1, making them promising compounds in anti-cancer therapy.[3]

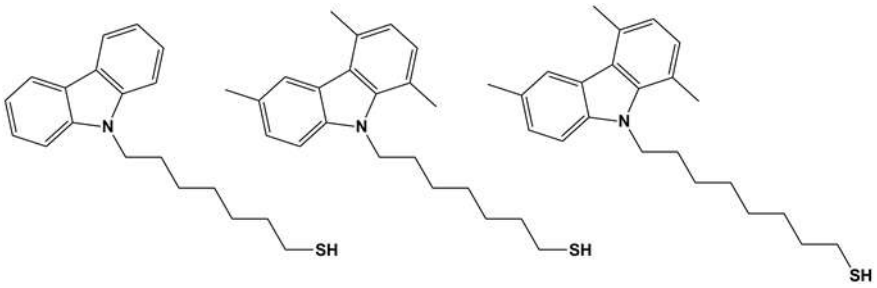


Figure 2. General chemical structures of the synthetized carbazole derivatives.

Finally these thiolcarbazole-based molecules have been used successfully as capping agents for gold nanoparticles synthesized in an organic solvent. The bond between the ligand and the nanoparticle exploits the known affinity of the terminal functional -SH group, suitable to act as stabilizing agents for the stabilization of gold nanoparticles with the formation of dynamic covalent Au-S bonds.

In this way, the formation of self-assembled monolayers of these ligands is obtained on the spherical surface of gold nanoparticles, with a stabilizing effect against aggregation. These systems might present a double innovative function, combining an antitumoral activity common of carbazoles, with the photothermal effects of gold nanoparticles

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Limits of carbon micro/nano particles utilization to improve properties of polymer matrices in fibre reinforced composites

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1. Introduction

This work focuses on the changes in properties of epoxy resin filled with five carbon forms in several volumes (graphene nanopellets, carbon particles from acrylic waste, and three different types of recycled carbon fibres). Main purpose is to enhance knowledge in influence of various carbon forms and their volume on final matrix structure and properties, and their applicability in fibre reinforced composites (FRC). Measurements show that all types of carbon particles influence matrix properties to a certain extent, as their presence activates overall structural changes in epoxy resins curing.

2. Experimental

2.1. Material

Epoxy specimens were made from Bisphenol A-based low viscosity epoxy resin, and cyklo-alifatic polyamine curing agent. As fillers were used following carbon materials: graphene nanopellets (GNP), milled carbon particles from acrylic waste (mCPAN), commercially available Carbiso Milled Carbon Fibres (CMF), nanomilled Carbiso (mCMF), and milled recycled carbon fibre from epoxy resin composites (mRCF). Epoxy specimen were filled with carbon particles in following concentrations: 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 wt% respectively. Higher concentration was not used due to striking increase of resin viscosity in 3wt%, which means it is useless as a fiber bonding in FRPC.

2.3.Methods of measurement

AC conductivity was measured using AGILENT 4294 according to ASTM D150-98:2015. Impact strength and energy were tested according to ISO 179-1:2010. Differential Scanning Calorimeter DSC6 (Perkin Elmer) was used to analyse glass transition of analysed set of filled epoxy specimen. Using dynamic mechanical analysis DMA DX04T (RMI) in 3PB mode the changes of elastic/plastic properties were scanned. Heat transfer was tested with Isomet 2114 - Thermal Properties.

3. Results

The measurements of epoxy resin filled with various carbon forms proved, that increase of particles' volume changes the properties of epoxy resin. As tested carbon fillings showed more or less similar behavior, and with respect to processing requirements on low viscosity of resin used as a composite bonding, we suggested 2.5wt% carbon filling as an optimum combination for both property improvement and matrix processability, and further experiments were done only for this filling volume. Overview of the results for 2.5wt% carbon filled epoxy resins is presented in Table 1.

Table 1. Selected properties of neat and carbon particles filled epoxy resin.

Properties	Neat Epoxy	GNP	mCPAN	CMF	mCMF	mRCF
AC conductivity x 10^{-8} [S.m^{-1}] at 10 kHz	13.4	9.12	7.55	18.2	8.34	8.51
AC conductivity x 10^{-7} [S.m^{-1}] at 100 kHz	16.2	11.2	9.10	22.1	9.51	10.0
AC conductivity x 10^{-5} [S.m^{-1}] at 1000 kHz	1.62	1.24	0.99	2.35	1.06	1.07
Impact strength [kJ.m^{-2}]	38.27	57.02	34.6	66.41	39.43	34.50
Flexural modulus [GPa]	3.28	3.45	3.31	3.78	3.52	3.33
Tensile modulus [GPa] calculated from 3PB	3.55	3.21	3.22	4.01	3.04	3.23
Tg [°C]	58.75	54.56	57.12	57.46	49.54	53.63
Thermal conductivity λ [W.m^{-1}.K^{-1}]	0.101	0.215	0.195	0.203	0.208	0.192

4. Conclusioons

Achieved results show, that limits of carbon micro/nanoparticles utilization as matrix filling in FRPC are derived from processing parameters based on resin viscosity, and from morphology of carbon particles. The fibrous particles (2D) exhibits better influence comparing to bulk particles (3D). Significant is also market price of selected fillings, which points to milled recycled fibers (CMF) as not only cost-effective but also environmentally friendly filling prepared from recycled carbon fibre wastes. Use of such material supports the ecological aspects in design, development, and processing of new fiber/polymer composites.

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Data Envelopment Analysis for Cities Efficiency

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Abstract- This paper discusses the envelopment analysis for selected cities. It uses the DEA (Data Envelopment Analysis) for both input and output oriented methods using a data set of 176 cities and tests several classifiers in classifying the dataset using both cross-validation and percentage split.

1. The Approach

The approach starts by obtaining dataset which contains 176 DMU. Each DMU represents a country with 14 attributes as input and 5 attribute as output. The attributes are { Real per capita GDP(Gross Domestic Product), Real per capita GDP growth, Population, Growth in population, Secondary school enrollment rates, IMF indicator of capital account restrictions, Institutional Investor Risk Ratings, Trade openness (exports + imports)/GDP, Financial openness (financial account inflows + financial account outflows)/GDP, Capital inflows (Inward FDI + inward portfolio + inward other)/GDP, Correlation of annual growth rates with OECD (Organization for Economic Cooperation and Development) average annual growth rates, Average annual growth rate of GDP deflator, Proportion of population speaking English, Proportion of population speaking major European language, Total ODA from all sources, Real per capita GNP, Oil export, Non-Oil Commodity Exporters, Ethnolinguistic fractionalization } and delete these fields from the dataset { Investment to GDP at PPP, Terms of trade shock (Growth in export deflator minus growth in import deflator, weighted by current LCU shares of exports and imports in GDP), Unweighted terms of trade shock }. The work is divided into these main parts:

A. *Data preprocessing:* The dataset is not ready for DEA yet many had to be done first some attribute removed others normalized to remove negative numbers since DEA does not deal with negative numbers , the dataset also contain missing values which filled with the attribute average, after that the dataset is ready for efficiency calculation.
B. *Efficiency calculation:* The efficiency calculated for the cities using input and output oriented and both CRS and VRS using EMS (Efficiency Measuring System).
C. *Classification:* After calculating the efficiency for the DMUs, the approach classifies the DMUs using the DMUs efficiency as class using the classifiers: Decision tree (J48), K nearest neighbor (KNN), Support vector machine (SVM) and Naïvebayse using both cross-validation and percentage-split for the dataset. The result is shown in table 1.

Table 1. The classifiers along with the accuracy using both Cross-validation and percentage-split

	Classifier	Accuracy Cross Validation	Accuracy Percentage Split
1	J48	85.2273 %	75 %
2	Naive Bayes	74.4318 %	78.3333 %
3	SVM	86.9318 %	75 %
4	KNN-9-1	86.9318 %	75 %

As shown in the table, the best classifiers are the SVM and KNN with K=9 which achieved an accuracy of 86.9318 %. The decision tree was the next and achieved an accuracy of 85.2273 %. Since the class is imbalanced in the dataset with 153 as efficient country and 23 as inefficient country, the SMOTE filter is used in Weka to balanced data. Table 2 shows the results after balancing the data.

Table 2. The classifiers along with the accuracy using both Cross-validation and percentage-split for each classifier after balancing the data for each class.

	Classifier	Accuracy Cross Validation	Accuracy Percentage Split
1	J48	87.2131 %	89.4231 %
2	Naive Bayes	74.4262 %	75 %
3	SVM	79.6721 %	75 %
4	KNN-4	83.2787 %	79.8077 %

The table shows that the best classifier is the decision tree with accuracy 89.4231 % followed by KNN with K=4 and accuracy = 83.2787 %.

D. Clustering: The K-mean cluster is used for clustering and the results are shown in Table 3.

Table 3. The clustering accuracy.

	Clusterer	Accuracy
1	K-mean	Incorrectly clustered instances : 45.2459% Correctly clustered instances : 54.7541%

III. Conclusion

This paper has discussed the envelopment analysis for a number of cities using a number of classifiers. The paper has shown that both input and output oriented DEA achieves almost the same result. The best classifiers were the support vector machine and k nearest neighbor in the unsmoothed data with accuracy of 86.9318 %. In the smoothed data, the best classifier was the decision tree with accuracy of 89.4231 %. However, the clustering shows a low accuracy of 54.7541% using the K-means.

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Automated News Categorization using Machine Learning Methods

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Being one of the most linguistically rich languages, Azerbaijani has been researched less in the context of natural language processing area. The text corpus created from Azerbaijani news articles is designed to apply supervised machine learning approaches for the case of automatic news labeling. Chi-squared test and LASSO methods have been implemented for feature selection and pre-processing. The application of supervised machine learning approaches to the text corpus allowed us to compare the performance results of well-established supervised machine learning approaches in the domain of Azerbaijani language.

The feature selection techniques reduce the burden of the classifiers in terms of choosing relevant features for classification. Namely, classifiers have been shown to perform better when they are provided with less and more important features. Chi-squared is a well-known statistical approach to measure the relation between each feature and target class. By taking the chi-squared test values of each feature and ordering them by descending order, we can select n features with highest values. Extracting relevant features, we got 88.6% accuracy with SVM which is 0.7% more than the accuracy result of SVM with tf-idf vectorization.

Least absolute shrinkage and selection operator is a well-known approach to feature selection. It applies the following l1 penalty to ordinary minimized sum of squares method:

$$\lambda \sum_{i=1}^{N} |\beta_i|$$

N denotes the number of features and λ denotes the regularization parameter. Choosing high values of λ makes the weights assigned to features go to zero. If we choose the parameter appropriately, only the features relevant for the classification have coefficients different from zero. In our case, extracting features with LASSO increased the accuracy of naïve Bayes classifier from 71.5% to 76.9% while it increased the SVM classifiers accuracy from 87.9% to 88.5%.

Firstly, we trained the naive Bayes classifier with count vectorization method. Bayes rule is at the core of naïve Bayes Classifier. In order this rule to work, it is assumed that features are independent of each other. As words are connected semantically in news articles, this assumption does not hold true. Regardless of that, for text classification problems naïve Bayes classifiers gives reasonable accuracy results. For instance, on famous 20 Newsgroups and WebKB datasets, it shows 85% and 86% prediction accuracy respectively.

By applying naive Bayes, the highest accuracy we got was 80.4%. This accuracy is achieved by applying count vectorization as feature extraction. The least accuracy observed was by using tf-idf approach with Naïve Bayes as seen in Fig.1. We can also observe from figure 1 that the most successful feature selection approach was chi-squared test with accuracy result of 79.6%.

Applying support vector machines (SVM) was the next goal for us. The prediction accuracy of SVM for other datasets is shown to be very high as it can handle classification problems with high feature space sizes. For our case also, SVM showed high performance results (88,3%).

Artificial Neural networks have been implemented in various settings and for solving a variety of problems. Text classification is amongst them and artificial neural networks is proven to perform well in this domain [13]. Artificial neural networks can be arbitrarily complex in terms of architecture. Therefore, getting highly accurate results can be computationally expensive. In order to make the calculations less expensive and to make the architecture more compact, the feature selection is a reasonable approach in text classification as it enables to deploy less and more influential features to the artificial neural network. Artificial neural network model gave 86.3% accuracy result on Azerbaijani news article dataset. Application of feature selection namely, Chi squared test increased the accuracy of artificial neural networks by 2.8%.

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Options indication

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Speeding DBLP Querying Using Hadoop and Spark

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Abstract
Big data is becoming bigger every day. Even for simple applications such as the DPLB database, the data is becoming unmanageable using the conventional databases because of its size. Applying big data processing methods such as Hadoop and Spark is becoming more popular because of that. In this work, we investigate the use of Hadoop and Spark in the querying process of big data and we compare the performance of them in terms of their execution time. We use the DPLB database as a case study. Results show that Hadoop and Spark enhances the query execution time significantly when compared with conventional database management system. We also found that Spark enhances the execution time over Hadoop.

Introduction and Background Information
Big data is a term for data sets that are so large or complex for traditional data processing application software to deal with them [1]. Relational database management systems and desktop statistics and visualization packages often have difficulty handling big data. This processing may require parallel software running on maybe thousands of servers.

Big data solutions can be classified according to the approach used in storing and processing these data. The first approach is the traditional enterprise approach where an enterprise have a mainframe computer to store and process big data. The second approach is the MapReduce algorithm [2], which was proposed by Google. MapReduce divides the task into small parts and assigns them to many computers, and collects the results from them which when integrated, form the result dataset. Apache implemented the MapReduce approach into Apache Hadoop [3] and Apache Spark [4].

DBLP is a computer science bibliography website which index all important journals and conferences on computer science.

In this paper, we loaded the DPLB dataset [5] in the aforementioned two approaches. More specifically, we used Oracle 12c to implement the first approach and we used Apache Hadoop with Apache Hive [6] and Apache SparkeSql [7] to implement the second approach. We compare the execution time of querying the DBLP dataset using the three approaches.

Materials and Methods
We installed Hadoop and Hive on a laptop that has 5th generation quad core i7, 16 GB or RAM, and an NVIDIA GTX 960M. We then loaded the DBLP database from an XML file that can be downloaded from the DBLP website. The file contains around 5 million records. For Apache Spark, an eclipse API can be used for our implementation. Using this API, a project can be created and used to configure Spark and SparkSQL. We then wrote a Scala program to write a code to load and process the dataset with the required queries.

Experiments and Results

On the three implements, we run the query in Figure 1 for ten times and we measure the execution time of each run. We then calculate the average of the 10 runs on each implementation. The results are shown in Table 1. As can be seen clearly from the results, the spark implementation outperformed all other implementations significantly. It reduces the execution time by 2X when compared with Hadoop and by 32X when compared with Oracle.

```
SELECT author
        FROM PUBLICATIONS
        where journal = 'IEEE Trans. Knowl. Data Eng.'
```

Figure 1. The SQL query

Table 1. Ecution time of different implementations

Implementation	Average Execution time (Seconds)
Oracle	16336.938
Hadoop	1014.6898
Spark	503.3

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Speech Recognition in Flight Simulator

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The article is devoted to the investigation of speech recognition in Flight Simulator cockpit. We have done research and developed software for speech recognition in Flight Simulator with limited vocabulary in C# from scratch. We processed approximately 33000 speech samples from 80 people and applied artificial neural networks to train collected data. The speech recognition system works in real time and offline mode in Windows platform. We used Mel Frequency Cepstral Coefficients and Linear Predictive Coefficients feature extraction algorithms in the system. The User Interface of platform is highly functional and allows users to update system parameters through the interface. Our Speech Recognition system results are compared to the results of Microsoft Speech SDK and received satisfactory achievement.

The main part of speech recognition system consists of training and recognition processes. Initially basic features characterizing speech signal are computed in both processes. The efficiency of this stage is one of the significant factors affecting behavior of the next stages and exactness of speech recognition. Using the time function of the signal as feature is ineffective. The reason for this is that when the same person says the same word, its time function varies significantly.

At present the methods of calculating MFCC (Mel Frequency Cepstral Coefficients) and LPC (Linear Predictive Coding) are widely used in speech recognition as speech features.

The LPC and MFCC cepstrals combined use in speech recognition system for calculating speech features. Calculation of the speech features algorithm is defined in the following form (fig.1).

Pre-emphasizing. The amplitude spectrum of a speech signal is dominant at "low frequencies" (up to approximately 4kHs). The speech signals are passed through a first-order FIR high pass filter.

Voice activation detection. The problem of locating the endpoints of an utterance in a speech signal is a major problem for the speech recognizer. An inaccurate endpoint detection will decrease the performance of the speech recognizer.

Framing. To increase the recognition quality, the input signal is divided into overlapping frames.

Windowing. There are a number of different window functions to choose between to minimize the signal discontinuities. One of the most commonly used for windowing a speech signal before Fourier transformation, is the Hamming window.

Calculating of MFCC features. To calculate Mel Frequency Cepstral Coefficients, the spectrum are calculated by applying the Fourier transformation to the windowing frames. The mel frequency spectrum reduces the amount of data without loosing vital information in a speech signal. By this aim a signal is passed through the Mel filter. After logarithming of signal by applying of Inverse Fourier transformation we are getting the Mel Frequency Cepstral Coefficients. Reminder 12 cepstrals are added to the feature vector after applying cepstral mean subtraction on the next stage.

Cepstral Mean Subtraction.. A speech signal may be subjected to some channel noise when recorded, also referred to as the channel effect. A problem arises if the channel effect when recording training data for a given person is different from the channel effect in later recordings when the person uses the system. The problem is that a false distance between the training data and newly recorded data is introduced due to the different channel effects. The channel effect is eliminated by subtracting the mel-cepstrum coefficients with the mean mel-cepstrum coefficients.

Calculating of LPC features. The LPC coefficients of each frame are found by applying Levinson-Durbin algorithm. Cepstrals of frames are calculated by means of found LPC coefficients. Getting 12 cepstrals are added to the feature vector after applying cepstral mean subtraction on the next stage.

The recognition process. As mentioned above, in the speech pre-processing block, its MFCC and LPCC features are calculated. Training and recognition are done based on both two features. Results are compared based on recognition according to both two features.

Recognition process is done in two steps:

1. Parallel recognition processes are done in MFCC-based and LPC-based subsystems.
2. Calculated recognition results are compared in MFCC-based and LPC-based subsystems, and speech recognition system decides on the result that both two subsystem decides.

Suggested Speech Recognition system results are compared to the results of Microsoft Speech SDK and received satisfactory achievement.

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Performance enhancement of a DFIG wind energy conversion system using phase advanced network

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Abstract. This paper presents the development of a phase advance network to enhance the performance of a variable-speed doubly-fed induction generator (DFIG) driven by a wind turbine under various operating conditions at Zafarana wind farm, Egypt . Firstly a fairly detailed simulation of a real DFIG-based wind energy conversion system is built using Matlab/SimPower environment. The simulation output is verified by comparing the simulation output with similar practical results and also with that published by Gamesa G5x standard test results. A phase advance network is designed and implemented to enhance the DFIG-based Gamesa G5x wind energy conversion unit. The FRT characteristics is examined when the system is subjected to a three phase short circuit test and the results obtained using the various enhancement techniques have presented in a comparative form with similar results using the implementation of the phase advance network. The results illustrate significant improvement in overall system performance and superior operation of the wind conversion unit using the phase network.

Speed control of 3-phase induction motor using rotor impedance

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Abstract-This paper introduces a method of rotor impedance control by using controlled capacitor/inductor connected in series in the rotor circuit. The proposed system can be operate as a speed control system or a soft starting system to limit the starting current of the motor. An approach to a three MOSFETs-based a rotor circuit of induction motor is presented. The experimental realization of the drive posed some serious problems, notably with regard to the successful driving pulses of MOSFETs over a wide speed range. Analysis of the secondary MOSFETs-controlled motor raised many interesting challenges. It was decided to use an equivalent circuit approach to the analysis because the primary voltage and current were both largely sinusoidal. The equivalent circuit used is based on the single-phase equivalent of a balanced sinusoidal three-phase system. The effective value of the external rotor inductance or capacitance is calculated. Moreover, the motor performance specially speed, motor starting current, and torque during the control of duty cycle of MOSFETs are studied. Also, MOSFETs performance has been studied. Closed loop speed control of the motor speed have been investigated using hysteresis control based on controlling MOSFETs duty cycle. Experimental results have been carried out in the Laboratory to verifying the analysis. The simulation results are given and proved to yield good agreement when compared with the experimental results.

Keywords: Microprocessor, Mosfets, Induction Motor, and Rotor Impedance Control

The effect of cotton fibre characteristic on yarn properties

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Abstract: In this study, the effects of cotton fibre properties on the tenacity, elongation, unevenness and hairiness of the compact yarns were investigated in detail. For this purpose, compacted yarns having four different yarn counts as Ne 30/1, 40/1, 50/1 and 60/1 with similar twist coefficient between α_e 4.2-4.4 were produced systematically. The fibre, sliver, roving and yarn, that in cops and package form, properties were measured step by step from the beginning to the end of yarn production. According to the findings, unevenness, imperfections, hairiness, breaking strength and elongation results of the compact yarns were evaluated taking into account unevenness results of sliver and roving, and fibre properties tested by High Volume Instruments (HVI).
Keywords: Cotton, compact yarn, HVI, unevenness, hairiness, tenacity.

Introduction

In order to produce high quality yarn, choosing the appropriate cotton for the field of use, quality of fibre properties and efficient use of fibre blends are priority requirements. Fibre cost constitutes more than 50% of the producing cost of cotton yarn, and quality properties of yarn change depending on the fibre quality. Considering this fact, many researchers have studied the effect of raw materials and spinning condition on yarn properties [1-6]. In this study, the quality properties of the materials were measured at each stage of production and very thin cotton compact yarns at different yarn count were investigated differently from the literature.

Materials and methods

In this study, four different types of cotton compact yarn at different linear densities were produced on the Saurer Zinser 35 2Impact FX compact spinning machine. The cotton bales that used in the study were mixed at the same blow room. Trützschler TC11 type carding machine was used. Two passages drawing process was used with Trützschler TD7 and Trützschler TD8. Rieter E 80 combing machine was used for combing processes and Saurer Zinser 670 machine was used to produce roving. The cotton compact yarns that produced in the study are presented in Table 1.

Table 1. The yarns produced in the study

Sample Code	Yarn Count (Ne)	Twist Coefficient (α_e)
1	30.15	4.20
2	39.92	4.21
3	49.88	4.31
4	59.74	4.39

The fibres, slivers and yarns were preconditioned in a conditioning room at standard atmospheric conditions (20 ± 2°C, 65 ± 2% RH) for 24 hours The fibre properties were measured on High Volume Instruments (HVI) in accordance with ASTM D4605. By using Uster Tester 4 and Uster Tensorapid-3, the measurements of breaking strength, elongation, hairiness and unevenness properties were performed in accordance with Uster and ASTM D2256 standards.

Results and discussion

The fibre properties, carding, draw and roving sliver properties, unevenness, imperfections, hairiness, breaking strength and elongation properties of the yarns were measured in the study. The results of the unevenness (CV%) and tenacity (RKM) of the yarns are shown in Figure 1. As understood from Figure 1, it is observed that the unevenness of the yarns increases with increase of yarn count. In terms of tensile strength results, there was an opposite condition to the results of unevenness. Tenacity values of the yarns decrease with the increase of yarn count. Besides CV% values of the yarns change between 12.19-13.74, which are good values in terms of yarn regularity.

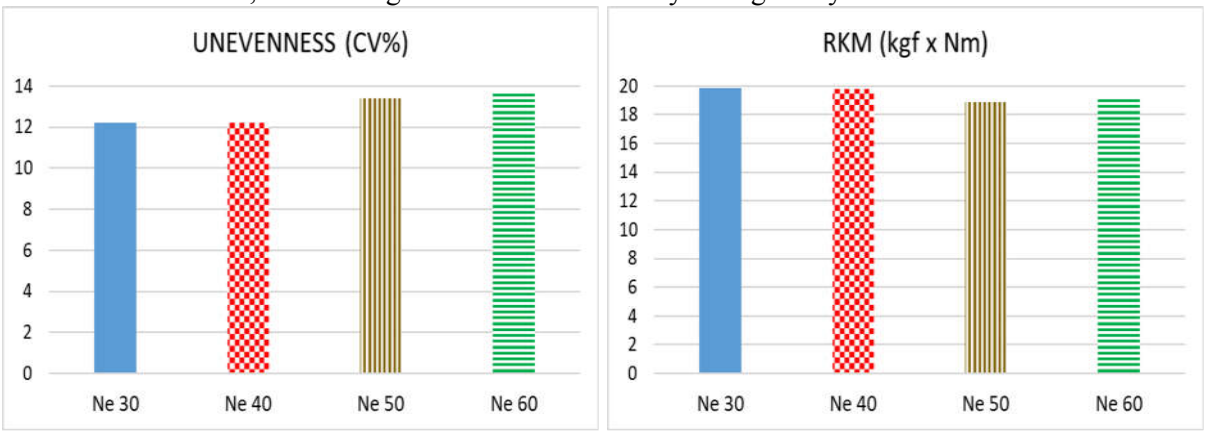

Figure 1. Unevenness and tenacity values of yarns produced in the study.

Conclusion

This study focuses at examining and evaluating the relation among fibre properties, process controlling and yarn properties. The test results have revealed the relation between cotton fibre properties, slivers and yarn properties, and the performance of thin cotton compact yarns. The findings of this study may be helpful for predicting yarn properties from fibre characteristic studies and cotton yarn manufacturers.

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Bending force of LLDPE monofilaments at high temperatures measured in DMA (Dynamic Mechanical Analyzer)

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Extended abstract
The use of artificial turf fields in sports and other surfaces has been increased recently [1]. There have been great and continuous improvements over the years on these fields [2, 3]. Although their first installations were made in regions with low air temperatures, nowadays synthetic turf surfaces are being installed more and more, even in locations where the air temperature is qualified high.
Artificial turf systems are mostly used in football fields and with football being the most popular sport in the world, the geography of installing and using these fields is worldwide. High temperatures are one of today's problems of the world of football. They have an impact not only on footballers in form of health problems and their playing performance, but also in the artificial turf field, by affecting the performance of the fibers and the whole system [4]. With artificial turf fields being mainly produced from linear low density polyethylene (LLDPE) monofilament, and with this polymer being sensitive to high temperatures [5-7], it is strongly needed to test and evaluate their behavior in high temperatures.
A new method for testing the bending force of monofilaments at different temperatures was developed and used in this study, consisting on performing the tests on the Dynamic Mechanical Analyzer (DMA). The DMA has a great advantage compared to other test methods used to evaluate the bending force of the fibers, because the tests can be performed at elevated temperatures [8].
The focus and the aim of this paper will be on measuring the bending force of LLDPE samples at different temperature, on the DMA. Based on the results taken from the tests, an analysis of the bending behavior of LLDPE monofilaments, depending on the temperature and the distance of the applied force is done.
Six different Linear Low Density Polyethylene (LLDPE) monofilaments fibers were used. The measurements of both linear density and cross section were performed at the University of Gent laboratories, Department of Textile. The linear density varies from 205 to 225 Tex. The cross sections of the fibers were of different shapes.
DMA TA Instrument was used to perform the measurements of the bending force. The testing is performed at the Department of Textile at University of Gent. The distance of applying the force is set to 2 mm and 3 mm. For each fiber are performed 3 repetitions. The testing is performed at three different temperatures. For data analyses is used the TA Instruments Universal Analysis (UA) Program [8]. The static bending force (N) is plotted versus the displacement (μm) (see Figure 1). The Onset Point (OP) 1 and Onset Point (OP) 2 are found in each graphic, through the UA Program and the mean value is calculated. The Onset Point determines the force at which a change in the curve occurs [12]. The same plot as below is obtained for each repetition of each sample.

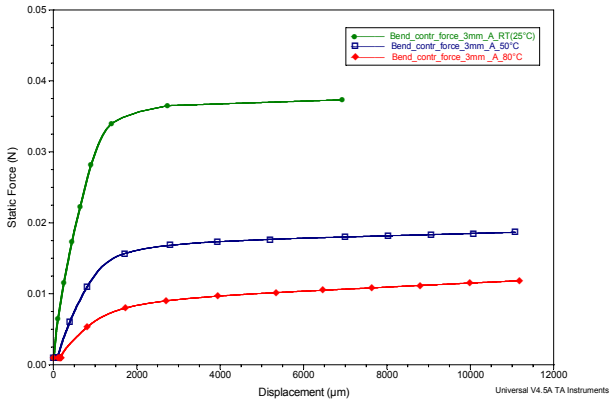

Figure 1. Bending force for Fiber A, at 3 mm distance, in RT - 50ºC - 80ºC.

All the results of the bending forces on the Onset Points 1 and 2, for both distances and different temperatures are represented on Table 1.

Table 1. Bending force values at Onset Points 1 and 2, for both distances and three temperatures.

Fiber sample	Onset Points	Bending force (cN)					
		RT (25°C)		50°C		80°C	
		2 mm	*3mm*	2 mm	*3mm*	2 mm	*3mm*
Fiber A	OP 1	3.361	***2.272***	1.944	***1.119***	1.178	***0.61***
	OP 2	4.243	***3.213***	2.586	***1.466***	1.43	***0.83***
Fiber B(l)	OP 1	4.669	***2.759***	3.055	***1.636***	1.571	***1.057***
	OP 2	6.115	***3.543***	4.058	***2.184***	2.024	***1.332***
Fiber B(m)	OP 1	7.433	***3.465***	3.919	***2.268***	2.083	***1.448***
	OP 2	8.278	***4.291***	5.090	***2.980***	2.568	***1.866***
Fiber C	OP 1	2.21	***1.101***	1.188	***0.768***	0.559	***NA***
	OP 2	2.8076	***1.401***	1.453	***1.044***	0.785	***NA***
Fiber D	OP 1	3.125	***1.423***	1.162	***0.636***	0.599	***NA***
	OP 2	3.869	***1.764***	1.5086	***0.858***	0.827	***NA***
Fiber E	OP 1	4.717	***2.299***	2.159	***1.064***	1.124	***NA***
	OP 2	6.121	***2.809***	2.8496	***1.588***	1.438	***NA***
Fiber F(l)	OP 1	2.835	***1.672***	1.39	***0.863***	0.836	***NA***
	OP 2	4.474	***2.2556***	1.984	***1.228***	1.153	***NA***
Fiber F(m)	OP 1	6.124	***3.625***	3.028	***3.028***	1.649	***NA***
	OP 2	6.69	***4.168***	3.517	***3.518***	1.904	***NA***

To be noticed is that the bending force of LLDPE monofilaments reduces with almost half of the value with the increasing of the temperature. The better performing fibers are the “c” shaped fibers, B and F at all temperatures. The bending force is also influenced by the distance of applied force.

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Strength loss of glass yarn during weft knitting

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Abstract

Weft knitted fabrics from glass yarns present many advantages in technical textile applications. However, due to their stiff and brittle nature; glass fibers can easily be broken during weft knitting process that deteriorates the performance of resultant fabric. Weft knitted glass fabrics with four different knit patters, and two different cam settings were produced. Number of yarn ply was also varied as 2- and 3-ply. The effect of all these parameters on strength loss of glass yarn was examined via measuring virgin and unraveled yarn strength.

Keywords: glass fiber, technical textiles, weft-knitted fabric, loop yarn strength

1. Introduction

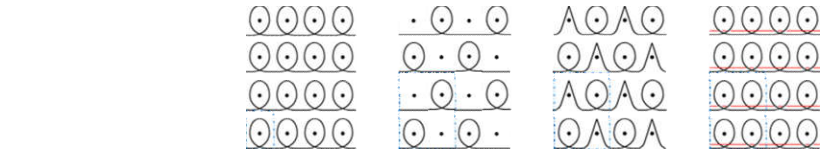
Weft knitted fabrics has stretchable, three dimensional, intermeshed, and porous structures that make them unique as compared with woven and nonwoven fabrics. Due to their snug fit comfortable nature, they are widely used in apparel production. Weft knitted fabrics also used in many technical textile applications. Once high performance fibers are converted in to weft knitted fabrics, they offer unique advantages: comfortable protective clothing against flame or chemicals, reinforcements for impact resistant composites, and filter media for filtration hazardous materials [1, 2]. Due to their low price, good mechanical properties, and high resistance against flame and chemicals; glass fibers are widely used in technical textiles applications. Due to stiff and brittle nature of glass fibers; conversion of glass fibers into weft knitted fabrics has many challenges. Glass fibers can easily be broken, as they are forced to take loop shape, and broken fibers deteriorate the performance of knitted fabrics in following service life. Quantification of this fiber breakage and determination of the most influential process and product input parameters on strength loss of the yarn after knitting process is important [3, 4]. Weft knitted fabrics from glass yarn was produced within the context of this study. We varied knit pattern, number of yarn ply, and cam setting and studied their effects on loop strength loss of glass yarn.

2. Material and methods

133 tex, E-glass multi filament yarn was consumed to manufacture fabrics on Brother KH-864 manual, flat weft knitting machine with a fineness of 5 gauge. Table 1 indicates the experimental plan of our study. Three input variables; knit architecture, cam setting and number of yarn ply were considered; thus sixteen (4x2x2) different samples were produced. Figure 1 indicates technical notations (needle diagrams) of the weft knitted fabrics.

Table 1. Experimental plan

Variables:	Knit architecture	Cam setting	Number of yarn ply
Levels:	Loop stitch Skip stitch Tuck stitch Weft-inlay	Loose fabric Tight fabric	2-ply 3-ply



: loop stitch : skip stitch : tuck stitch : weft-inlay : knit repeat boundaries

Figure 1. Technical notations of the knit architectures

3. Results and discussion

3. 1. The effect of knit pattern on unraveled yarn strength

While unraveled yarns from skip stitch patterned fabric exhibited the highest yarn strength and unraveled yarn from weft-inlay showed the lowest unraveled yarn strength, no statistically significant difference was observed among the unraveled yarn strength of all knit pattern that proved lack of effect of knit pattern on yarn strength (Figure 2 and Table 2). Contrary to expectation, virgin yarns exhibited less strength than unraveled yarn that was attributed uniform distribution of fiber over yarn cross section as a result of knitting process.

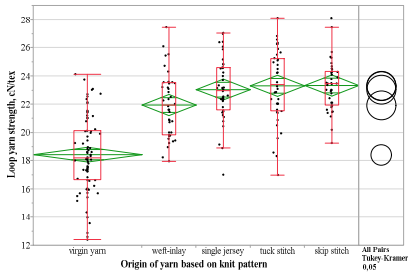


Table 2. Knit pattern versus unraveled yarn strength, cN/tex

Knit pattern		mean	sd	LL	UL
skip stitch	A	23,34	1,76	22,77	23,90
tuck stitch	A	23,31	2,58	22,49	24,14
single jersey	A	23,05	2,22	22,34	23,76
weft-inlay	A	21,95	2,26	21,23	22,68
virgin yarn	B	18,43	2,64	17,85	19,02

Note: levels not connected by the same capital letter are significantly different. sd: standard deviation, LL: lower limit, UL: upper limit. Limits are based on 95% confidence level.

Figure 2. The effect of knit pattern on loop yarn strength

Note: The top and bottom of each green diamond represent the 95% confidence interval for each layer level. Comparison circles (given on the right column) for means those are significantly different either do not intersect, or intersect slightly.

4. Conclusion

This study investigated the effect of knit pattern, cam setting, and number of yarn ply on strength of unraveled yarns from weft knitted fabrics. Contrary to expectations, knit pattern and other independent input variables did not show statistically significant effect (at $\alpha = 0{,}05$ significance level) on unraveled yarn strength. Virgin yarns displayed less strength than unraveled yarn that was attributed to uniform fiber distribution in the cross section of unraveled yarns as a result of knitting process.

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Properties of Goat(s) Fibres from Albanian Region

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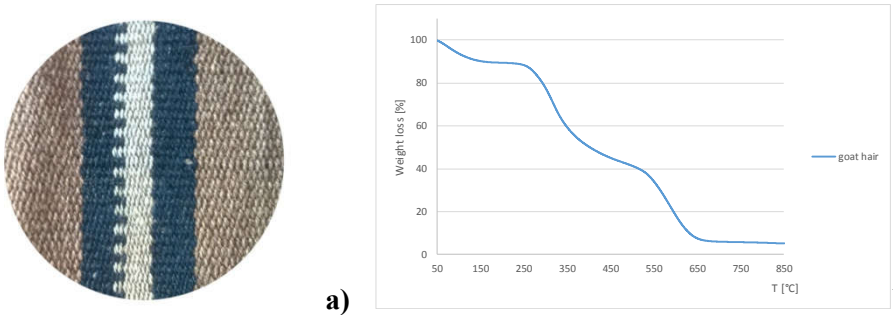
Extended abstract
In Albania, wool products, especially handmade ones are famous and used since ancient time. Among several textile products are textile floor coverings from fibres of sheep or goats. Wool is regarded as a naturally flame-resistant fibre and wool fabrics were the traditional material for flame and heat protection. These fibres are the main attractions as a component in high performance thermal protection applications to provide protection from fire. In general wool is known to have a high ignition temperature, high limitation oxygen index (LOI) and a low heat release from the combustion but it varies a lot from the type of wool and from the region of the collected samples. In Albania there are several regions where the interest to collect these fibres is raising but not much is known about the quality. Thus, because the race of sheep'sor goats, are mixed with other races (not autochthon), and as a result, the information about the properties of these fibres is missing. The focus of this article is to study the quality of wool fibres received from goats. Also in this article it will be given information about LOI for textiles produced from goats fibres. The structure of textile 100% goats wool is R=1/1, density of warp and weft yarns are respectively 23y/10cm and 34y/10cm. From the obtained results the finesses of the fibres are at very high values approximately 75µ but the values of LOI are quite promising, 41LOI, comparable values with the special fibres used for fire protection. Apart of these results, more tests are needed in order to determine the real value in terms of industrial processing.

Results of LOI, MCC, TGA and SEM measurements and analysis at TTF, UNIZG Zagreb, Croatia

Table 1.LOI values of goat fabric.

Sample	LOI	$t_{100\ mm}$ [s]	t_{glow} [s]
Goat fabric	41	113	120
	41	118	105
	41	115	111



a) **b)**

Figure 1. a) Picture of textile. **b)**TGA curve of goat hair in the air, heating rate 10 °C/min.

Table 2. Thermogravimetric data of goat hair measured in the air

Sample	$T_{onset\ 5\%}$ [°C]	T_{max1} [°C]	T_{max2} [°C]	Residue at 800 °C [%]
Goat hair	92	247	526	4,9

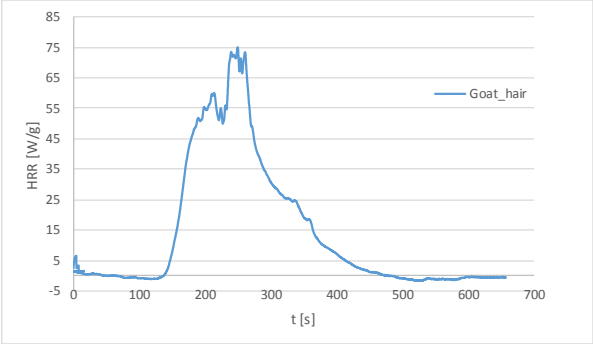


Figure 2.MCC curve of goat hair

Table 3.MCC data of goat hair.

Sample	Heat release temperature Tmax1 (°C)	Maximum specific heat release Qmax1 (W/g)	Specific Heat release hc (kJ/g)	Heat release capacity ηc (J/g-K)	Yield of pyrolysis residue Yp (g/g)	Spec. heat of fuel gases combustion hc.gas(kJ/g)
Goat hair	351,1	80,9	9,6	92	0,24	12,7

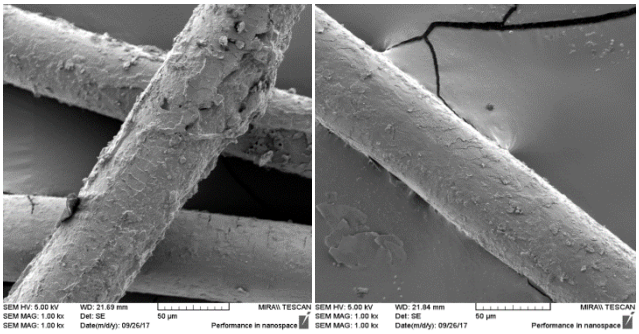


Figure 3.SEM of goat hair.

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Yarn Deformation with view of its Structural Structure

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Yarn deformation, elastic fiber contact, spinning triangle, fiber bundle stress, axial stress, compact and conventional yarn

The subject of research is the improvement of mechanical models of yarn. The behavior of fibers in the initial stage of their loading, which are oriented in the direction of the action of the load, is considered. The location of the fibers along the spiral lines has been studied, which contributes to a reduction in the cross section of the yarn as a result of the approach of the fibers.

It is revealed that when the axial force is removed in the fibers, irreversible deformations remain, and in some fibers, residual stresses. This leads to an uneven distribution of strain across the section and it is one of the reasons for the structural unevenness of the yarn.

It is established that the time for the realization of the internal resource of the yarn depends on the properties of the raw materials used, the way the yarn is formed, the condition of its winding and other factors.

Two types of yarn are considered - compact and conventional, and the change in their deformation in time has been experimentally investigated. Various rheological models were used to develop the patterns of yarn deformation, taking into account the change in its structure during the loading process.

The evaluation of yarn deformation taking into account its structure was performed using the Kelvin model with time-variable parameters, which take into account the instant and long modulus of elasticity of the material and the increase in strength characteristics of compact yarn is proved.

The comparative study of nursing pads by electrospun cellulose acetate, polyethylene oxide and thermoplastic polyurethane nanofibers

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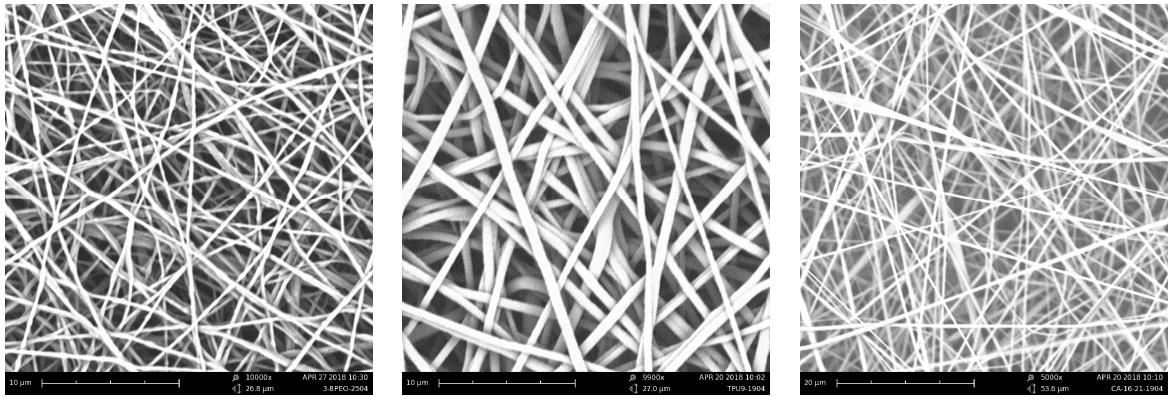
This study summarizes the general information about nursing pads and novel electrospun nanofiber mats as potential component for nursing pads. It also compares electrospun cellulose acetate (CA), polyethylene oxide (PEO) and thermoplastic polyurethane (TPU) nanofibers with a polypropylene (PP) conventional disposable nursing pad in terms of hydrophilicity, breathability, air permeability and swelling properties.

Nursing or breast pads are commonly used by nursing women to prevent milk, which may leak from the woman's breasts, from staining clothing and bed linens when the woman is not nursing [1]. These nursing pads generally divided into two subcategories; reusable pads and disposable pads [2]. Typically, a disposable breast pad contains a multilayered design, including a non-permeable layer for preventing transfer of breast milk from the liner to clothing, an absorbent layer for holding the milk within the liner, and a wicking layer to draw the liquid away from the breast and into the absorbing layer. A non-permeable layer may also be disposed about the outer periphery of the liner so that a reservoir is formed between the outer surface non-permeable layer. An adhesive may be applied to the outer portion of the liner to hold the liner in place in a bra cup [3]. Wicking top layer and the absorbing layer are the most critical part of these disposable pads. Top layer should deliver the absorbed milk immediately to the inner absorbing layer to prevent the discomfort of the mother. Wet nipples also may increase the sensitiveness of the skin.

In that point, nanofiber mats prepared by the electrospinning method have unique properties such as smooth surface, high specific surface area and high porosity with fine pores which will lead to improved wicking properties. These properties make nanofibers potential component for disposable nursing pads. Electrospinning method can be applied to synthetic and natural polymers, as well as polymer blends. Polymer solutions could also be loaded with functional nanoparticles, or active agents [4]. A large number of drugs [5-8], vitamins [9,10] could also be immobilized in polymer fibers [11] which make them functional other than casual nonwovens. More than fifty different polymers have been successfully electrospun into ultrafine fibers using this technique [12]. In this study, CA, TPU and PEO nanofibers were selected and compared with a commercial nursing pad in means of hydrophilicity, breathability, air permeability and swelling properties. Water contact angle measurement is used to determine the hydrophilic or hydrophobic properties of produced nanofiber mats. Water vapor permeability and air permeability are measured to determine the comfort properties of these nanofiber mats and finally swelling properties are measured to determine the absorption

capacity of these fibers. The surface morphology of electrospun CA, TPU and PEO nanofibers were investigated by SEM imaging. According to the SEM images bead free, smooth nanofibers were produced (Figure 1). Mean diameters of produced nanofibers were 284.39, 609.70 and 219.30 nm for CA, TPU and PEO, respectively. Water contact angle measurement revealed that these nanofibers show good wettability properties better than commercial nonwoven nursing mat and air permeability results revealed that these nanofibrous mats have considerably adequate permeability which can provide the breathability of the skin as well as liquid permeation through the mats. Besides, water vapor permeability results showed these nanofibers still show good breathability despite their compact structure.



a) **b)** **c)**

Figure 1. SEM images a) CA, b) TPU and c) PEO

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