DEVELOPMENTS OF 3D KNITTED HEAD ITEMS

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Rezumat

În momentul de față, cel mai reprezentativ articol de acest tip, realizat prin tricotare pe un utilaj specializat, este basca (bereta) al cărui procedeu de formare este tricotarea de rânduri incomplete şi repetarea într-un număr determinat a unei secvențe identice (clinul beretei). Forma spațială a beretei este ulterior definitivată prin operații de termoformare şi finisare.

Lucrarea face în prealabil o inventariere a formelor (modelelor) impuse de tendințele de modă actuale (majoritatea obținute prin tricotare manuală), urmată de definirea caracteristicilor dimensionale ale acestora.

Prin similitudine cu produsele de acest tip, confecționate din țesături, sunt proiectate formele plane elementare (desfăşuratele în plan) care prin asamblare pot genera formele tridimensionale.

Pentru formele luate în studiu este vizată parametrizarea elementelor plane şi formularea instrucțiunilor de tricotare, astfel încât să se asigure obținerea formelor 3D.

Lucrarea analizează posibilitățile de diversificare a acestei categorii de produse în vederea reflectării tendințelor de modă şi a răspunde astfel cerințelor diferitelor categorii de beneficiari.

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Abstract

Currently, the most representative head item produced on a specialised knitting machine is the berets, based on the technique of knitting on a limited number of needles and repeating the sequence that creates the basic elements. The spatial shape is subsequently defined through finishing operations.

The paper reviews the possible models for berets, some imposed by current fashion trends (most of them obtained through hand knitting) and characterises the specific product geometry.

Similar to the same berets obtained using woven fabrics, elementary 2D shapes are designed so that after assembly they will generate the 3D shape. The definition of the 2D elementary shapes and the knitting sequence is intended for the examples taken into consideration.

The paper investigates the diversification possibilities, the reflection of the fashion trends and the enlargement of user range for this group of products.

1. Introduction

The head items are costume elements that posses functional, aesthetic, symbolic attributes. Their functionality comes from the need to protect the head against the environment, while their shape is determined by the anthropomorphic characteristics of the human head. With similar weight within the product, the aesthetic function can generate shapes different

Considering the surface characteristics of the human body, the head is the most complex. As a consequence, the main problem in the production of such head items is how to generate a 3D product geometry based on a 2D fabric.

The differences between fabrics (woven, knitted fabrics, skin, leather, nonwovens) impose different ways of creating products with spatial geometry. In the case of woven fabrics, a complex shaped product is obtained by assembling parts with different shapes and dimensions, while the specific geometry of knitted fabrics allows the production of a 3D fabric, eliminating completely or almost completely the cutting and sewing operations.

2. Shapes of knitted head items

A clear and hierarchical classification of head items is required in n order to present the specific production processes. The following classification criteria are therefore considered:

1. the number and shape of the basic elements
   a) simple crown (caps, knit beanies), figure 1.a
   b) crown and brim bent outward (hats), figure 1.b
   c) crown and brim bent inward, and trim (beret), figure 1.c
2. the finishing process of the 3D shape
   a) without special treatments;
   b) with felting, thermal treatments, etc.;
3. the knitting process
   a) using circular knitting machines;
   b) using flat knitting machines.

The diversity of shapes and models (see Figure 1) is generated by the different dimensions of the product elements, the different finishing of the 3D shapes obtained on circular or flat knitting machines. Apart from shape, the aesthetic characteristics will be defined by the yarn, the fabric structure, the applied ornaments, etc.

a)

b)

c)

Figure 1. The main shapes for knitted head items

3. The design of the beret basic shape

The paper presents a design algorithm for beret design, based on the specific dimensional indexes that allow the control of the berets shape and implicitly their aesthetic diversification.

Each constructive element of a beret is characterised by a set of dimensions that relate differently to the head zone dimensions. Figure 2 presents the basic shape of a beret and its dimensional indexes. As a calculus hypothesis, the 3D beret surface is considered to be generated by the intersection of a cone with a frustum of a cone, characterised by a disc, respectively a circular corona with different angles as 2D evolutes. Most berets made of woven fabrics are based on this hypothesis, the parts with the two mentioned geometries being cut and sewn [2].

The 3D surface of the beret is considered to be divided in a number of basic 2D elements that are specific to rotation bodies (sphere or ellipsoid).

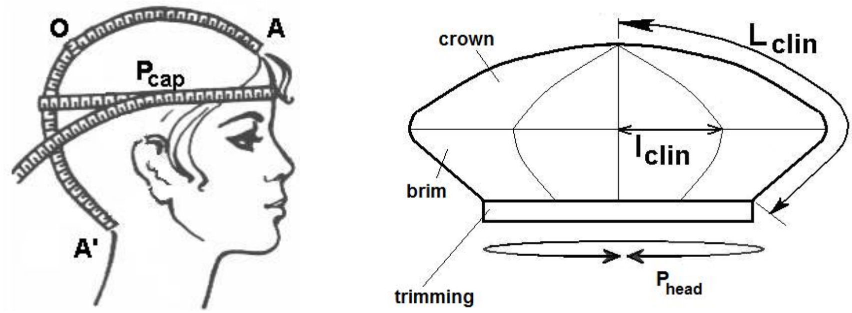


Figure 2. Dimensional indexes required for the design of the beret shape

Based on the dimensional indexes defined in Figure 2 and a set of assumptions, the following empirical algorithm for the basic 2D element for the spatial geometry of the beret (see Figure 3) is presented.

Initial data required for the design of the 2D basic element:

- Head perimeter P_{beret}
- Length of the 2D element L_{clin}
- Maximum width of the 2D element
- Surface coefficient for the crown K1= 1 – 1, 75
- Spatial coefficient for the crown K2 = 1 – 1,5
- Number of basic elements (n)

The pattern is defined according to the following algorithm:

$OR = L_{clin} + 0.6$ cm

$Ra = 0.6$ cm

$ab = 0.2$ cm

$aA = a\,A' = P_{beret}/2n$

The angle of the basic element is: 360x K1/ n

$P_{max} = n\,(l_{clin})$, where P_{max} = maximum beret perimeter;

$OR_1 = K_2\,(P_{max}/2\pi)$

CC’ = l 2D basic element

DD’ = CC’

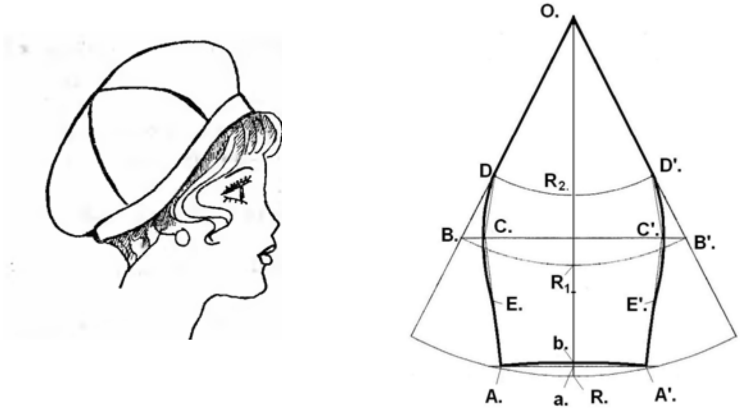


Figure 3. Design of the basic element for the classic beret

The basic element presented in Figure 3 can be used for berets made of woven fabrics, but in the case of knitted berets the final product 3D shape is obtained during knitting and the basic elements are different. The shape and dimensions of the basic element are established based on:

- The knitting technology – flat knitting or circular knitting
- The yarn count and the machine gauge
- The knitting direction relative to the maximum beret perimeter
- The finishing treatments applied and their influence on the structural parameters of the knitted fabric

Due to the performance level of the flat knitting machines, it is obvious that the knitting direction considered along the basic element width presents the largest shape diversification possibilities. Generally, the 2D basic elements knitted on flat machines are symmetrical, the maximum element width being placed exclusively on one side of the length line. This knitting technique is based on producing a supplementary amount of stitches by knitting incomplete rows and then starting to work on the needles that miss.

The shape of a knitted element can be defined with the following relations, similar to the algorithm of a symmetrical element:

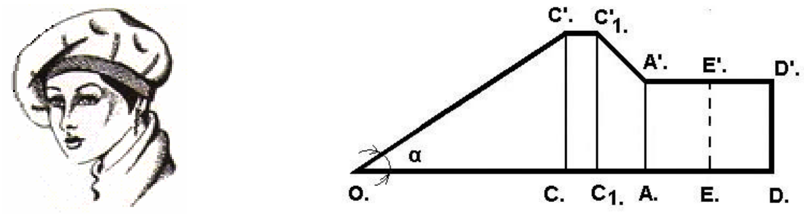
$OA = L_{clin}$; $AA' = P_{beret}/2n$

$\alpha = 360^0 K_1/n$

$OC = l_{clin}/ tg\ \alpha$; CC' = width of the basic element = $l_{basic\ element}$

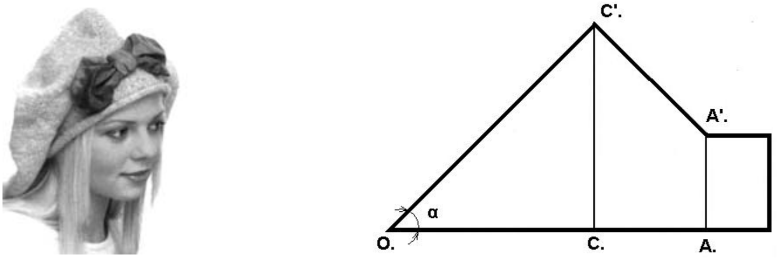
AD = trimming width, according to the beret model (the trimming can have different width, can be simple or doubled, etc).

In order to ensure a softer passing from crown to brim, a CC1 distance can be placed along the element width. This distance will influence directly the visual aspect of the beret.



a)

n = 8

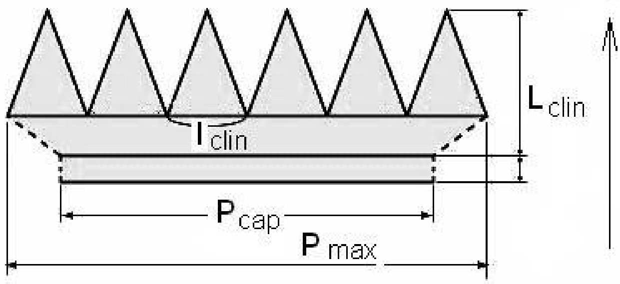


b)

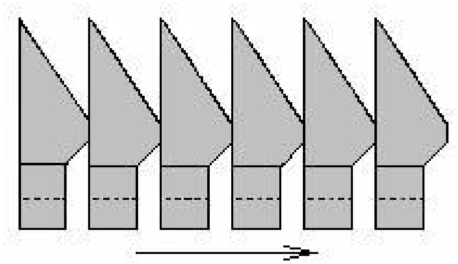
n = 6

Figure 4. Berets made of basic elements produced using the knitting incomplete rows technique

Different from the basic elements knitted on circular machines, this type of basic elements are knitted successively (Figure 5). The beret shape is controlled through the values selected for the calculus parameters. The elements will be emphasised within the product by ‘assembly’ lines where the missing needles start working again. The number of basic elements varies between 6 and 28 and the knitting programming must take into consideration possible dimensional modifications of the fabric during finishing.



a) 2D aspect of a beret made of 6 basic elements on a circular machine



b) 2D aspect of a beret made of 6 basic elements on a flat machine
Figure 5. Variants of a classic beret according to the knitting technology

4. Development directions for the complex 3D shapes modelling

Considering the basic beret shape, a set of modifications are possible regarding:

- The geometry of the 2D basic element
- The relative positioning of the elements
- The dimensions of the successive basic elements

Figure 6 presents a beret with a brim symmetrical in relation to the crown. The basic element is made of two zones, white and grey in the image that has different colour or structure patterns. The beret will alternate the patterns along its width. Figure 7 illustrates a basic element designed to generate a creasing effect between the trimming and the brim. The diversification can be enlarged using different types of yarns and knitted structures.

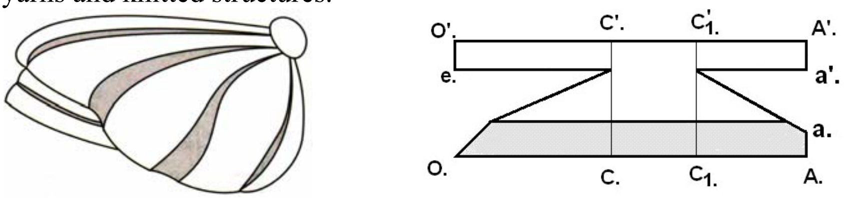


Figure 6. Beret with basic element with different patterns

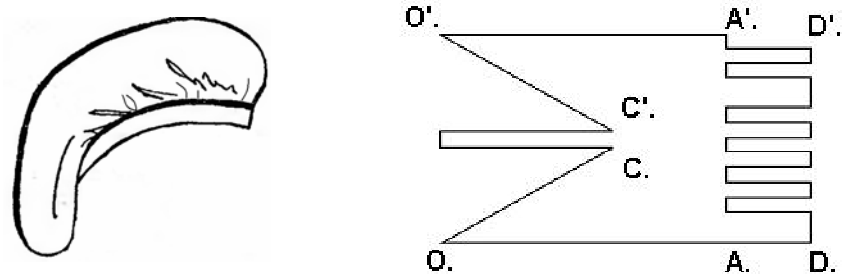


Figure 7. Beret with creasing effect

5. Conclusions

The large shape diversity for head items requires a systemic approach and the definition of the design algorithm. The definition of the 2D basic element and the variation of the element geometry open new diversification directions for this type of products produced through knitting.
The paper presents examples of new basic elements with modified geometry for the production of berets with complex spatial shape.

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