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Development of Constructive Parameters of the Vest on the Basis of the National Iranian Costume

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Annotation
The proposed, as a result of the research, the method of analytical calculation of the parameters of the women's vest patterns makes it possible to simplify the process of calculating the parameters of sweeps, improve the fit of the product on the figure, improve the ease of use during wearing, and the aesthetic perception of the suit.
Key words: national costume, modern clothing, radius vector, slope, profile section, discrete series, approximation.

Purpose. Determination of an analytical method for calculating the parameters of sweeps of product parts based on the construction of profile sections of a women's vest, designed on the basis of the national Iranian suit, as well as an improved construction of the vest armhole line, to improve aesthetic and ergonomic qualities.
Methodology. In the work, modern methods of analytical and geometric modeling were used with the use of a box line of arcs of curves of the 2nd order and an analytical method of straightened threads for building sweeps.
Results. Analytical algorithms for constructing an improved line of women's vest armholes have been developed and analytical support has been developed for calculating the parameters of patterns and geometric information for the automated design of structural elements.
Scientific novelty. The principles of analytical calculations of the parameters of the patterns and the construction of the armhole line of a modern women's vest, designed on the basis of the national Iranian costume, have been developed; a new method for constructing patterns of patterns using the method of straightening threads is proposed, which makes it possible to improve the fit of the product on the figure and use automated design methods in the design of modern clothes.

Introduction

The process of developing a project for a modern product is a creative process that obeys the general laws of design activity. The studies carried out show that the transition to a new quality of designed products is confirmed by the development of technologies for the design process of clothing. The transitions from uncut to cut, and universal in the constructive structure of clothing, took place under the influence of various factors that influenced new forms and methods of constructing structures.
The increasing complexity of design objects requires the use of fundamentally new, modern methods. Therefore, to solve design problems, methods of mathematical and geometric modeling were included in the methodology of the design process [1].
The specificity of designing garments is that they are simultaneously objects of decorative and applied art and objects of industrial production. In this regard, the combination of creative and engineering in the process of designing clothes becomes most relevant when

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creating new promising models, where the creative process is the most important part of the design process.

Modern CAD systems for clothing make it possible to modify designs and provide almost unlimited possibilities for creating a variety of model transformations based on basic ones [2].

Formulation of the problem. The sequence of development of clothing models in modern CAD systems makes it possible to perform various stages of design preparation for the production of clothing in an automated mode: from developing a sketch of a model to obtaining ready-made patterns and design documentation. To date, almost all stages of the design preparation of garment production have been automated, which greatly speeds up the process of designing clothes, but requires the development of a quality control system at all stages of design. Techniques for designing new clothing models on the basis of associative methods, using a variety of creative sources, for example, folk or national costumes, which largely enrich the existing basic designs and the foundations of building model designs, have not been sufficiently developed.

When choosing Iranian folk clothing as the basis for a model design, analytical support for calculating the parameters of patterns for a modern women's vest, designed on the basis of a national costume, will make it possible to improve the quality characteristics of building the basic design of a product.

It is impractical to approximate the profile section of the vest passing through the protruding point of the breast with regular curves of the 2nd, 3rd or 4th order, since this section is a convex, concave or straight line. Its shape depends on the size of the breast and its height. Therefore, this section is proposed to be approximated by a box line of arcs of curves of the second order, or rather, “circular arc – straight line – parabolic arc” of the shelf and “straight line – parabolic arc” of the back [3].

Research results. 1. It is possible to determine the parameters of the arc in the section 1-2-3 (Fig. 1) using the equation of a circle passing through three points (x1, y1), (x2, y2), (x3, y3):

$$\begin{vmatrix} x^2+y^2 & x & y & 1 \\ x_1^2+y_1^2 & x_1 & y_1 & 1 \\ x_2^2+y_2^2 & x_2 & y_2 & 1 \\ x_3^2+y_3^2 & x_3 & y_3 & 1 \end{vmatrix} = 0 .$$

Accept: $A = x_1^2 + y_1^2$, $B = x_2^2 + y_2^2$, $C = x_3^2 + y_3^2$.

Let us bring a square matrix to a triangular form

$$\begin{vmatrix} x^2+y^2 & x & y & 1 \\ x_1^2+y_1^2 & x_1 & y_1 & 1 \\ x_2^2+y_2^2 & x_2 & y_2 & 1 \\ x_3^2+y_3^2 & x_3 & y_3 & 1 \end{vmatrix} = (x^2+y^2)\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} - x\begin{vmatrix} A & y_1 & 1 \\ B & y_2 & 1 \\ C & y_3 & 1 \end{vmatrix} + y\begin{vmatrix} A & x_1 & 1 \\ B & x_2 & 1 \\ C & x_3 & 1 \end{vmatrix} -$$

$$-1\begin{vmatrix} A & x_1 & y_1 \\ B & x_2 & y_2 \\ C & x_3 & y_3 \end{vmatrix} = 0.$$

Where:

(x2 + y2) (x1·y2 + y1·x3 + x2·y3 – x3·y2 – x1·y3 – x2·y1) – x (A·y2 + B·y3 +C·y1 – C·y2 – – A·y3 –
B·y1) + y (A·x2 + C·x1 + B·x3 – C·x2 – A·x3 – B·x1) –

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–(A·x2·y3 + C·x1·y2 + +B·x3·y1 – C·x2·y1 – A·x3·y2 – B·x1·y3) = 0.
Accept: D = x1·y2 + y1·x3 + x2·y3 – x3·y2 – x1·y3 – x2·y1.

Then finally in the coordinate system y Oz (profile projection) we have:

A = y12 + z12 , B = y22 + z22 , C = y32 + z32 ,
D = y1·z2 + z1·y3 + y2·z3 – y3·z2 – y1·z3 – y2·z1,
y
2
·D + z2·D + y (A·z2 + B·z3 + C·z1 – A·z3 – B·z1 – C·z2) + z (A·y2 + B·y3 + C·y1 –
–A·y3 – B·y1 – C·y2) – (A·y2·z3 + B·y3·z1+ C·y1·z2 – A·y3·z2 – B·y1·z3 – C·y2·z1) = 0.

From the theoretical drawing of the projected model, the following coordinates of points 1, 2 and 3 were determined:

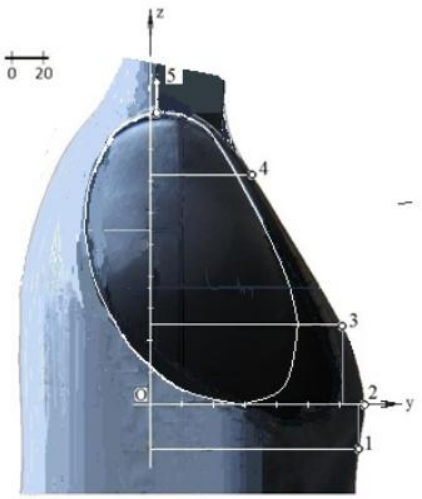


Fig. 1. Profile projection of the vest

1. To determine the lengths of circular arcs between the horizontal cutting planes for the purpose of further building sweeps, another approximation method was used (Fig. 2.)

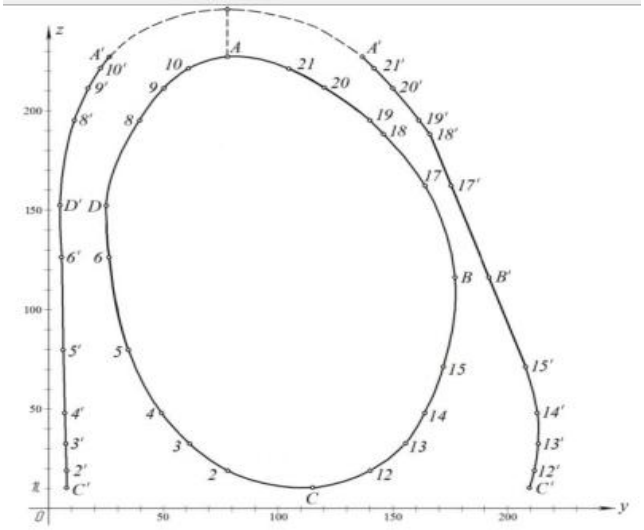


Fig. 2. Profile projection of the armhole and profile section

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1.1 Angular coefficients of chords 1′-2′ and 2′ -3′:

k1 = (z1 – z2) / (y1 – y2) =(10 –38,7) / (189,5 – 193,5) = 7,175 ,

k2 = (z2 – z3) / (y2 – y3) = (38,7 – 90,3) / (213,5 – 198,5) = – 3,44.

1.2 Coordinates of the midpoints of segments 1′-2′ and 2′-3′:

yC1 = (y1 + y2) / 2 = 211,5 , zC1 =(z1 + z2) / 2 = 24,35,

yC2 = (y2+ y3) / 2 =206 , zC2 =(z2 + z3) / 2 = 64,5.

1.3 The coordinates of the center of the arc of a circle, from which we approximate the section 1′-2′-3′ of the breast:

$$y_{O'} = \frac{k_3\, yC_1 - k_4\, yC_2 + zC_2 - zC_1}{k_3 - k_4} = 114{,}432225\,,$$

$$z_{O'} = k_3(y_{O'} - yC_1) + zC_1 = 37{,}881248\,,$$

where k_3 and k_4 are the slopes of the perpendiculars to the corresponding chords.

1.4 Solving jointly the equation of the tangent passing through point 4′ to a circle of radius R centered at the origin:

$$\frac{z - z_4'}{y - y_4'} = \frac{-y_4' z_4' + R\sqrt{y_4'^2 + z_4'^2 - R^2}}{R^2 - y_4'^2},$$

Parameters of approximating curves and vest sweep coordinates

Armhole points	Armhole section	Curve Fitting Options:	Sweep coordinates	Transformed abscissas				
semi-axis of an ellipse	focal parameter of the parabola							
a	b	p	X0	Li	Y0	X′0		
C	CD	210	107	–	255,5869	–	0	–
2	213	70,186	–	236,7945	9,195	9,195	–	
3	204,6	53,969	–	220,706	13.729	22,924	–	
4	196	41,997	–	207,0547	15.715	38,639	–	
5	186,3	28,269	–	192,2552	24.347	62,986	–	
6	172,7	21,939	–	176,7865	43.038	106,024	–	
D	168,6	20	–	171,9489	36.008	142,032	–	
8	DA	162	28,2237	2,458572	167,5416	44.398	186,43	–
9	159,6	32,6468	3,339015	167,2719	17.0	203,43	–	
10	158	38,4142	4,669781	168,9213	10.81	214,24	–	

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A	155,2	51,5866	8,57338	172,7737	6.49	220,73	–	
C	CB	210	94,5	–	247,836	–	0	255,587
12	194	71,549	–	219,8038	9,195	9,195	283.6192	
13	182,3	58,042	–	201,6029	13,729	22,924	301.8201	
14	173,4	49,216	–	189,5835	15,715	38,639	314,6936	
15	164,3	32,314	–	172,2846	24,347	62,986	331.1384	
B	BA	153,6	14,712	–	155,238	47.98	110,966	348.185
17	152,5	11,285	–	153,6755	49.35	160,316	350,1444	
18	151,9	21,5	1,530629	156,2195	26.678	186.364	348,0858	
19	151,85	21,484	1,523308	156,1651	–	195,67	347,6011	
20	151,8	31,108	3,187443	159,7645	–	215,304	343.6585	
21	152,2	37,478	4,554476	162,9368	–	228,196	338,57	
A	155,2	58,562	11,04867	176,5816	–	236,28	326.8414	

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Точки пробы	Участок пробы	Параметры аппроксимирующих кривых:			Координаты развертки			Преобразованные координаты
		полуоси эллипса		фокальный параметр параболы				
		a	b	p	X_0	L_i	Y_0	X'_0
C	CD	210	107	–	255,5869	–	0	–
2		213	70,186	–	236,7945	9,195	9,195	–
3		204,6	53,969	–	220,706	13.729	22,924	–
4		196	41,997	–	207,0547	15.715	38,639	–
5		186,3	28,269	–	192,2552	24.347	62,986	–
6		172,7	21,939	–	176,7865	43.038	106,024	–
D		168,6	20	–	171,9489	36.008	142,032	–
8	DA	162	28,2237	2,458572	167,5416	44.398	186,43	–
9		159,6	32,6468	3,339015	167,2719	17.0	203,43	–
10		158	38,4142	4,669781	168,9213	10.81	214,24	–
A		155,2	51,5866	8,57338	172,7737	6.49	220,73	–
C	CB	210	94,5	–	247,836	–	0	255,587
12		194	71,549	–	219,8038	9,195	9,195	283.6192
13		182,3	58,042	–	201,6029	13,729	22,924	301.8201
14		173,4	49,216	–	189,5835	15,715	38,639	314,6936
15		164,3	32,314	–	172,2846	24,347	62,986	331.1384
B	BA	153,6	14,712	–	155,238	47.98	110,966	348.185
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19		151,85	21,484	1,523308	156,1651	–	195,67	347,6011
20		151,8	31,108	3,187443	159,7645	–	215,304	343.6585
21		152,2	37,478	4,554476	162,9368	–	228,196	338,57
A		155,2	58,562	11,04867	176,5816	–	236,28	326.8414

Of the known methods of constructing sweeps - analytical, graph-analytical and graphic - the analytical method of straightened threads was used in the work [4]. This method

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was used when constructing conditional sweeps of bodies of revolution, taking into account possible assumptions:

- the surfaces of the bodies are formed by many threads - weft threads: - each thread, when straightened or bent, is deformed independently of the neighboring ones. Here, instead of the word "bending", it is advisable to use the expression "dressing the surface" often used by architects. The area of the surface to be developed is displayed accurately with the establishment of a one-to-one correspondence between the points of the surface and its flat display.

AE Svyatkina suggested using this method in designing clothes [4].

Together with the threads perpendicular to them - the warp threads - a mesh is formed, which is well known in the construction of sweeps. The length of the threads was determined in horizontal sections, the shape of which (elliptical or parabolic) depends on the height of the secant planes.

The parameters of the approximating curves and their lengths are given in table. A scan of the back and front of the vest, designed on the basis of the national Iranian costume, in Fig. 3. The use of the proposed methods for constructing sweeps of details of modern products, taking into account the model features of national clothing, makes it possible to improve its quality and performance [5].

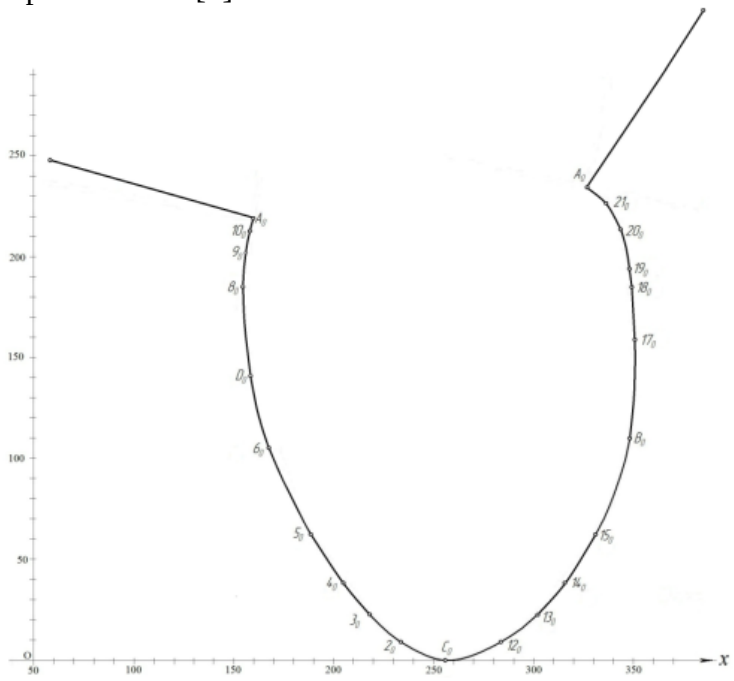


Fig. 3. Development of the back and front of the vest

Conclusions: For the first time, in the design of modern women's clothing based on the model designs of the national Iranian costume, the methods of geometric and analytical support for calculating the parameters of the women's vest patterns were used. The use of the method of oblique projection of the spatial line of the armhole, taking into account the position of the points of the anterior and posterior angles of the armpit, more accurately takes into account the relationship between the main dimensional features, which makes it possible to improve the fit of the product on the figure, improve the ease of use and aesthetic perception of the shape of the suit, and is also a premise for the use of automated methods for designing modern clothing in Iran, using national and ethno-artistic traditions.

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