UDC 687.016:658.512
DOI: 10.15587/1729-4061.2021.232014

DEVISING A METHOD TO PARAMETRIZE THE JACKET STYLE VARIETIES THROUGH THE MODIFICATION OF TIPOLOGICAL SERIES STRUCTURES

The study reported here has revealed the issue related to the inefficient scaling of the uniformity of jacket model designs in the processes involving a typical representative as a result of modification parameters uncertainty.

A variant has been proposed to synchronize the critical points of silhouetted allowances by grouping the numeric series in the vector of choosing the value for an increase in the allowance according to the characteristics of style varieties. The influence of shape-forming segmentation on the formation of a classifier of the structural and technological solutions for a jacket has been determined. The built model to support modification vectors has made it possible to describe the sequence of procedures execution by the method of typical representation. The presence of one design category, the same structural parts, the uniformity of style simplifies the processes of choosing and selecting the most characteristic models of the jacket.

It was found that the morphological combination of attributes of the physical appearance affects the adjustment of style preferences in a manufacturer's products. The parameters for typical segmentation relative to the junction points of the structural zones of the optimized five-seam prototype design have been defined as the most influential vectors of jacket modification.

A method for scaling the allowance for free fitting has been devised on the basis of data from empirical research. An adequate regression model has been derived for normalizing the silhouette allowance parameters. The constructed model makes it possible to scale silhouette structures by changing the increments at the corner points of the contour according to the prototype of gradation under an automated mode.

Practical recommendations have been compiled on the parameters of zonal-modular modification of silhouette designs of jacket varieties: a linear character of the state silhouetted transformation relative to ASi1=5 cm. The normalized parameters for constructing functional and decorative parts have been proposed

Keywords: typological series, parameterization, calibration, silhouette allowance, normalization method, jacket variety

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Received date 22.03.2021
Accepted date 20.05.2021
Published date 10.06.2021

How to Cite: *Slavinska, A., Mytsa, V., Syrotenko, O., Dombrovska, O. (2021). Devising a method to parametrize the jacket style varieties through the modification of tipological series structures. Eastern-European Journal of Enterprise Technologies, 3 (1 (111)), 92–105. doi: https://doi.org/10.15587/1729-4061.2021.232014*

1. Introduction

The communication system of taking into consideration the advantages in the design and technological preparation of production is based on forecasting the dynamics of demand and sales of product range, the concept of the development of fashion trends in information technologies via the Internet [1–3].

Achieving compliance between the supply of products and the demand for them is associated with the minimization of procedures for choosing prototypes from both the basic range of clothing and a set of models that correspond to the «recognition of the image» of the prototype for steady use of the type of assortment.

Statistical analysis of the anthropomorphic structure of design is used for the optimized choice of a prototype in shape categories according to aesthetic and functional attributes of the constructive solution of products [6]. The concept of design argumentation is aimed at the targeted management of hypothetical models of the style image of the product from the point of view of typifying the design and manufacturing processes at an enterprise [7]. The social role of style in behavior for purchasing an assortment model is determined by the valence of communications in the dimensional scale of image uniqueness from the position of the consumer [8]. Accordingly, studies aimed at increasing the mobility of flexible reorientation of the production of the established assortment by means of regulating the positive perception of style individualization should be considered relevant.

2. Literature review and problem statement

The expediency of using three-dimensional anthropometric data in CAD/CAM systems is considered in paper [9]. This approach expands the possibilities of using computer systems in the design preparation of production.

The concept of combinatorial application of 2D and 3D methods in an interactive algorithm for solving problems of engineering and spatial design of clothes is based on the formation of key modules of 3D digital modification of the morphological structure of the body with the reproduction of 2D images of structural parts [10]. However, the possibility to adjust the silhouettes derived from converting a basic silhouette was not considered.

The methodology of experimental research into the structural parameters of shape formation for forecasting the appearance of dresses is given in paper [11]. Techniques of technology for visualizing pressure zones in the fit of the fabric [12] are insufficient. The parameters of physiological and dimensional silhouette allowances, which are directly related to fitting to choose the right size, were ignored. Virtual modeling of physical and psychological interaction under static and dynamic conditions is considered on the example of correlation of properties of materials and pressure in the system «figure – dress» of only one structural module – a sleeve [13].

The historical aspect of the typological approach to the design of style varieties of the jacket is considered in work [14]. The use of modules of variant modification of the design of the classic jacket creates prerequisites for the formation of a structurally unified series of models based on the optimal prototype. A personalized approach to taking into consideration the sex-age characteristics of the morphological structure of the body to minimize structures built by classical methods is considered in paper [15]. Using the fuzzy clustering method [16] makes it possible to evaluate the suitability of part of the database on fashion design for the role model of consumption. Case studies of brand tectonic characteristics based on the formation of attributes and properties of the product [17] make it possible to take into consideration the effect of cognitive age on the individual adjustment of style preferences in intentions to purchase clothes. Study [18] theoretically substantiated the technological rationality of scaling options in orthogonal and diagonal movements of the corner points of workpiece contour. However, changes in width measurements are considered in general without zonal distribution of the sizes of allowances in the segmentation of the structure. Since silhouette allowance parameters in one assortment type contain a variable spacing for style varieties, this prevents the term «critical point» from being used in the silhouette group's default representative identification procedure.

Thus, it is advisable to conduct research on the group parameterization of the silhouette designs of the jacket based on the coordination of typical representatives of the style features of physical appearance in the recognition of the image.

3. The aim and objectives of the study

The purpose of this study is to devise a method of parametrical style modification of structures in the topological series of the jacket.

To accomplish the aim, the following tasks have been set:

– to build an algorithm for determining the typical representatives of style varieties of the jacket within a typological series;

– to investigate the linearization of the numerical series of silhouette allowances by calibrating the typical representatives of style varieties of the jacket;

– to compile practical recommendations for the zonal-modular modification of the design parameters for jacket style varieties.

4. Materials and methods to study the parameters of style coordination of the jacket by means of 2D-modification of the design of a typical representative

4. 1. An algorithm for differentiating the style features of jacket varieties in the historical aspect

The historical aspect of changes in segmentation, the proportionality of parts, proportions, scale, defines the range of names of the modern jacket. Image recognition is due to two morphological features such as a silhouette, to delineate the figure, and a length, to determine the proportions [19]. The formation of the relationship of the silhouette, proportions confirms belonging to the typological series of attribute parameters (Fig. 1).

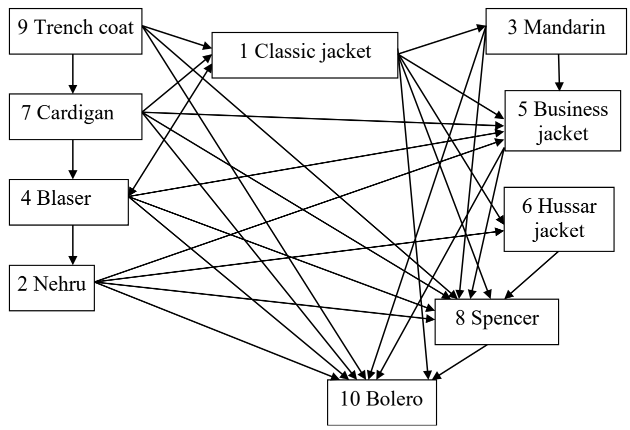


Fig. 1. The original graph for the formation of a relationship among the silhouette and proportions in the nomenclature of historical varieties of the jacket

The chosen basis for identifying the morphological combinations of segmentation in the jacket design is the principle of identity in the zones where the torso is covered by flat primitive shapes (Fig. 2) [14].

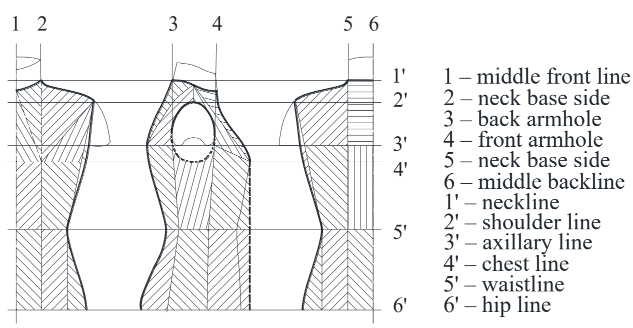


Fig. 2. Diagram of the structural zones of conditional flat primitive shapes in the anthropometric planes of the dummy surface

The typical design of the women's classic jacket corresponds to the universal structural solution for products in the jacket group in the form of a basic design (Fig. 3).

The morphological combination of flat primitive shapes reproduces the principle of design identification in the schemes of typical segmentation [20]. Each segmentation type has a number k of variants to modify the prototype. The total number of solutions in the set of possible variants of morphological features is determined from the following formula:

$$N = \prod_{i}^{n} k_i, \quad (1)$$

where N is the total number of solutions; k is the number of variants.

The set of morphological features of the basic design of the jacket, taking into consideration the mechanism of formation (Fig. 3), characterizes the graph of shape-forming segmentation (Fig. 4).

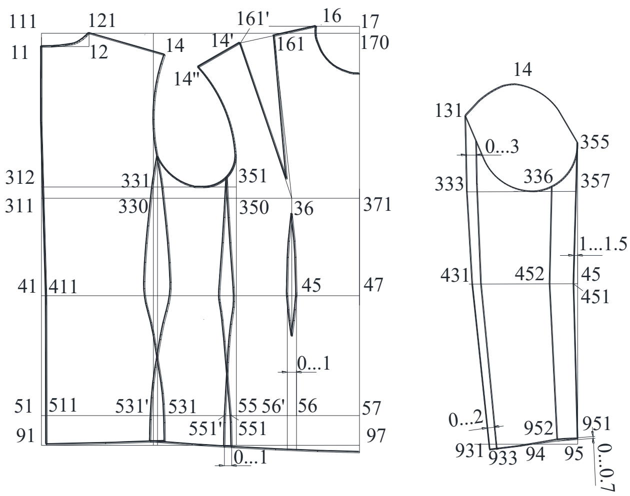


Fig. 3. Optimized prototype of the basic jacket design

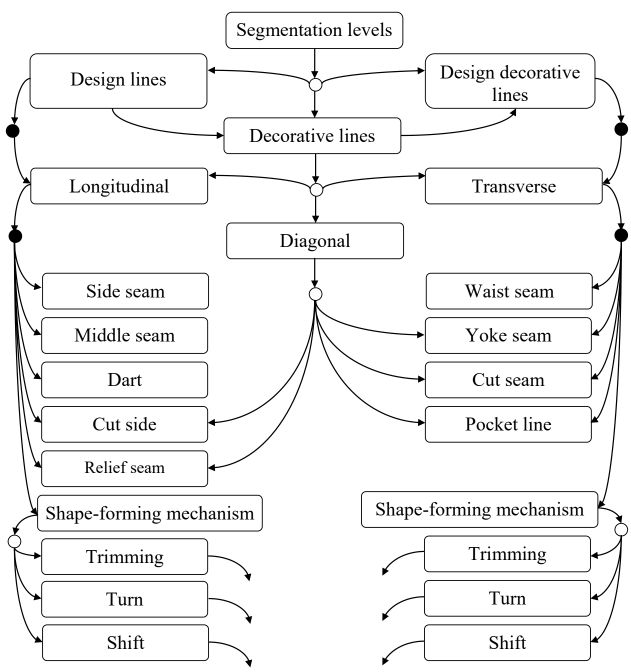


Fig. 4. The AND-OR graph of the shape-forming segmentation of jacket model structures: ● — AND type vertex; ○ — OR type vertex

To form a set of the most common morphological features, it is advisable to use a classifier of structural and technological solutions of jacket style varieties. The full list of groups of classification features of jacket-type products contains 10 items, which are divided into two groups – nominal and additional [21]. The parallel encoding method makes it possible to develop authentic classifiers from any level.

As a result of studying the world experience in the formation of assortment policy, a manufacturer found that the selection of fashionable clothing offers affects not only the circulation of the model but also the adjustment of style preferences in the manufacturer's products [21]. A stable typical set of elements of the functionality of the shape undergoes minor changes in the preservation of the «image» of the structure and ensures technological uniformity of models due to adaptability to a specific group of equipment [14, 22].

The procedure of searching for the sequence of modification of the basic design into a style type of the jacket includes vectors $\mathbf{B}_1$ and $\mathbf{B}_2$, which should ensure the quality of the finished product fit. The $\mathbf{B}_1$ vector – silhouette transformations describe two functions:

– F_{11} – the transformation of basic silhouettes;

– F_{12} – the modification of silhouette derivatives.

The dummy is provided with the minimum required allowance ASi0=2.0 cm. In the classic jacket, for F_{11}, the following allowances are used for basic silhouettes: ASi1=5.0 cm; ASi2=6.5 cm; ASi3=8.0 cm. The silhouettes of the jacket varieties F_{12} are derived from the basic ones and are subordinate to the variability in the fashion allowance Af within the discrete quantity ASi2–ASi1=1.5 cm, ASi3– ASi2=1.5 cm.

Vector 2 characterizes the scale of the volume and the proportions of the length of the jacket. The F_{21} function describes the transformation of an armhole depth, F_{22} – describes a length change.

The armhole depth (F_{21}) calibration is as follows: ACda0=2.5 cm; ACda1=3.5 cm; ACda2=4.5 cm; ACda3=6.5 cm. Discrete change value is a=1.0 cm.

The F_{22} function takes into consideration the scales of the recommended length of the product [19]. The scale of the recommended length includes three variants: shortened – 52.0–58.0 cm (bolero, Spencer, Hussar jacket), ordinary – 66.0–72.0 cm (classic, blazer, business, mandarin), elongated – 74.0–80.0 cm (cardigan, trench coat, Nehru).

The relationship of vectors $\mathbf{B}_1$ and $\mathbf{B}_2$ ensures modification of the width and length of style varieties of the geometric shape of the jacket.

The research algorithm is supported by a database of methods: graph theory – to identify the relationship of the silhouette and proportions in the nomenclature of varieties of the modern jacket; cluster analysis of the common characteristics of the design of the main parts – to highlight the prototype by the method of typical representation; mathematical modeling – to optimize the parameters of silhouette allowances by regression analysis methods; mathematical statistics – to estimate the results of experimental studies of morphological combinations of segmentation in the design of the jacket.

4. 2. A procedure to linearize the numerical series of silhouette allowances in the designs of the jacket

To study silhouettes in the jackets of different styles, a method for scaling the allowance for free fitting in empirical constructs was applied, which were designed on the basis of the following procedures: 1 – UMDC CMEA, 2 – Muller and son, 3 – CFPD Center for Fashion and Product range development). All procedures reproduce a typical set of attributes of the shape of the jacket. In the jacket, the central element for determining the silhouette is the body design. Classification features of the body parts segmentation are consistent with the requirement for constant use, despite changes in fashion and type of production.

Statistical treatment of methodological recommendations for the normalized values of structural allowances for a silhouette (Tables 1–3) confirms the presence of values for basic silhouettes (Fig. 5).

Table 1

Structural allowances for free fitting (FF) within suit product range. Women, girls

Degree of fit	Allowances to the width of the entire product, cm			
	chest level	waist level	hip level	shoulder girth level
Very tight Si0	2.0–2.5	0.5–1.0	0.5	3.2
Tight Si1 (fit silhouette)	3.0–4.0 3.5	1.0–2.0 2.5	1.0–2.0 2.5	4.0
Medium Si2 (semi-fit silhouette)	4.0–5.0 5.0 (4.0–6.0)	3.0–4.0 3.5 (3.0–4.0)	2.0–3.0 3.5 (2.5–4.5)	1.5 (3.5–5.5)
Free Si3 (direct silhouette)	>7.0 6.5 (5.5–7.5)	>4.0 4.5 (4.0–5.0)	>3.0 4.5 (3.5–5.5)	5.0 (4.0–6.0)

Table 2

Structural allowances in women's jackets on silhouettes ASi

Silhouette	Absolute values of allowances ASi along the lines, cm			
	chest silhouette	waist silhouette	hip silhouette	shoulder girth silhouette
Fit	5.0	4.0	4.0	4.5
Semi-fit	6.5 (5.5–7.5)	5.5 (4.5–6.5)	5.5 (4.5–6.5)	5.5 (4.0–6.0)
Direct	8.0 (7.0–9.0)	7.0 (6.0–8.0)	7.0 (6.0–8.0)	5.5 (5.0–6.0)

Table 3

Free fit allowances at varying degrees of fit (DF) along product lines

Article type	Allowances, cm														
	Very tight			Tight			Medium			Free			Very free		
	ACb	ACw	ACh	ACb	ACw	ACh	ACb	ACw	ACh	ACb	ACw	ACh	ACb	ACw	ACh
Jacket	3.0–4.0	1.5–2.0	0.5–1.5	4.0–5.0	3.0–4.0	1.5–3.0	6.0–7.0	5.0–7.0	3.0–5.0	7.0–9.0	–	–	9.11	–	–

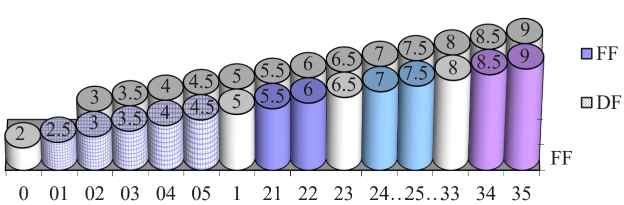


Fig. 5. Distribution diagram of ASi1=31-37 allowance in basic silhouettes

To study the designs by the method of control measurements, the ratio of 0.25–0.5–0.25 from the FF value was chosen as the basic variant.

The list of normalized control measurements for FF parameterization corresponds to the table of measurements of technical description. These include the width of the back, the width of the front, the width of the article under an armhole. To design silhouette variants, it is enough to change the width along the chest line by the size of the increment (Fig. 6).

The Si1 design is the basic design for Si2 and Si3.

The use of the scaling method for the automated modification of the design of the jacket Si1 (Table 4) helps minimize the construction of the basic structure since the variative range of allowance is replicated according to the prototype gradation (Fig. 7).

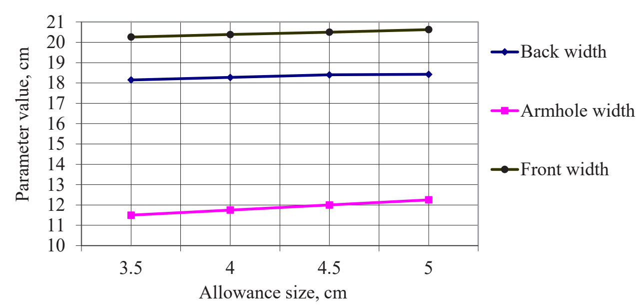


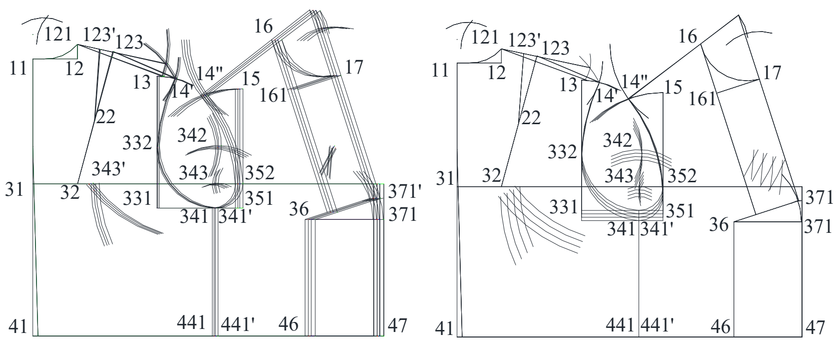
Fig. 6. Silhouette modification Si1 coverage

The transformation of the silhouette ensures a change in the volume of the article in general, along the lines of the chest, waist, and hips. The transformation of the armhole depth ensures local adjustment of the lower area of the armhole.

Table 4

Parametric characteristics of the transformed matrix design of the women's jacket 158–88–96 in the system of allowances, cm

Allowance		Body				Sleeve			
Conditional designation	Allowance size	Wb	Wa	Wf	Lp	Wsh	Hsh	Ls	Ws
ACb	4.0	18.46	12.5	20.76	65.99	17.05	14.31	56.25	32.90
	4.5	18.49	12.75	20.89	65.99	17.05	14.41	56.34	32.90
	5.0	18.51	13.00	20.92	65.99	17.05	14.51	56.43	32.90
ACda	4.5	18.35	12.0	20.50	65.99	17.05	15.51	56.31	32.85
	5.0	18.35	12.0	20.50	65.99	17.05	16.21	56.31	32.83
	5.5	18.35	12.0	20.50	65.99	17.05	16.91	56.31	32.81
	0.08	18.45	12.50	20.77	69.15	17.55	14.13	56.02	34.65



a *b*

Fig. 7. Drawings of the silhouette transformation in the design of women's clothing: *a* – the transformation of the silhouette; *b* – the transformation of the armhole depth

4. 3. Zonal-modular approach to the parameterization of operators for modifying the typical segmentation of a part's design

In empirical structures, the geometric object is a flat component described by a curvilinear path. The theoretical basis for the formation of a curvilinear path is determined by three conditions such as the number of points for which the coordinate change is assigned, a change in the length of the curvilinear section, and a change of derivatives at the ends of the path area.

This process is executed by commands: point, segment, arc, circle, line [23].

Three-dimensional spatial shape-formation in a flat part is implemented in the $\mathbf{B}_3$ vector by the following functions of F_{31} – the distribution or movement of darts in the support section; F_{32} – the formation of the internal segmentation of the part. The F_{31} function describes the transformation of a typical design of the upper dart (chest or shoulder) decorated with straight lines from the shoulder cut.

The effect of the rigidity of the material on the length of the dart is accounted for in the graphical model of the project field of experimental studies [10]. The boundary angles of the project field regulate the reduction of the length of the dart from 0 to 5 cm (Fig. 8).

The nomogram of rational harmonic positions of the chest dart (Fig. 9, *a*) implements the modification of the dart for any size and height (Fig. 9, *b*).

To verify the model transfer of the dart parametrically, a unified series of linear dimensions (Table 5) and a template of guide lines are used (Fig. 10).

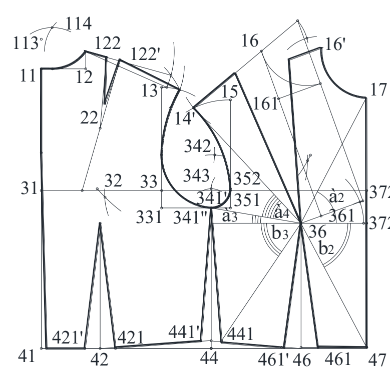
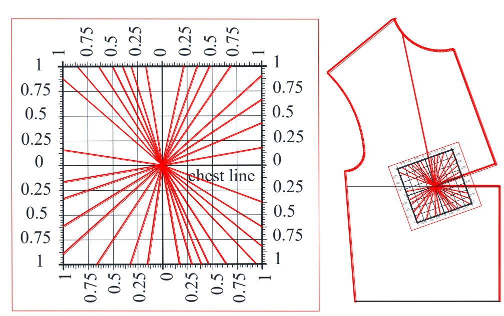


Fig. 8. Estimation scheme of the boundary angles of the project field according to the UMDC CMEA methodology



a *b*

Fig. 9. Determining the harmonious positions of a chest dart: *a* – the rational harmonious positions of the chest dart; *b* – an example of using a template

Table 5

Unified series of chest dart linear sizes

T_{46}	l	Y	X
8.6	15.75	15	4.81
8.9	15.85	15	5.11
9.2	15.94	15	5.39
9.5	16.03	15	5.65
9.8	16.12	15	5.90
10.1	16.21	15	6.14
10.4	16.30	15	6.37
10.7	16.38	15	6.59
11.0	16.47	15	6.80
11.3	16.55	15	7.00
11.6	16.63	15	7.19
11.9	16.71	15	7.37
12.2	16.79	15	7.55
12.5	16.87	15	7.72
12.8	16.95	15	7.88
13.1	17.02	15	8.04
13.4	17.09	15	8.19
13.7	17.16	15	8.34
14.0	17.23	15	8.48
14.3	17.30	15	8.62

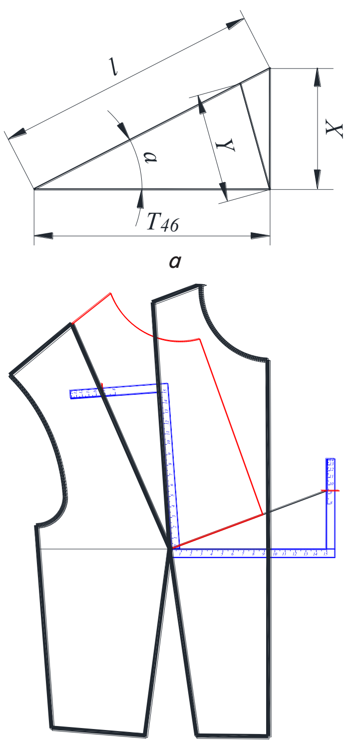


Fig. 10. Template of the chest dart model transfer: *a* — estimation scheme of chest dart parameters for template development; *b* — checking the correctness of the transfer of the chest dart to the model position

The F_{32} function that shapes the reliefs, yoke, trimmings is executed after the modification transformations of upper darts by trimming off the model line relative to the junction point of the structural zones of the segmentation areas.

Using an upper dart as the default representative meets the linear approximation condition of the curvilinear inner segmentation path.

The $\mathbf{B}_4$ vector characterizes the design of functionally decorative parts of the jacket. The F_{41} function describes the construction of edge lines of the clasp, neck, bottom. The F_{42} function describes the design of the collar. The F_{43} function describes the types of pockets. Parameters for the structural-decorative parts typically summarize the practical experience and are of a recommendation character.

The group set of modules N_{mod} for the study of modification operators BC as an optimized prototype is determined by the sum of F_i functions in the modification vectors $\mathbf{B}_i$:

$$N_{\text{mod}} = \prod_{i=1}^{4} \mathbf{B}_i(F_i) = \mathbf{B}_1(F_{11}, F_{12}) + \mathbf{B}_2(F_{21}, F_{22}) + \\ + \mathbf{B}_3(F_{31}, F_{32}) + \mathbf{B}_4(F_{41}, F_{42}, F_{43}) = 9 \text{ modules.} \quad (2)$$

Vectors $\mathbf{B}_1$ and $\mathbf{B}_2$ characterize control measurements of the finished article. Vector $\mathbf{B}_3$ characterizes the three-dimensional shape formation of a part. Vector $\mathbf{B}_4$ characterizes the parametrization of the structural-decorative parts.

5. Results of studying the style coordination of parameters for modifying the jacket design

5. 1. An algorithm for determining the typical representatives of the jacket style varieties within a typological series

A theoretical model of the typological systematization of morphological features of the physical appearance of 10 varieties of modern jackets represents an optimized prototype of a five-seam structure with a sewn-on sleeve (Fig. 3). The model of the cycle of attributes of the silhouette and proportions ensures modification of the design of the classic jacket according to the parameters of width and length (Fig. 11).

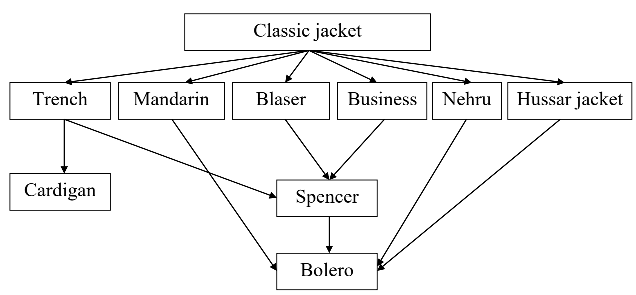


Fig. 11. The structural-semantic model of the typological series of vectors of the jacket style modification

Hussar jackets and bolero jackets that do not have universal use are excluded from the studies of uniformity of structures.

A sketch project of model designs of style varieties is given in Table 6.

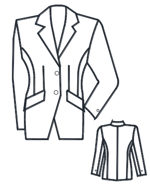
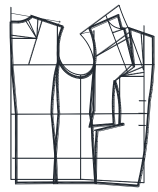
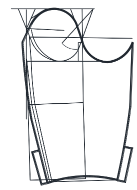
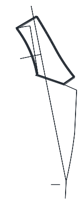
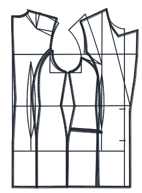
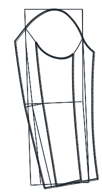
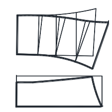
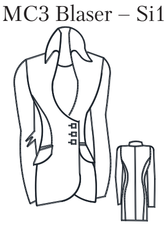
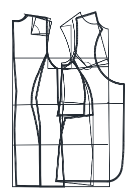
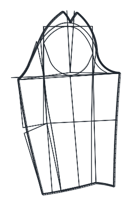
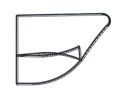
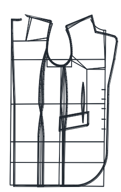
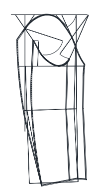
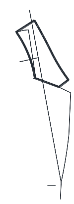
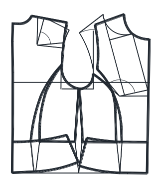
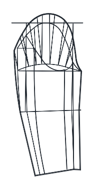
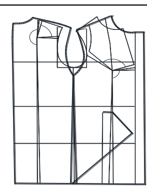
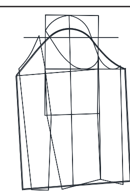
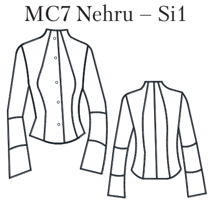
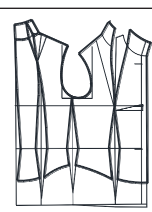
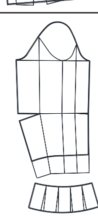
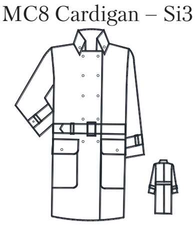
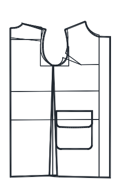
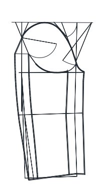
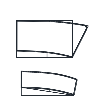
The adequacy of information on the sample size to differentiate the style varieties of the classic jacket, built according to procedure 1, is tested by the following formula:

$$N = p^k, \quad (3)$$

where N is the number of observations; p is the number of levels; k is the number of factors.

Table 6

Sketch project of model designs of the main parts of the jacket

Jacket model, silhouette	Article structure		
	Body	Sleeve	Collar
MC1 Classic – Si2 			
MC2 Trench coat – Si1 			
MC3 Blaser – Si1 			
MC4 Business – Si2 			
MC5 Spencer – Si1 			
MC6 Mandarin – Si3 			
MC7 Nehru – Si1 			–
MC8 Cardigan – Si3 			

The number of levels $p=2$ (the type and variety of a jacket). The number of factors $k=3$ (silhouette Si1, Si2, Si3). Then $N=2^3=8$ varieties (Table 6).

The classifier of segmentation variants characterizes five levels of the structural solution for the main parts of the jacket (Table 7).

Table 7

Classifier of segmentation variants of the structural solution for the main parts of the jacket

Level	Part name	Structural solution variant
Level 1	Body	B1 – 2 parts B2 – 3 parts B3 – 4 parts
Level 2	Back	B1 – solid B2 – middle seam B3 – relief B4 – combination B1+B2 B5 – combination B2+B3
Level 3	Front	B1 – solid B2 – side and darts B3 – relief B4 – combination B2+B3 B5 – combination B1+B3
Level 4	Sleeve	B1 – one-seam long B2 – two-seam long B3 – bottom with a vent B4 – bottom with a cuff
Level 5	Collar	B1 – no collar B2 – standing collar B3 – standing-folding collar B4 – collar with lapels (jacket-type)

The matrix of pairs of ciphers of the classification features of model structures of the jacket is given in Table 8.

The chosen criteria for a structural-technological evaluation of model designs in a typological series are as follows: a coefficient of structural homogeneity $K_{s.h.}$ for the use of a typical technological process as the most productive one; a matrix sparsity coefficient $K_{m.s.}$ to determine the volume of reduced group design documents. The calculations involved the number of combinations of parts $\sum D_i$ and the number of combination variants $\sum B_i$ from Table 8.

The structural uniformity of typological series models is determined from the following formula:

$$K_{s.h.}=\frac{\sum_1^n D_i-\sum_1^n B_i}{\sum_1^n D_i}=\frac{66-19}{66}=0.7. \quad (4)$$

The combinations matrix sparsity is checked by the following formula:

$$K_{m.s.}=\frac{\sum_1^n B_i}{\sum_1^n D_i}=\frac{19}{66}=0.29. \quad (5)$$

Our analysis of $K_{s.h.}$ and $K_{m.s.}$ has determined the assessment of model structures by the level of recommendations. In studying the typological group MC2, MC3, MC4, in order to finalize the mathematical support to the linearization of the numerical series of a silhouette allowance, the basic base chosen was MC1 (Table 8). MC5, MC7 belong to Si1 and are subject to verification of segmentation variants. MC6, MC8 belong to Si3, which allows us to assert the expediency of forming a separate typological group within the typological series.

5. 2. Results of studying the calibration of silhouette allowances for differentiating the jacket style varieties

To calibrate the silhouette allowance, three models were studied on the basis of the figurativeness of the silhouette shape. MC1, the classic jacket, includes five vertical prototype segmentations. MC4, the business jacket, is close to the design of the men's jacket and has a flattened chest shape. MC3, the blazer, has seven sections of vertical segmentation of the adjoining tight silhouette to emphasize the gender equality of the club jacket. Accordingly, they demonstrate variations in the basic silhouette allowances, given in Tables 1–3.

To use the F_{12} function that modifies silhouette derivatives, the assumption of maintaining a stable deviation of silhouette allowances ASi2–ASi1=1.5 cm; ASi3–ASi2=1.5 is taken into consideration. To verify the assumption, we studied the silhouette transformations of the design on the chest line based on the normalization of allowance size along the chest line in the industrial templates of 24 structures for the selected typological group. The results of studying the allowance for freedom along the chest line are given in Table 9.

Table 8

Morphological analysis of variants in the design solutions for a typological series of jackets

Model cipher	sil-houette	Name of the part and cipher of the variant					Number of combinations	Estimate
		Body	Back	Front	Sleeve	Collar		
BMC1	Si2	B2	B2	B2	B2	B1	6	basic
MC1	Si2	B2	B2	B2	B1	B4	6	recommended
MC2	Si1	B3	B2+B3	B2+B3	B2	B2	8	recommended
MC3	Si1	B3	B2+B3	B2+B3	B1	B3	8	recommended
MC4	Si2	B2	B2+B3	B2+B3	B2	B4	8	recommended
MC5	Si1	B2	B1+B3	B2+B3	B2	B2	8	debatable
MC6	Si3	B2	B1+B3	B1+B3	B1	B3	8	non-recommended
MC7	Si1	B3	B2+B3	B3	B3	B1+B2	8	debatable
MC8	Si3	B1	B2	B1	B2	B2	6	non-recommended
Number of parts combinations $\sum D_i$	9	9	15	14	9	10	66	
Number of combination variants $\sum B_i$	3	3	3	3	3	4	19	

Table 9

Statistical analysis of the allowance along a chest line ACb in the style types of designs of the women's jacket

Jacket type	Position	The size of allowance ACb in silhouette structures, cm								Average arithmetic value X, cm	RMS deviation S, cm
		Tight silhouette				Semi-tight silhouette					
Classic	x_1	5.2	5.4	6.0	6.3	6.1	6.6	7.1	7.5	6.275	0.7852
	Δx_1	−1.075	−0.875	−0.275	0.025	−0.175	0.325	0.825	1.225	0	
	$\lvert\Delta x_1\rvert$	1.075	0.875	0.275	0.025	0.175	0.325	0.825	1.225	0.6003	
	Δy_1	0.2898	0.0898	−0.5102	−0.7602	−0.6102	−0.4602	0.0425	0.4398	−0.1849	
Business	x_2	5.6	5.8	6.5	6.6	7.1	7.7	8.0	8.3	6.95	1.0129
	Δx_2	−1.35	−1.15	−0.45	−0.35	0.15	0.75	1.05	1.35	0	
	$\lvert\Delta x_2\rvert$	1.35	1.15	0.45	0.35	0.15	0.75	1.05	1.35	0.825	
	Δy_2	0.3371	0.1371	−0.579	−0.6629	−0.8629	−0.2629	0.0371	0.3371	−0.0649	
Blaser	x_3	6.0	6.2	6.6	6.9	7.5	8.0	8.5	8.8	7.3125	1.0517
	Δx_3	−1.3125	−1.1125	−0.7125	−0.4125	0.1875	0.6875	1.1875	1.4875	0	
	$\lvert\Delta x_3\rvert$	1.3125	1.1125	0.7125	0.4125	0.1875	0.6875	1.1875	1.4875	0.8875	
	Δy_3	0.2608	0.0608	−0.3445	−0.6392	−0.8642	−0.3642	0.1358	0.4358	−0.1849	

The experimental data are described by the following linear dependence:

$$y = a_1 x + a_0. \tag{6}$$

The a_1 and a_0 values were calculated by a least-square method.

The calculations of the minimized $ACb_{\min}$, typified ACb_{typ} have made it possible to determine the values of the mean allowance: $\underline{X} = ASi1 = 6{,}08$ cm; $\underline{X} = ASi2 = 7{,}6$ cm. Compliance with the conditions of ACb linearization was checked by control $\Delta\underline{X} > \sum \Delta ACb = 3.31 > 3.11$ cm.

The feasibility of the linear formula was tested by the linear interpolation of the source data ΔX_i and ΔY_i (Fig. 12).

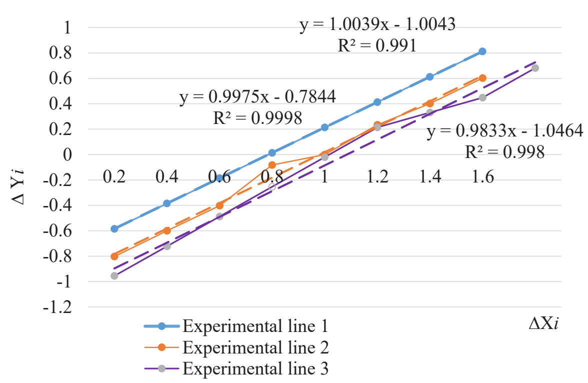


Fig. 12. The trendline of deviations ΔY_i in the allowance ACb in the women's classic jacket

The beginning of the variative series ASi1 of the classic jacket was checked by the equations of linear regression (Fig. 12): line 1 y=1.0339·6.08–1.0043=5.09 cm; line 2 y=0.997·6.08–0.7844=5.28 cm; line 3 y=0.9833·6.08–1.0464= =4.93 cm. The size of the discrepancy is 0.18 cm, this corresponds to the basic silhouette: ASi1=5.0 cm.

For Si2: ASi1+1.5=5.0+1.5=6.5 cm, which is included in the numerical series of both Si1 and Si2.

The structure of the normalized values of silhouette allowance along the chest line is given in Table 10.

Interdimensional build-up of ACb is characterized by the diagonals of 5.0; 6.0; 7.0 cm (Si1), and 6.0; 7.0; 8.0 cm (Si2).

The total difference in progression a=1.5 cm corresponds to the condition of stability of discrete deviations ASi1 in basic silhouettes.

The same ACb values confirm the presence of critical points for silhouette transformation. That makes it possible to use the pre-emptive unification of the main parts of the women's jacket as a family of models in the typological group: classic, business, blazer.

5. 3. Practical recommendations for the zonal-modular design of the structural parameters of jacket style varieties

The model structures represented by the sketch project in Table 5 have common design features ($K_{s.h.}$=0.71) and are distinguished by the design of edge lines and finishing parts.

A zonal change in the silhouette of the body design was investigated using the functions F_{11}, F_{12} with respect to ASi1=5.0 cm (Fig. 13).

Table 10

Matrix of normalized allowances along the chest line in the designs of a traditional women's jacket

Jacket variety	Allowance numerical series		Communication valence		Progression difference, a, cm	
	Si1, cm	Si2, cm	Si1	Si1	between values	between sizes
Classic	5.0; 5.5; 6.0	6.0; 6.5; 7.0	3	3	0.5	1
Business	5.5; 6.0; 6.5	6.5; 7.0; 7.5	3	3	0.5	1
Blaser	6.0; 6.5; 7.0	7.0; 7.5; 8.0	3	3	0.5	1

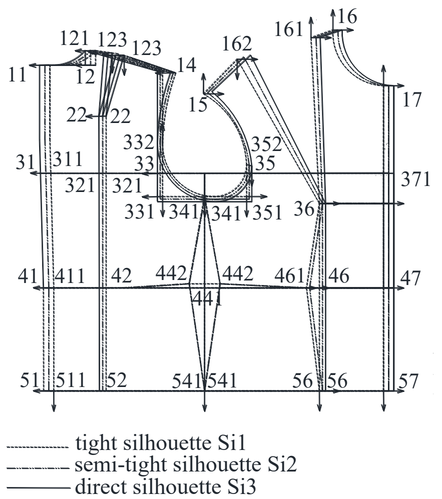


Fig. 13. Silhouette transformation of the seven-seam design of the women's jacket Si1→Si2→Si3

The dimensions of the part are changed equidistantly in all areas of the path [23]. The ambiguity of design of the modules of the curvilinear contours of the neck and armhole is provided for by the radiusography method [15] (Fig. 14).

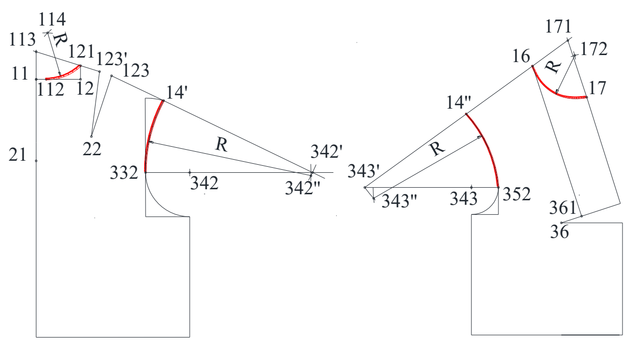


Fig. 14. Design of the curvilinear path modules by the radiusography method

The module of shape-forming segmentation is provided for by the functions of graphical models of the flat-rotational displacement of chest dart F_{31} and relief formation F_{32}. A prerequisite is to comply with the rule of priority design of segmentations that cross the outer contours of the part.

The areas of the width of a double-seam sleeve (F_{11}) for the module of the front rollback consider the displacement parameters relative to the line of laying a template by 2.0–4.0 cm. The typological series of the normalized values of front roll in the methods of 1.0–3.0 cm, taking into consideration the values of arithmetic progression $a=0.5$ cm, is as follows: 2.0; 2.5; 3.0; 3.5; 4.0 cm.

The $\mathbf{B}_4$ vector zone is an add-on to BC (Fig. 3) for the functional-decorative design of the jacket in the form of modules of clasp, jacket-breast, lapel, collar, pockets, vent. The vent design has the unified parameters of length and width, which are subordinated to the type of technological equipment. The bottom of the body and sleeves of the jacket can be decorated with a vent (elongated length) and be without a vent (shortened length). The design of the classic vent has typical parameters for the unification of structural lines. A sleeve vent length is 6.0–9.0 cm; width, 2.0–3.5 cm. The length of the vent in the middle seam, lateral seams is subordinated to measuring the length of an article and is oriented to a level below the hip line. The width of the vent has the typical parameters of 4.0–4.5 cm for the unification of structural lines.

The jacket-breast fastening module (F_{41}) includes the lapel zone and the edges of the jacket-breast, which are separated by the level of the first loop. The recommended fastening parameters in the articles of jacket assortment are given in Table 11.

Table 11

Recommended fastener parameters

Garment type	Distance from the jacket-breast side, cm		Allowance for fastening, cm	
	to the edge of the button	to the beginning of the first row of loops	central	shifted
Jacket	1.0–1.5	1.5–2.0	2.0–3.5	6.0–8.0

The width of the jacket-breast is determined as the sum of 1/2 of the diameter of the button d_{but} and the distance between the edge of the button and the edge of the jacket-breast (Fig. 15) but not less than 3/4 of the diameter of the button:

$$k=\frac{d_{but}}{2}+m, \tag{7}$$

where m is the allowance that determines the distance from the edge of the button to the edge of the jacket-breast.

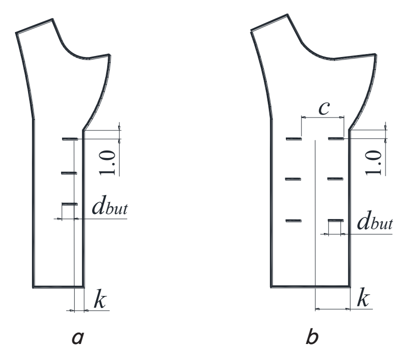


Fig. 15. Fastening module: *a* — central; *b* — offset

If an article has a decorative line, then the allowance for the fastener is increased taking into consideration its size:

$$k=\frac{d_{but}}{2}+a, \tag{8}$$

where a is the width of the finishing line along the edge of the jacket-breast.

The maximum allowance for the shifted fastener should not exceed the measure T_{46} since the edge of the jacket-breast should not overlap the relief line or the chest and waist dart in the finished article.

An allowance for the shifted clasp (Fig. 15, *b*) is calculated according to the following formula:

$$k=\frac{c+d_{but}}{2}+m, \tag{9}$$

where m is the distance between two parallel rows of buttons.

A typical distance between the buttons and horizontal loops in outerwear is 10.0–14.0 cm. The typological series of the distance between loops is as follows: 10.0; 10.5; 11.0; 11.5; 12.0 cm. An article silhouette adjusts the distance setting. In the articles with a tight silhouette, the level of loops and buttons should correspond to the level of extreme points of the chest, waist, and hips. In the articles with a direct silhouette, the level of the lower loop is subordinated to the location of pockets or a waist level. In the fastener for three buttons, the lower loop is located at the level of a side pocket, for two buttons – the lower loop is located in the middle between the waist and side pocket, for one button – at the waistline level of ±1.0 cm.

According to the contour of the lower part of a jacket-breast, the following types of jacket-breast design are distinguished: straight, rounded, beveled. The extreme contour change point is located 11.0 cm below the waistline, the second is 5.5 cm (5.5 cm) tangent below the width. The normalized rounding (bevel) series is 5.5; 6.5; 8.5 cm.

The lapel module is defined relative to the starting point of the folding line. The upper loop is located 0.5–1.0 cm below the end of the lapel from the position of aesthetic expediency not to overlap the button. The width and length of the lapel are interrelated with the number of loops and buttons [24]. There are 4 defaults for the number of buttons in the fastener: 1, 2, 3, 4. Lapel variants are represented by four variants of the upper loop level relative to the waistline, three groups of lapel width, two groups of lapel ledge variants. The level of the upper loop relative to the waistline is 3; 6; 9; 12 cm. The width of the middle lapel is 8.0–10.0 cm; narrow, 6.0–7.0 cm; wide, 11.0–15.0 cm. Lapel ledge angle variants for size group 88–104 are 40, 50, 60, 75, 95; for size group 108–120–45, 55, 70, 80, 100.

The parameters of jacket-breast are typified by reducing the number of variants, taking into consideration the lower and upper deviation boundaries at the main points of the contour (Fig. 16).

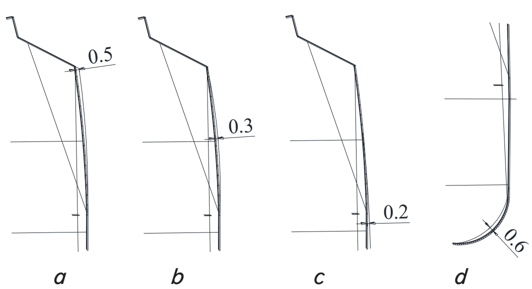


Fig. 16. Jacket-breast parameters that are typified at a section: *a* – ledge; *b* – lapel; *c* – the edge of the jacket-breast; *d* – the lower corner of the jacket-breast

A module of the functional-decorative node of the collar is subordinated to the classification features of the structural elements of the collar (Table 12).

Table 12

Parameters of collar's structural elements

Collar structural element	Standing middle riser height, cm									
	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Riser height	4.0	3.5	3.3	3.0	2.8	2.5	2.0	1.8	1.7	1.5
Outreach width	4.5	4.5	4.7	5.0	5.2	5.5	6.0	6.2	6.5	7.0
Riser cross-section deflection	0.5	1.0	1.2	1.5	2.0	2.2	2.5	3.0	3.0	3.5

The modules of the jacket collars are subordinated to the classification of collar structures by fastener type: open – to the lapel (Fig. 17) and closed – to the top (Fig. 18).

The module of typical riser structures with different values of lifting the middle of the collar is shown in Fig. 19.

A module of the typical pocket design characterizes the varieties of pockets according to the manufacturing technology and structural parameters (Table 13).

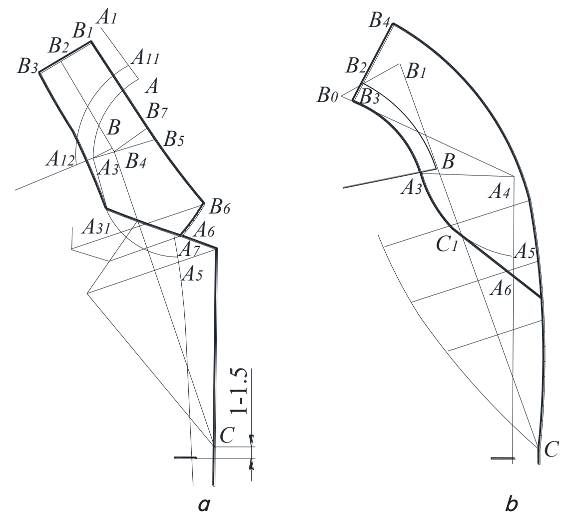


Fig. 17. Module of typical designs of collars of women's jacket for open fastener: *a* – jacket; *b* – shawl

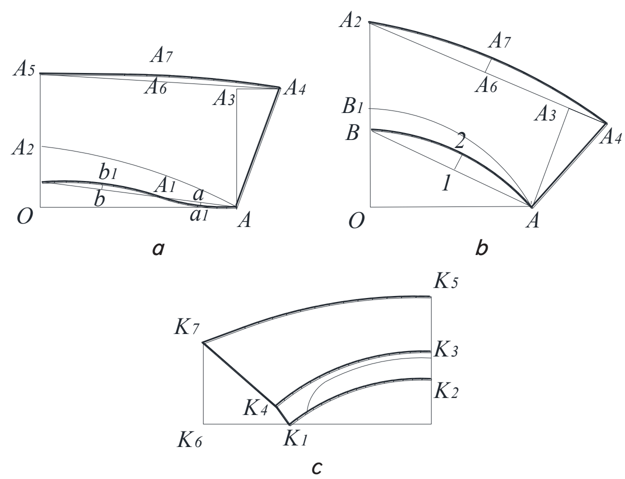


Fig. 18. Module of typical designs for standing-foldable collars of women's jacket for a closed fastener: *a* – with a neck lag; *b* – with a tight fit to the neck; *c* – with a cut-off riser

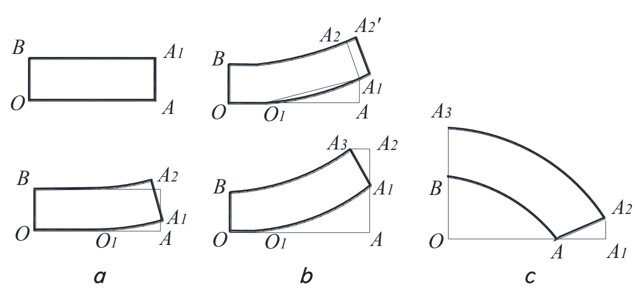
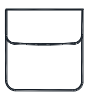


Fig. 19. Module of typical cut-off riser designs with deflection values of the middle of the collar: *a* – small, 1.0 cm; *b* – medium, 3.0–6.0 cm; *c* – large, 8.0–10.0 cm

Table 13

Typical parameters of women's jacket pockets (basic size, 164–96–104)

Physical appearance sketch	Varieties of pockets	A part from the main fabric	Conditional designation of measuring places, cm			
			1	2	3	4
Side, cut-off. Inclination angle to the vertical – 93°						
	with a lap	lap	6.0–8.0	14.0–17.0	9.0–14.0	6.0–7.0
	frame-type	cladding	6.0–8.0	14.0–17.0	9.0–14.0	6.0–7.0
Side, cut-off. Inclination angle to the vertical – 75°						
	with a lap	lap	4.0–7.0	14.5–17.5	9.0–14.0	6.0–8.0
	frame-type	cladding	4.0–7.0	15.5–17.5	9.0–14.0	8.0–12.0
	with a leaf	leaf	6.0–7.0	14.5–17.5	9.0–14.0	2.0–3.5
Side attachable, cut-off. Inclination angle to the vertical – 93°						
	Attachable with cladding or a lap	attachable, lap	8.0–9.0	17.0–19.0	10.5–11.5	18.0–20.0

*Notes: *1 – distance from the waistline to the front edge of the pocket; 2 – the length of the entrance to the pocket; 3 – the distance from the half-shift line to the front edge of the pocket; 4 – the width of the main pocket part. **Between sex size groups, the difference in the length of the entrance to the pocket is 1.0 cm*

The modeling of pockets considers the unified dimensions in accordance with the technological characteristics of the equipment. Groups of sizes and angles of inclination normalize the length parameters by the value of the arithmetic progression a=0.5 cm.

6. Discussion of results of studying the influence of parameters for the structural modification on the coordination of the style features of the jacket

The advantage of this study is the use of style coordination of varieties of jackets subordinated to the utilitarian function of «image recognition» from the position of the consumer (Fig. 1). The complexity of the graphic interpretation of the prototype design is that the morphological combination of segmentation of jacket design, on the one hand, should ensure the identity of the areas that cover the torso, on the other hand, to provide for a flexible reorientation to a positive perception of the individuality of the style.

Studying the aesthetic and functional attributes of the model series of the jacket indicates the complexity of the parametrical scale of the design concept in the dynamics of the development of nominal external features of an article. In this sense, the scale of silhouette transformations in the vector of scale and proportions [21] is of particular interest. The practical use of the linear character of allowance change (Tables 1–3) by the value of the arithmetic progression a=0.5 cm indicates the linear variability of the allowance for a silhouette. That confirms the expediency of changing the width along the chest line by the size of the silhouette increment (Fig. 6), which agrees with actual data reported in [5, 7]. The use of the scaling method in the automated modification of the basic design on the gradation prototype ensures the transformation of Si1–Si2–Si3 (Fig. 13).

In empirical constructions of the three-dimensional shape of a flat part of the cut, the formation of a curvilinear contour is described by models of graphical interpretation of the position of points in the length of the contour. The results of studying the internal segmentation of a flat part [10] indicate the impact of the rigidity of the material on the boundaries of the project field of directions and lengths of the chest dart selected as the optimized prototype of shoulder garment segmentations. The acquired models of a silhouette transformation (Fig. 7), the design of the contours of the neck and armhole (Fig. 14) confirm the ambiguity of design by a radiusography method. However, in contrast to the results of studies into the effect of the measure of fit on the geometry of the relief contour [11], our data suggest a zonal-modular model for the adaptation of flat primitive shapes (Fig. 2). According to the principle of disconnection and joining in the matrix of combinations of classification characteristics codes (Table 9), the recommendations for the choice of model structures are influenced by structural homogeneity within the typological series. Regulation of the identity of modules is ensured by a mechanism of sparseness in the variants of combinations. However, the variability of structural solutions in the typological series of jackets imposes a limitation on the group application of functional-decorative pocket parts (Table 13).

Unlike the traditional use of typical dimensions of the functional-decorative parts [21], numerical series of the normalized parameters are offered to adjust the modules of edge lines.

Normalization of modification parameters in $\mathbf{B}_1$–$\mathbf{B}_4$ vectors is of practical significance and could be used as a normative database for modifying clothing designs of another assortment.

A potentially interesting area for further research of the style varieties of the jacket is the inclusion of age groups based on the versatility of the design considered in [25]. Geometric models of modules in combination with zones of the age difference of morphological body structure make it possible to substantiate silhouetted selection of zones for the positive perception of compositional dominant of style.

7. Conclusions

1. We have proven the influence of style coordination of classic representatives of the jacket assortment on the

algorithm of graphic interpretation of the prototype design. Owing to this, it can be argued that the design concept of a modern jacket reproduces the segmentation of individual perception of style. The variability of the attributes of the appearance of the jacket is manifested in the scale and proportions in silhouette transformations. The morphological analysis of variants of the typological series of historical varieties of the jacket has revealed an optimized prototype of the jacket design, which corresponds to the five-seam model design of the classic jacket of a semi-tight silhouette. The tight silhouette has a seven-seam structure with back and front reliefs.

2. The study of calibration of silhouette allowances in the empirical structures of the jacket makes it possible to perform linearization of the allowance size on a silhouette in the transformation of basic silhouettes: ASi1=5 cm; ASi2=6.5 cm; ASi3=8.0 cm. Discrete deviation ΔASi=1.5 cm provides a linear character of modification of silhouette derivatives in the types of jacket relative to critical points: Si1, relative to a value of 6.0 cm; Si2, relative to a value of 7.0 cm. The diagonals of 5.0; 6.0; 7.0 cm (Si1) and 6.0; 7.0; 8.0 cm (Si2) ensure an interdimensional increase in the allowance along the chest line.

3. The practical feasibility of zonal modification of design parameters has been confirmed by variants of interchangeable modules in the structure's parts, the basis of which should be the normalized parameters of the typological series of the structure construction. The values of the arithmetic progression step for the series of modifications of parts are 0.5 cm – to allow for free fitting, the width of the fastener, and the distance between the loops; 1.0 cm – for rounding (bevel) of the jacket-breast, intergroup width of the lapel, an allowance in silhouette derivatives, dimensional silhouettes; 1.5 cm – for an allowance in the basic silhouettes.

Reference

1. Nasibov, E., Demir, M., Vahaplar, A. (2019). A fuzzy logic apparel size decision methodology for online marketing. International Journal of Clothing Science and Technology, 31 (2), 299–315. doi: https://doi.org/10.1108/ijcst-06-2018-0077
2. Ceballos, L. M., Bejarano, M. (2018). Value segmentation of adolescents: a performance of appearance. International Journal of Fashion Design, Technology and Education, 11 (2), 148–159. doi: https://doi.org/10.1080/17543266.2017.1352039
3. Hong, Y., Bruniaux, P., Zeng, X., Liu, K., Curteza, A., Chen, Y. (2018). Visual-Simulation-Based Personalized Garment Block Design Method for Physically Disabled People with Scoliosis (PDPS). Autex Research Journal, 18 (1), 35–45. doi: https://doi.org/10.1515/aut-2017-0001
4. Paço, A., Leal Filho, W., Ávila, L. V., Dennis, K. (2020). Fostering sustainable consumer behavior regarding clothing: Assessing trends on purchases, recycling and disposal. Textile Research Journal, 91 (3-4), 373–384. doi: https://doi.org/10.1177/0040517520944524
5. Hong, Y., Bruniaux, P., Zeng, X., Curteza, A., Liu, K. (2017). Design and evaluation of personalized garment block for atypical morphology using the knowledge-supported virtual simulation method. Textile Research Journal, 88 (15), 1721–1734. doi: https://doi.org/10.1177/0040517517708537
6. Pei, J., Fan, J., Ashdown, S. P. (2020). A novel optimization approach to minimize aggregate-fit-loss for improved breast sizing. Textile Research Journal, 90 (15-16), 1823–1836. doi: https://doi.org/10.1177/0040517519901318
7. Zalkind, V. V., Riabchykov, M. L. (2008). Vykorystannia teoriyi mentalnosti yak neobkhidna umova udoskonalennia protsesu proiektuvannia odiahu. Visnyk Skhidnoukrainskoho natsionalnoho universytetu im. V. Dalia, 2, 130–133.
8. Seo, S., Lang, C. (2019). Psychogenic antecedents and apparel customization: moderating effects of gender. Fashion and Textiles, 6 (1). doi: https://doi.org/10.1186/s40691-019-0175-3
9. Dāboliņa, I., Viļumsone, A., Dāboliņš, J., Strazdiene, E., Lapkovska, E. (2017). Usability of 3D anthropometrical data in CAD/CAM patterns. International Journal of Fashion Design, Technology and Education, 11 (1), 41–52. doi: https://doi.org/10.1080/17543266.2017.1298848
10. Slavinska, A., Zakharkevich, O., Kuleshova, S., Syrotenko, O. (2018). Development of a technology for interactive design of garments using add-ons of a virtual mannequin. Eastern-European Journal of Enterprise Technologies, 6 (1 (96)), 28–39. doi: https://doi.org/10.15587/1729-4061.2018.148984
11. Saharova, N. A., Kuzmichev, V. E., Tsan Ni (2013). Forecasting of indicators of dresses outline shape under their patterns. Izvestiya vuzov. Tekhnologiya tekstil'noy promyshlennosti, 4 (346), 92–99. Available at: https://ttp.ivgpu.com/wp-content/uploads/2015/10/346_24.pdf
12. Guo M. Kuzmichev V., Adolphe D. (2015). Human-Friendly Design of Virtual System «female body-dress». AUTEX Research Journal, 15 (1), 19-29. doi: 10.2478/aut-2014-0033
13. Nakhaychuk, O. V., Zakharova, E. A., Mizrah, A. A., Gorobchyshyna, V. S. (2020). Pressure forecasting of textile materials in the «figure-dress» system. Herald of Khmelnytskyi national university, 2 (283), 135–140. Available at: http://journals.khnu.km.ua/vestnik/wp-content/uploads/2021/01/23-4.pdf
14. Slavinska, A. L., Shtompil, O. M. (2012). Kontseptsiya rehuliuvannia hnuchkosti konstruktorsko-tekhnolohichnoi pidhotovky onovlennia asortymentu v umovakh pidpryiemstva. Herald of Khmelnytskyi national university, 4, 173–178. Available at: http://journals.khnu.km.ua/vestnik/pdf/tech/2012_4/35sla.pdf
15. Islam, M. M., Jalil, M. A., Parvez, M. S., Haque, M. M. (2020). Assessment of the factors affecting apparel pattern grading accuracy: Problems identification and recommendations. Tekstilec, 63 (3), 166–184. Available at: http://www.tekstilec.si/wp-content/uploads/2016/03/10.14502Tekstilec2020.63.166-184.pdf
16. Zarezade, T., Payvandy, P. (2019). 3D Garment Design using Interactive Genetic Algorithm and Clustering. Trends in Textile Engineering & Fashion Technology, 5 (1). doi: https://doi.org/10.31031/tteft.2019.05.000604

17. Yang, Z., Kim, C., Laroche, M., Lee, H. (2014). Parental style and consumer socialization among adolescents: A cross-cultural investigation. Journal of Business Research, 67 (3), 228–236. doi: https://doi.org/10.1016/j.jbusres.2013.05.008
18. Slavinska, A., Syrotenko, O., Mytsa, V., Dombrovska, O. (2020). Development of the production model of scaling uniformity of the assortment complex clothing family look. Fibres and Textiles, 4, 106–117. Available at: http://vat.ft.tul.cz/2020/4/VaT_2020_4_15.pdf
19. Shtompil, O. M. (2011). Vyznachennia strukturnykh zviazkiv v systemi vymiriv lekal modelnoi konstruktsiyi zhinochoho zhaketa. Herald of Khmelnytskyi national university, 4, 90–94. Available at: http://journals.khnu.km.ua/vestnik/pdf/tech/2011_4/23sto.pdf
20. Vovk, Y. V. (2013). Determination of correlations of drawings primitives is in matrix of structural modules of half-length products. Herald of Khmelnytskyi national university, 2, 88–91. Available at: http://journals.khnu.km.ua/vestnik/pdf/tech/2013_2/23vov.pdf
21. Slavinska, A. L., Mytsa, V. V., Syrotenko, O. P., Dombrovska, O. M. (2021). Method of optimization of geometric transformations of design surfaces of a man's jacket. IOP Conference Series: Materials Science and Engineering, 1031 (1), 012021. doi: https://doi.org/10.1088/1757-899x/1031/1/012021
22. Tretiakova, L., Ostapenko, N., Kolosnichenko, M., Lutsker, T. (2015). Zonally module model for development of complete sets of protective clothing. Herald of Khmelnytskyi national university, 2 (223), 69–72. Available at: http://journals.khnu.km.ua/vestnik/pdf/tech/2015_2/(223)%202015-2-t.pdf
23. Ihnatyshyn, M. I., Matviychuk, S. S. (2012). Osoblyvosti aproksymatsiyi konturu detalei odiahu polinomamy ta liniyamy druhoho poriadku. Herald of Khmelnytskyi national university, 5, 72–79. Available at: http://journals.khnu.km.ua/vestnik/pdf/tech/2012_5/22ign.pdf
24. Bohushko, O. A., Sviatkina, A. Ye., Demerash, O. V. (2012). Pobudova kryvoliniynykh konturiv latskanu verkhnoho odiahu. Visnyk Kyivskoho natsionalnoho universytetu tekhnolohiy i dyzainu, 2, 60–63.
25. Slavinska, A., Syrotenko, O., Dombrovska, O., Mytsa, V. (2020). Simulation model of the morphological field of data for constructing a universal design of trousers. Eastern-European Journal of Enterprise Technologies, 1 (1 (103)), 52–61. doi: https://doi.org/10.15587/1729-4061.2020.192590