PROBLEMS AND SOLUTIONS OF SCIENTIFIC AND INNOVATIVE RESEARCH
Volume 03, Issue 6, 2026

CREATING VIRTUAL MODELS OF MEN'S JACKETS BASED ON A DATABASE

Abduraximova Manzura Sodiqovna
Fergana State Technical University
ORCID: 0009-0007-5631-5561
manzuraabduraximova5@gmail.com

Abstract. This paper investigates the creation of virtual models of men's jackets based on a database of the physical and mechanical properties of suiting materials. It considers an approach for transferring the measured properties of materials into a set of parameters accepted by simulation software, creating a digital material passport, and automatically adapting construction parameters in a digital design environment. The armhole–sleeve system of a men's jacket is modelled using a parametric construction. The distribution of stress and pressure on a virtual mannequin is analysed in static and dynamic conditions. The ease-allowance capacity of different material groups is calculated, and the virtual modelling results are experimentally compared with sewn samples. The results show that the number of fit defects is reduced in the sample produced using the improved construction.
Keywords: database, men's jacket, virtual modelling, digital passport, suiting materials, parametric construction, armhole–sleeve system, stress, pressure, garment fit.

Introduction. The development of digital design technologies in the garment industry is expanding opportunities to create garment constructions in a virtual environment, take material properties into account, and assess garment fit on the body in advance. The physical and mechanical properties of materials have a direct effect on the formation of the construction and the performance quality of shoulder garments with complex structural designs, such as men's jackets [1].

In traditional design, a garment construction is often developed relatively independently of the material type. When the material is changed, the construction parameters need to be reviewed. This approach leads to the creation and subsequent modification of separate patterns for different materials.

To address this problem, it is important to enter the measured physical and mechanical properties of materials into a digital database and link these values to a parametric construction [2; 3].

Research methodology. One of the main stages of virtual modelling is converting the measured properties of a material into parameters accepted by the simulation software. For this purpose, a digital passport of the material is created.

All values in the digital passport are based on physical and mechanical properties measured in accordance with applicable standards. Expert estimates and ready-made material values from the software library are not used. This approach helps ensure the repeatability of virtual modelling results.

A system of global variables is established in the digital design environment to link construction and material parameters (Table 1) [2].

Table 1.

System of global variables in the digital design environment

Parameter group	Variables	Source
Body measurements	Ог₃, Шс, Шг, Шп, Оп, дв.р	Anthropometric measurements

Material properties	h, Y_2	Digital material passport
Calculated parameters	Км = f(h), H = f(Y_2)	Mathematical relationships
Construction parameters	Пс.пр, Пш.пр, Ah*, Ad*	Calculation results
Control parameters	Пг, α, Пв.е, Ппос	Construction control conditions

As shown in the table, material properties are directly linked to construction parameters. In particular, the coefficient Км is determined from material thickness h, while parameter H is determined from the shrinkage value Y_2. These parameters are used to recalculate the construction lines of the armhole–sleeve system.

In the proposed approach, the pattern is not static but is organised parametrically. When the material article is changed, the values of Км and H are recalculated, and the associated construction lines are automatically updated. As a result, a single parametric pattern can be adapted to different materials [4].

With this structure, the pattern library is separated from the material library: one parametric pattern can be adapted to any material. In the traditional approach, a separate pattern had to be stored for each material. The work carried out in the digital environment is shown in Figure 1.

Results and discussion:

1. Formation of a parametric virtual construction based on material properties. When creating the virtual model of the men's jacket, the twelve-step construction algorithm developed in Chapter 2 is entered into the digital environment in the form of global variables. Body measurements, material properties and calculated construction parameters are integrated into a single system. The material thickness and shrinkage values affect the corresponding construction parameters. The appearance of the jacket on a virtual mannequin is examined in static and dynamic conditions. In the static condition, the balanced position of the garment on the mannequin is assessed; in the dynamic condition, changes in the construction are observed as the arm is extended forward and raised upward [1].

This process makes it possible to assess the geometric parameters of the armhole–sleeve system and their compatibility with body movements.



Figure 1. Digital design environment: a, b, d, e -testing on a virtual mannequin in static conditions; j, k, l -testing in dynamic conditions; m, n -views of the parametric pattern and avatar in the editor.

2. Calculation of the ease-allowance capacity of material groups. Before virtual modelling, the quantitative control conditions of the construction are checked. In particular, the amount of ease introduced when joining the armhole-sleeve system must comply with the technological capabilities of the material.

The calculation results for three material groups for the size-50, Variant B construction are presented in Table 2.

Table 2.

Compatibility of the ease allowance with material capabilities

Indicators	**M1**	**M2**	**M3**
Км	1.057	1.000	1.114
Н	0.050	0.060	0.080
ДП, cm	54.71	54.42	55.01
Ппос = Н·ДП, cm	2.74	3.27	4.40
Ппос max, cm	3.50	3.50	3.50
Excess amount, cm	–	–	0.90
Required NIIB shrinkage, %	–	–	2.53
Available Y_2, %	2.13	2.50	3.25
Result	Meets requirement	Meets requirement	Using NIIB reserve

According to the calculation results, the ease amount is 2.74 cm for material group M1 and 3.27 cm for group M2; both values are within the specified limit of 3.50 cm.

For material group M3, the ease amount is 4.40 cm, exceeding the permissible limit by 0.90 cm.

This excess amount must be absorbed by heat-and-moisture treatment in the upper area of the sleeve cap. The length of this area is determined as follows:

$L = 0.60 \cdot ДОР = 35.64$ cm.

The required amount of shrinkage is:

$\varepsilon = 0.90 / 35.64 \cdot 100 = 2.53\%$.

Since the measured shrinkage value of material group M3 is $Y_2 = 3.25\%$, there is a sufficient technological reserve to achieve the required shrinkage of 2.53%.

Thus, it was established that the process of assembling the armhole–sleeve system in material group M3 depends significantly on the heat-and-moisture treatment regime.

Reducing the ease-allowance standard was also considered as an alternative solution. In this case, the limiting value is:

$Hmax = Ппос\ max / ДП = 3.50 / 55.01 = 0.0636$.

The calculation showed that this value corresponds to $Y_2 = 2.64\%$. Therefore, for group M3, the choice between reducing the ease-allowance standard and using the available shrinkage reserve should be made according to the technological capabilities of the material.

3. Evaluation of virtual models in terms of stress and pressure. After the calculated control conditions of the construction have been satisfied, the virtual model is simulated on the mannequin. The simulation results are evaluated using stress (kPa) and pressure (Pa) maps [1; 3]. For this purpose, five ranges are set in the software's "Clothing Fitting Property" window (Table 3).

Table 3.

Criteria for evaluating virtual simulation results

Range	Stress, kPa	Pressure, Pa	Colour	Construction interpretation
Min	0	0	Blue	Material is relaxed; reserve is available
Med3	25	250	Light blue	Lower part of the working range
Med2	50	500	Green	Working range; no defect expected
Med1	75	750	Yellow	Local tension, increases under dynamic conditions
Max	100	1000	Red	Severe tension or pressure

The stress ranges are set at 0, 25, 50, 75 and 100 kPa, while the pressure ranges are set at 0, 250, 500, 750 and 1,000 Pa. Transparency is set to 80% for all ranges, and to 0% for the lowest range.

Static and dynamic conditions are assessed separately. Under static conditions, loading is observed mainly in the shoulder area and the upper part of the armhole. Under dynamic conditions, stress is concentrated where the back part of the sleeve cap joins the armhole and in the scapular region.

Therefore, simulation results under dynamic conditions are important for assessing the actual fit quality of the construction.

In evaluating pressure, the recommended hygienic limit of 2.0 kPa for shoulder garments worn for extended periods is taken into account. In this study, the software's Max range is set at 1,000 Pa, or 1.0 kPa. Therefore, areas falling within this range are recorded as locations where a construction defect may be present.

The main advantage of virtual simulation is that it makes it possible to identify, in a spatial representation, the areas of the construction where stress and pressure accumulate.

4. Experimental verification of the virtual modelling results. To verify the reliability of the calculations and simulation results, two men's jacket samples were made using the same material and for a body with the same measurements (176-100-88).

The first sample was made using the ЦНИИШП method, while the second was produced using an improved method based on the M. Müller & Sohn construction system.

To ensure identical comparison conditions, both samples were sewn by the same tailor, using the same technological settings and the same interlining materials.

The experimental assessment revealed diagonal wrinkles extending from beneath the back armhole towards the scapular region in the sample made using the ЦНИИШП method. This defect was attributed to an insufficient shoulder slope.

In the original construction, the shoulder slope was $\alpha = 13.26°$. In the improved construction, this parameter was increased to $\alpha = 19.50°$. The defect was not observed in the second sample, in which the shoulder slope was brought within the recommended range of 17–20°.

The experimental assessment results are summarised as follows:

- In the sample made using the ЦНИИШП method, defects were identified in 4 of the 12 assessment criteria;
- In the sample made using the improved construction, defects were identified in 1 of the 12 assessment criteria [15; 16].

Thus, the number of defects in the sample made using the improved construction decreased from four to one. This confirms the practical effectiveness of the construction changes identified through calculation and virtual modelling.

Conclusion. The study developed an approach to virtual modelling of men's jackets by linking the physical and mechanical properties of suiting materials, represented in a digital passport, with a parametric construction. The approach enables construction parameters to be automatically recalculated according to material properties, the ease amount to be assessed based on technological capabilities, and garment fit to be evaluated in static and dynamic conditions using a virtual model. Experimental comparison confirmed that the number of defects in the improved construction decreased from four to one, and that increasing the shoulder slope to 19.50° eliminated the diagonal wrinkles beneath the back armhole.

References

[1] Unicut System. Automated Garment Construction and Cutting: Unicut System Manual / Unicut Schweiz AG. - Zurich, 2002. -128 p.

[2] Ashimova E., Tyurin I., Tashpulatov S., Zanetti E. M., Pascoletti G., Zufarova Z., Voxidova U., Zhilisbayeva R., Mamaxanova Z. Anthropodynamic Optimization and Virtual Fitting of Workwear: A Biomechanical Approach to Ergonomic Design.

[3] Buyukaslan E., Kalaoglu F., Jevsnik S. Drape Simulation and Subjective Assessment of Virtual Drape // IOP Conference Series: Materials Science and Engineering. -2017. -Vol. 254. -Article 162002. -DOI: https://doi.org/10.1088/1757-899X/254/16/162002

[4] Kim J., Kim Y. J., Shim M., Jun Y., Yun C. Prediction and Categorization of Fabric Drapability for 3D Garment Virtualization // International Journal of Clothing Science and Technology. -2020. -Vol. 32, No. 4. -P. 523–535. -DOI: https://doi.org/10.1108/IJCST-08-2019-0126https://doi.org/10.1088/1757-899X/254/16/162002https://doi.org/10.1108/IJCST-08-2019-0126

[5] Maksimović N. Methods to Digitizing Physical Properties of Fabric for Virtual Simulation // Tekstilna industrija. -2020. -Vol. 68, No. 3. -P. 36–43. -DOI: https://doi.org/10.5937/tekstind2003036Mhttps://doi.org/10.5937/tekstind2003036M

[6] Ancutienė K., Sinkevičiūtė D. The Influence of Textile Materials Mechanical Properties upon Virtual Garment Fit // Materials Science. -2011. -Vol. 17, No. 2. -DOI: https://doi.org/10.5755/j01.ms.17.2.486https://doi.org/10.5755/j01.ms.17.2.486