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INFORMATION MODELS OF KNITWEAR IN COMPUTATIONAL SCIENCE AND ENGINEERING

Purpose. *Formation of basic concepts of the theory of three-dimensional knitwear modelling in terms of determining their levels*

Key words: *knitwear, multiscale 3D modelling, simulation.*

Objectives. Modelling as a cognition method not only becoms increasingly popular, but with the advent of powerful computer simulation tools, is moving to a fundamentally new level. By definition, a model is a material or virtual object that replaces the system under study and adequately reflects its essential characteristics. Computer simulation of air transport processes and heat transfer through textile materials is the subject of many scientific research. Together with the creation of ontology of this subject area, conceptual and terminology is being created, while the definition of basic concepts needs clarification.

Methodology. Method of theoretical analysis of scientific information.

Research results. The analysis of scientific publications shows that most researchers agree that the more accurately the geometry of the yarn model in the knitwear structure corresponds to the geometry of its real prototype, the higher the accuracy of the results can be expected in the problems of simulation of flows, heat transfer and other processes [1,2]. But using such models increases computational time, which makes the virtual experiment expensive, and sometimes even impossible to carry out. Therefore, it is proposed to use the multiscale approach, which helps maintaining accuracy on the one hand and considering principle of rational use of information resources on the other [3]. Fig. 1 shows a multilevel design diagram, in which the stages of creating and integrating models of different scales are located from left to right as the level of the model increases. The first in this diagram is mesomodel of knitted material, built considering the deformation state of the prototype. It is a graphical implementation of a mathematical description with detailed geometric characteristics of the thread in the knitted structure. Based on this model, effective characteristics (as, for example, effective air permeability, effective thermal conductivity) are determined using the means of engineering analysis.

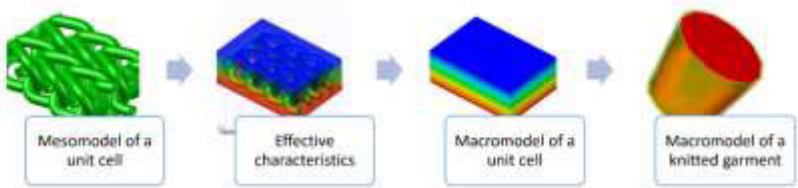

Fig. 1. **Stages of formation of higher-level models based on data obtained using lower-level models (left-to-right)**

The obtained indicators are directed to the macromodel as characteristics of the material. The model of the next level, the highest level in this hierarchy, is the macromodel of a knitted garment. In this stage the knitted material is considered as a shell with specified effective properties distributed considering deformation zones.

Conclusion. During the study, it was shown that multiscale modelling allows combining the advantages of a high modelling level in compliance with the reasonable computation time.

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References

1. Chen X (Eds). Modelling and predicting textile behavior. Woodhead Publishing Series in Textiles: No 94. Woodhead Publishing Limited and CRC Press LLC, 2010, 536 p.
2. Meso-macro integration of modeling of stiffness of textile composites. S. Lomov, L. Dufort, P.D. Luca, and I. Verpoest. Proceedings of 28th International Conference of SAMPE Europe, Porte de Versailles Expo, Paris, 2007, 4003-4008.
3. Yelina T.V., Halavska L.Ye. Use of computer tools in forecasting the properties of knitwear. Visnyk KHNU. 2020. №5 (289). C. 264-268.