

DEVELOPMENT OF THE LIBRARY FOR 3D MODELING AND COMPUTER-AIDED DESIGN OF PLATED KNITTED FABRICS

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I. INTRODUCTION

3D technologies and computer-aided design (CAD) systems are used in various fields of human activity. 3D modeling allows to estimate the physical properties, appearance and other characteristics of products before they are made. The use of CAD systems reduces product cost, and automates the production process.

The task of developing a program for 3D modeling and computer-aided design of knitted fabrics is relevant. The program should be able to automatically create 3D models of knitted fabrics made of different raw materials. The fabrics yarns can be of different linear densities. The program should be able to calculate the structure parameters of knitted fabrics.

II. PROGRAM DEVELOPMENT

The program was developed as a library (external module) for CAD system KOMPAS-3D. The program algorithm is as follows:

- 1) allowing the user to select the stitch pattern of knitted fabric, raw material of yarns, linear density of yarns, set the number of courses and wales;
- 2) calculation of knitted fabric parameters based on the input data entered by the user;
- 3) connection to the KOMPAS-3D system installed on the user's computer;
- 4) opening of a base 3D model file in KOMPAS-3D system;
- 5) replacing the model variables with the new values calculated in step 2 and thus creating a new knitted fabric 3D model with custom parameters;
- 6) saving the new 3D model file to the hard drive;
- 7) display the calculated parameters of the knitted fabric on the screen;
- 8) allowing the user to save the values of these parameters to a text file.

The structure of knitted fabric is represented by a geometric model to facilitate the study and prediction of its properties. The geometric model approximates the actual knitted fabric structure and the shape of its loops with varying degrees of accuracy. The yarn thickness of the geometric model of the knitted fabric is the same in all parts of the loop. The cross-sectional shape of its yarn is a circle. The yarn thickness is averaged and characterized by the average diameter [1].

The program is able to work with 3D-models of double-layer plated knitted fabrics. In the process of development it was also necessary to implement the possibility to work with 3D models of single-layer plain knitted fabrics. Geometric models of these fabrics are shown in Figure 1 (a – single-layer plain knitted fabric; b – double-layer plated knitted fabric).

Plain knitted fabric (Fig. 1a) consists of loops of the same shape and size, formed one after another along a course. The loops of the plain knitted fabric are formed from a single yarn. The loops of the plated knitted fabric (Fig. 1b) are formed from two yarns: ground *a* and plated *b*. Plated yarn forms the face side 2 of the fabric. Ground yarn forms the backing side 1 of the fabric.

The first step in the development process was the creation of a basic parametric three-dimensional model of single-layer plain knitted fabric in the KOMPAS-3D system. The variables of the model were defined in the KOMPAS-3D system: *d* – yarn diameter; *A* – wale space; *B* – course space; *Columns* – number of wales; *Rows* – number of courses. Then, based on the described 3D-model, a basic parametric three-dimensional model of double-layer plated knitted fabric was built in the KOMPAS-3D system. The variables of the model were defined in the KOMPAS-3D system: *d1* – face side yarn diameter; *d2* – backing side yarn diameter; *A* – wale space; *B* – course space; *Columns* – number of wales; *Rows* – number of courses.

Creating of the visual interface was the next step in the development of the library. After that, program code was written to calculate the parameters of knitted fabric structure and rebuild the 3D model. The Embarcadero RAD Studio system and the C++ programming language were used for this purpose.

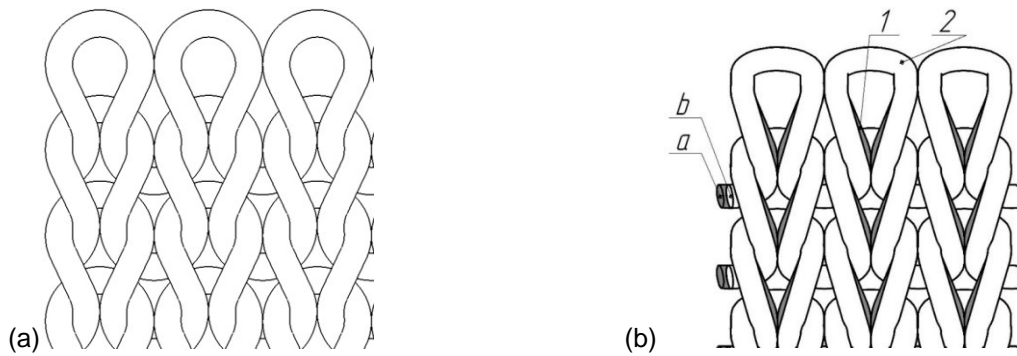
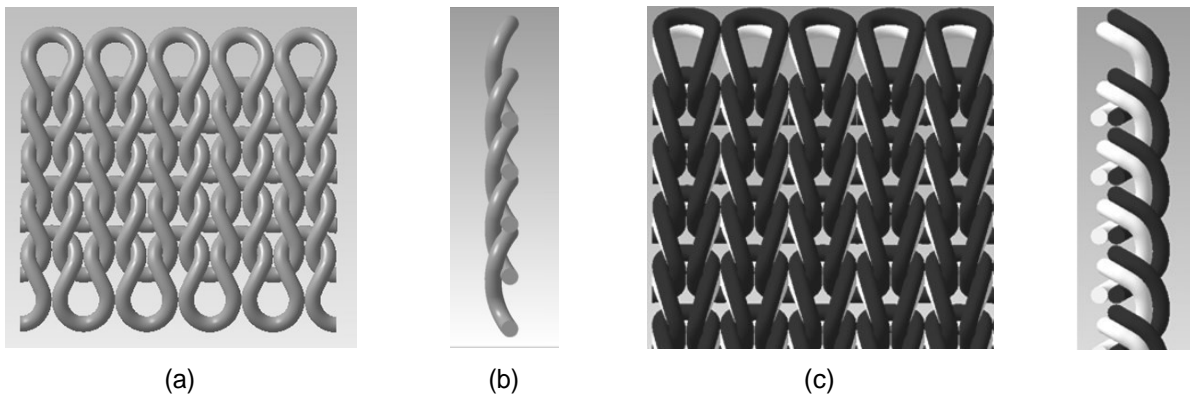


Figure 1. Geometric models of the knitted fabrics

The interface contains an element for selecting a knitted fabric structure (plain or plated), numeric fields for entering the linear density, elements for selecting the raw materials, a block with two numeric fields for entering the numbers of wales and courses, button "Build Model". Pressing the button launches the 3D model building process. Geometric parameters of knitted fabric structure are calculated in the program in accordance with [2]. Examples of 3D models built with the help of the library are shown in Figure 2 (a – single-layer plain knitted fabric; a – front view of the single-layer plain knitted fabric; b – side view of the single-layer plain knitted fabric; c – front view of the double-layer plated knitted fabric; d – side view of the double-layer plated knitted fabric).



(d) Figure 2. Geometric models of the knitted fabrics

III. CONCLUSIONS

The library for 3D modeling and computer-aided design of single-layer plain knitted fabrics and double-layer plated knitted fabrics has been developed. It is advisable to use the library in the educational process to visually demonstrate to students the features of structure of knitted fabrics. The library was used by the authors in scientific research on the development of knitted fabrics with improved hygienic properties.

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