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DESIGN OF MODELS OF ZONE CLOTHES WITH USE OF ELEMENTS OF DISCRETE MATHEMATICS

ПРОЕКТИРОВАНИЕ МОДЕЛЕЙ ПОЯСНОЙ ОДЕЖДЫ С ИСПОЛЬЗОВАНИЕМ ЭЛЕМЕНТОВ ДИСКРЕТНОЙ МАТЕМАТИКИ

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In article the possibilities of application of a problem of discrete optimization for automation of design of clothes connected with questions of the maximum feasibility of a logical formula are considered. In this regard, the solution of this task is one of the relevant directions of improvement of technological preparation of production.

В статье рассмотрены возможности применения задачи дискретной оптимизации для автоматизации проектирования одежды, связанные с вопросами максимальной выполнимости логической формулы. В связи с этим решение данной задачи является одним из актуальных направлений совершенствования технологической подготовки производства.

Keywords: design automation, garment, mathematical model, logical formula.

Ключевые слова: автоматизация проектирования, швейное изделие, математическая модель, логическая формула.

Modern computer technologies offer new prospects for improvement of a designing process of clothes, the solution of a large number of the difficult and various tasks arising at the same time enough. In this regard recently the considerable attention is given to development of a CAD of clothes. Now in clothing industry are created and such computer programs as function: Leko, Cuat, CorelDRAW Graphics Suite, AutoCAD, Adobe Photoshop, Gerber, Investronika, Assol, the Apportion, Avtokra, Grazia, GRAFIS which are widely used in a clothes designing process, beginning from the outline sketch and finishing with technological process [1].

Therefore, successful advance in the specified direction demands wider use of a mathematical apparatus, especially from area of optimization and a research of operations, development of new mathematical models and methods. The designing process of garments which are formed of a set of components is for this purpose considered (details, the complicating elements and characteristics). The number of characteristics joins silhouette forms, volumes, properties of materials, etc. The specified components get out of rather broad set which is peculiar to this class of products. A similar variety is available also at selection of characteristics.

It is known that by preparation of design decisions especially important role is played by restrictions of logical type as they significantly influence the main structure of future product and its characteristic. Therefore problem definition in which it is required to choose the elements meeting logical conditions taking into account their importance is considered by authors [2].

Logical restrictions naturally arise and are considered by the designer when using various provisions and recommendations following from the theory of harmonization of a suit. Importance of logical conditions is connected with the fact that at design of a suit the optimum arrangement of details, their sizes and forms is required not only to find, but also to receive a harmonious product in general.

Undesirability of a combination of certain elements in one model or need of repetition of similar forms for various details and products when developing a series of models for maintaining the general idea and so forth can be an example of such restrictions. The considerable number of logical and other restrictions arises at design of women's skirts. Logical restrictions for each concrete situation can be "rigid", i.e. obligatory and rather "soft", allowing violations under certain conditions. Besides, at design of clothes have to be executed technological, economic and some other restrictions.

For mathematical statement of the task of design of garments we will enter the following designations:

Vj – a component of a product, j=1, …, n;

Xj – logic variable which accepts value the truth, if Vj is a part of a product, and value a lie – in opposite case;

Sj – Vj weight characterizing a level of feasibility of switching on Vj in a product;

P – lower bound for summary weight of Vj switched on in a product;

Ci – the logical formula corresponding to i-mu logical to restriction, i=1, …, m which represents disjunction of the Xj variables and/or their denial of Xj;

formulas with numbers i=1, …, m' shall be surely executed, $0 \le m' \le m$;

Di – the formula Ci weight characterizing a level of its need executions, i=m '+1, …, m;

Akj – the volume of k-go of the resource demanded for production of j-y making products, k=1, …, g; j=1, …, n;

Bk – the available volume of k-go of a resource, k=1, …, g.

Therefore, the task consists in searching of values of logic variables in case of which formulas Ci with numbers i=1, …, m are executed', restrictions on resources and on summary weight of component Vj, j=1, switched on in a product, …, n, and weight of the executed formulas Ci for $i \ge m'+1$ will be maximum.

To construct model of integer programming, it is necessary to transfer from logic variables to Boolean, and to replace logical restrictions with the equivalent with it the linear inequalities.

We will enter sets of indexes of the Ci variables ˆ and Ci ˇ, being a Ci part with denial and without it respectively. We will replace Xj with the Boolean Yj variable, its denial – on 1 – Yj, and the disjunction character "∨" – on the sign "+". To a condition of feasibility of a logical formula Ci there corresponds solubility of the following linear inequality:

$$\sum_{j \in Ci^{\wedge}} Yi - \sum_{j \in Ci^{\vee}} Yi \le |Ci^{\wedge}| - 1. \qquad (1)$$

If formula Ci (! under certain conditions it is not executed, for it the auxiliary Boolean Zi variable is entered and inequality is built:

$$\sum_{j \in Ci^{\wedge}} Yi - \sum_{j \in Ci^{\vee}} Yi + Zi \le |Ci^{\wedge}|. \qquad (2)$$

So, the model of integer linear programming for the problem of design of garments formulated above has an appearance:

$$Yo = \sum_{i=1}^{m} Di\ Zi \rightarrow \max. \qquad (3)$$

If in an optimal solution of this task for some i Zi=1 takes place, then the appropriate formula Ci accepts value the truth. Different methods and application program packages can be applied to the decision of the task [3].

The optimal solution of a task received by means of some algorithm gives option of the projected product taking into account the formulated requirements and degree of their importance. However the optimal solution often isn't the only thing therefore in a designing process can be useful and other decisions which will generate new models of products.

Actually at this stage allocation of a subset of perspective models of skirts is carried out. At the following stage it is possible to apply other mathematical designs for the purpose of more detailed study of model of a product.

Thus, for optimization of the choice of suitable models of garments it is possible to use some more criteria, for example, to minimize labor input of production of a product, to raise operational characteristics and others, that is to pass to multicriteria optimization.

CONCLUSIONS

1. The offered approach is represented rather perspective for automation of design of clothes. On its basis it is possible to receive and analyze models of garments of various degree of complexity.

2. It is established that logical formulas, tasks and methods of integer programming are the most convenient for the description of restrictions and optimization of the choice of interesting and various models of clothes.

3. Important line of the developed mathematical models is the possibility of their development and adaptation to more difficult situations (introduction of new components: range of clothes, property of materials, seasonality and so on).

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