OPTIMIZATION METHODS FOR THE SELECTION OF PROTECTIVE PRINTING COMPLEX

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The problem of selection of protective printing technologies to hinder the unauthorized reproduction (faking) has been discussed in. Tend to emphasize the creative nature of the solution of this problem and the need for cooperation with an expert in this field.

In addressing the specific problems of optimization researcher must first select a mathematical method by which it will be possible to get the final result with the least computational cost, or such that will provide the greatest amount of information about the desired solution [1]. The choice of method is largely determined by the formulation of the optimization problem and mathematical model of the object of optimization.

We formulate the problem of optimizing the parameters of the security printing complex follows [2].

Let the values of the protective complex, i.e. a list of the technologies used to protect products from counterfeiting printing is some set X. We select a subset of the plurality of x: x ∈ X, which represent the parameters of the complex, potentially applicable in this case. For example, the use of sticker printing microtext with the usual definition, high-resolution micro text, microimages - the parameters of the complex, which belong to the set X, while Orlov printing or irisdruck this set do not belong.

In this case, the parameter set corresponds to the presence (absence) of a technology protection and printing can be represented as

$$\{x_i \geq 0; x_i \subset x; i = \{1, n\}\}.$$

We make up for the task of integral security products (the objective function). In this case x_{ij} will be parameters that need to determine on the basis of maximizing the aggregate level of protection. The correctness of this is shown in the background and is based on the fact that the conjunction logic function can be interpreted as the sum of the corresponding components in the arithmetic sense.

$$\begin{gathered} R_{инт} = R_1 x_1 + R_2 x_2 + \ldots + R_n x_n = \sum_{i=1}^{n} R_i x_i \to \max, \\ R_{инт} = \sum_{i=1}^{N} A_i \sum_{j=1}^{M} R_{ij} x_{ij} \to \max. \\ C = \sum_{i=1}^{n} c_i x_i \to \max \\ A = \sum_{i=1}^{n} a_i x_i \leq A_0. \end{gathered} \tag{1}$$

General problem of linear programming to select the parameters that determine the range of printing protections may look like a formula 1.

In solving this problem for specific results will display the values of the vector applied in the protective complex technologies, expressed by binary values ("1" - the technology is enabled, the "0" - the technology is not included). However, an analysis algorithm for solving linear programming problems indicate the unilateral nature of this method of optimization with respect to the chosen direction of its application - the process of selection of printing elements of a comprehensive protection. The essence of this shortcoming is that the above statement of the problem is possible to select a number of similar low-cost security technologies, which are based on the same technological principles.

Thus, we consider it appropriate to supplement the problem of optimizing the parameters of a comprehensive selection of printing protection taking into account the technological series by introducing an additional condition - each process number should be presented to only one protection technology.

$$\sum_{j=1}^{M} x_{ij} = 1, \tag{2}$$

for each i-th row process.

Statement of the problem remains the same for all types of printing products, but is supplemented by the condition shown by the expression 2.

As a result, the general problem of linear programming to select the parameters that determine the range of printing protections may look like [3]

$$\begin{aligned} R_{инт} &= \sum_{i=1}^{N} A_i \sum_{j=1}^{M} r_{ij} x_{ij} \to \max, \\ C_{инт} &= \sum_{i=1}^{N} \sum_{j=1}^{M} c_{ij} x_{ij} \le C_0, \\ \sum_{j=1}^{M} x_{ij} &= 1 \,|\, \forall i = 1, N. \end{aligned} \tag{3}$$

In this paper we were shown methods of optimization. A study was conducted with the help of which was supplemented with the optimization problem into account technological series that further provide maximum protection in choosing the printing industry. Also taken into account was the index increased cost of the finished product, and then was put more precisely linear programming problem.

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