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MATEMATYKA

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IEW named after E.O. Paton of NASU, Cherkasy State Technological University

A SIGN MODEL OF THE DETECTION OF THE BEST FINGER-PRINTS SENSORS FOR LASER TECHNOLOGICAL COMPLEX

Abstract

A sign model for the detection of power reserve of modern biometric finger-prints sensors on the basis of the theory of incomplete similarity and dimensions at physical simulation is offered.

Keywords: biometric sensors, technical parameters, dispersion power, size of pick-up area, criterion equation.

I. Introduction

Biometric technologies find more and more wide use in various spheres with the purpose of the creation of protective barriers (obstacles) to any unauthorized interference (prohibition of access), in particular in the process of functioning of microintegrated system of laser technological complex (LTC).

It is confirmed by the necessity of the creation of LTC safe working conditions for personnel in a workshop or a department, taking into account such feature of laser radiation, as invisibility for a human eye, and by the need to prevent human factor influence during technological laser equipment operation.

The list of basic requirements, presented to biometric access systems, includes providing of: reliability, operation speed, high authenticity of a result and low cost.

Biometric finger-prints sensors are one of basic elements of biometric access control systems [1-3].

Therefore the determination from a great number of modern biometric finger-

prints sensors of those with the best characteristics after basic technical parameters, which answer LTC requirements, is an actual task.

II. Problem statement

The purpose of the work consists in the construction of a sign model for the detection of the best from a great number of modern biometric finger-prints sensors simultaneously after few parameters, in which the developers of LTC access control systems are most interested in, that will considerably shorten the time for planning and promote a development cost saving.

III. Results

Difficulties of problem task solution are connected with the absence of mathematical description of basic technical parameters interrelations.

In works [4-5] a method of parameters research in the direction of the detection of power reserve of an object of research on the basis of the theory of incomplete similarity and dimensions is shown. The advantage of such approach consists in the following: the information concerning the parameters of an object of research has objective character, and visualization of results is a simple one.

Concerning biometric finger-prints sensors a sequence of the solution of the put task of parameters research in the direction of power reserve detection, that provides reliability of sensors work, includes the following:

- the formation of the list of basic technical parameters of an object of research which is adequate list of determining values;
- the creation of generalized mathematical description of dependences between the parameters of an object of research;
- the choice of the method of similarity criteria determination;
- the creation of criterion equation;
- the construction of a sign model.

On the base of heuristic method the list of modern biometric finger-prints sensors with basic technical parameters, which are presented in table 1, is made.

Table 1 Basic technical parameters of modern biometric finger-prints sensors

№	Type	Reso-lution, q	Size of reading area, V	Working tempe-rature, T°C		Consump-tion voltage, U		Con-sumption current,, I
				min	max	min	max	
ATMEL FingerChip™ (thermal sensors)								
1	AT77C101B	500	280x8	0	+70	3	5.5	7
2	AT77C102B	500	280x8	-40	+85	3	3.6	7
3	AT77C105A	500	232x8	-40	+85	2.3	3.6	4,5
FUJITSU (capacity sensors)								
4	MBF110	500	300x300	0	+60	3.3	5	51,5
5	MBF200	500	256x300	-20	+85	3.3	5	20
6	MBF300	500	256x32	0	+60	2.8	5	20
7	MBF310	500	218x8	-20	+85	2.7	3.6	12

Using the theory of incomplete similarity and dimensions, the list of parameters (Table 1), generalized mathematical description of dependences between the parameters of biometric finger-prints sensors is made, which takes the following form:

$$F(P_p, P_a, V, q, U_{min}, U_{max}, I, T_C^a) = 0, \quad (1)$$

where $P_p = \frac{150 \quad T_C^a}{0.23}$ – dispersion power [mW],

T_C^a – maximal temperature [°C];

$P_a = U \cdot I$ – consumption power [mW],

U – voltage [V],

I – current [mA];

V – size of reading area [pixel];

q – resolution [pixel];

U_{min} – minimal consumption voltage [V];

U_{max} – maximal consumption voltage [V].

Physical simulation and the theory of incomplete similarity and dimensions allow to build equations on the basis of conditional criteria [4]. As similarity conditional criteria simple dimensionless power complexes, formed from determining values at physical simulation, are referred to [5].

The choice of a method of similarity criteria determination is offered on the basis of short analysis which is given below:

– a method of zero degrees, based on criteria presentation as a dimensionless power complex which contains all determining values; it is very difficult;

– a method of dimensions elimination, based on a successive elimination of all basic units symbols from formulas of determining values dimensions; this method hasn't been widely disseminated because of impossibility of elimination of all basic units symbols;

– heuristic method, based on a selection of similarity conditional criteria; it is characterized by high-rate results discovery and very simple realization.

Using physical simulation, the theory of incomplete similarity and dimensions, such similarity conditional criteria are offered:

– $\frac{P_p}{P_n}$, the value of which characterizes power energy reserve, that influences on sensor work reliability;

– $\frac{V}{q}$, the value of which characterizes an amount of specific points, lines of a finger-print, got from a biometric sensor that influences on result authenticity.

At the use of physical simulation a criterion equation takes the following form:

$$\psi = (\psi_1; \psi_2) = \begin{pmatrix} \psi_1\left(\frac{V}{q}, \lg\frac{P_p}{U_{\min} \cdot I}\right); \\ \psi_2\left(\frac{V}{q}, \lg\frac{P_p}{U_{\max} \cdot I}\right) \end{pmatrix} = 0. \quad (2)$$

On the base of π–theorem, criterion equation (2) and determining values (Table 1) a graph of the dependence between the given similarity criteria in dimensionless co-ordinates is built (Fig. 1).

From Fig. 1 it is evident, that the investigated array of biometric finger-prints sensors is divided in two groups: A – with high quality indexes and B – with high power reserve.

Hence, there is a dependence – at low power reserve quality indexes of biometric finger-prints sensors grow, and vice versa, with the growth of power reserve a value, which characterizes a result authenticity, becomes lower. Biometric sensors of AT77C101B, MBF200, MBF300, MBF310 type, and especially AT77C102B sensor, are the best from the side of power reserve. But all of them have a relatively low value of a result authenticity (to 20).

Thus, offered sign model of the detection of power reserve of modern biometric finger-prints sensors, which represents the interrelation of four basic technical parameters, in dimensionless co-ordinates $\left(\frac{V}{q}; \lg\frac{P_p}{U \cdot I}\right)$, allows to determine quickly the best modern biometric finger-prints sensors.

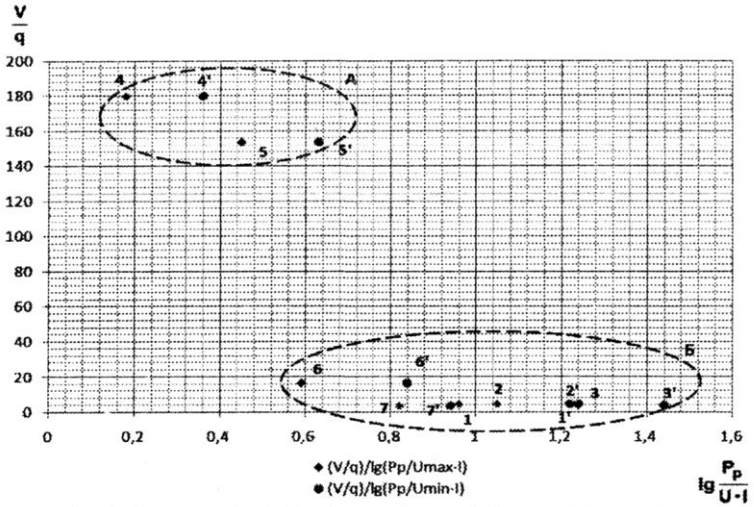

Fig. 1. The graph of the dependence of determining values in dimensionless co-ordinates $\left(\frac{V}{q}\right)$ and $\left(\lg\frac{P_p}{U \cdot I}\right)$

Note: numbers of points 1, 2, ..., 7 correspond to a sequence number of sensors (Table 1) at maximal voltage, and 1', 2', ..., 7' – at minimal voltage.

IV. Conclusions

1. The list of basic technical parameters of modern biometric finger-prints sensors on the basis of heuristic method is formed. Generalized mathematical model of the dependence between basic technical parameters of biometric finger-prints sensors is determined.

2. Similarity conditional criteria for a physical simulation on the basis of the theory of incomplete similarity are offered. A sign model in dimensionless co-ordinates for four determining values is built.

3. Power reserve in AT77C102B sensor is determined, that allows to enter additional circuit solutions on a crystal, which will extend functional possibilities of the sensor and will provide more high sensitiveness.

In future it is expedient to carry out a system analysis of modern biometric finger-prints sensors with the construction of their classification scheme.

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