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DETERMINATION METHOD OF EFFICIENCY UNITS FOR CONDITIONAL SIMILARITY CRITERION

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Abstract. *The technical parameters analysis of multifunctional electronics products is based on the theory of similarity and dimensionality. The opportunity of identifying parameters reserves in electronics devices is theoretically proved and confirmed by model experiment. Dependence of technical parameters in dimensionless coordinates* ($P_{dis}/(P_m-P_d)$) *та* ($t_{incl}f/N$) *is shown.*

Keywords: *method, the incomplete similarity theory, information systems, relatively complex model, multichannel redistributive device (MRD).*

МЕТОД ВИЗНАЧЕННЯ ОДИНИЦЬ ЕФЕКТИВНОСТІ ДЛЯ УМОВНИХ КРИТЕРІЇВ ПОДІБНОСТІ

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Анотація. *Проведено аналіз технічних параметрів багатофункціональних виробів електроніки на основі теорії подібності та розмірності. Теоретично обґрунтовано можливість виявлення резервів параметрів у приладах електроніки і підтверджена модельним експериментом. Показано залежність технічних параметрів в безрозмірних координатах* ($P_p/(P_n-P_d)$) *та* ($t_{incl}f/N$).

Ключові слова: *методика, теорія неповної подібності, інформаційні системи, умовно комплексна модель, багатоканальний розподільчий пристрій.*

Existing methods to improve the parameters of modern control devices in information systems are reduced to the new figurative and symbolic models design. If one wants to receive one the best option, it takes much time. Although it is known that the existing instruments on some parameters have store of the stock value. To determine the allowance of such parameters it is proposed to use the theory of complete and incomplete similarity.

Theory of incomplete similarity allows to investigate not all but only some points of variables that characterize the process under study. This greatly simplifies the design process as well as planning and the experiment conducting, that significantly reduces production time and the cost of managing the device. The theory of incomplete similarity should be used while physical modeling, when physical model and the designed object have the same physical nature. In addition, physical modeling allows to improve the parameters values in the mathematical description absence of the model and the original. Since the analytical expression of functional dependence between all parameters is uncertain, for a large-scale conventional equations similarity criteria are used [1]. Conventional similarity criteria are based on dimensional analysis of defining variables.

Method for the effective devices determination on conditional criteria of similarity and pi-theorem leads in the following [2-4].

1. The dimension of the defining parameters to their list of passport data, or in the technical specifications of the device is set. The dimension of any physical quantity is represented as the product of the main unit dimensions rising in power.

2. Values are calculated according to known constitutive equations for the parameters, whose influence on the signal processing is the most significant.

3. Conventional similarity coefficients are identified.

4. Functional relationships between the criteria of similarity are constructed.

5. Spare capacity of the model parameters are identified, adding physical interpretation to the simplex effect sizes as the stock model parameters to a set of requirements to the original settings.

6. Decisions are made according the direction choosing and method of the device improving due to the similarity factor conventional integrated model (KIM) and the reference terms for device parameters.

Technical characteristics comparison for similar devices methods of the incomplete similarity theory and dimension makes it possible to identify a base unit that can be taken as a model to develop a new device - the original.

For physically homogeneous objects remains an open question selection coefficients of similarity to the original parameters corresponding scaling equation. The solution to this problem is based on the creation of KIM. In determining values for conventional KIM the best settings for a group of physically homogeneous devices is included.

The next step is to determine the oproportionality similar Kc values coefficient for conventional integrated model and considered devices in the group.

The coefficient K_c ratio value is determined through appropriate similar parameters. In summary, the mathematical model of K_c can be written as following:

$$K_{iC} = O_{i\ KIM} / O_{iMRD}, \qquad (1)$$

where K_{iC} – is a proportionality coefficient matching values KIM and considered devices under;

$O_{i\ KIM}$ – is a i-th concurrent values defining of KIM value;

$O_{i\ MRD}$ – is a i-th meaning of considered devices.

Value K_{iC}=1 shows that in the group considered the option value considered definitive concurrent devices in the same in group and KIM.

Physical model is chosen according to maximal number of such units. Destination improvement of this model is determined by the value of K_{iC}>1 for the corresponding parameter.

The next step is to define the boundary (minimum – $K_{i\ C\ min}$, , maximum – $K_{i\ C\ max}$) values of $K_{i\ C}$ group devices in investigation.

Analysis of the limits of the method $K_{i\ C\ min}$, $K_{i\ C\ max}$ allows to select the direction for improving the designed device parameters, and the expected results order towards the similarity factor. Concrete numerical scale values for such devices are recommended to choose according to thresholds congruent variables and equations according to the scale.

Identification of specific numerical scale values is based on dimensional analysis determining the parameters list for pi-theorem and defining conditional similarity criteria. It is known that the number of similarity [3] is established either by heuristic method or by the method of zero degrees or by elimination dimensions process.

The simplest is a heuristic method. Taking into consideration that the congruent indicator binds together the coefficients of similarity and is equal to one, respectively, their graphic images are built due to pi-theorem.

Simplex values graphic dependings are adopted for stock options performance reveal their spare capacity. For example switching devices (main technical parameters are summarized in Table 1 and graph of the main technical parameters in dimensionless coordinates is given (Fig. 1)

Table 1

Main technical parameters of switches

№	Switch type	parameter								Temperatures range (θ_1,... θ_2), K
		N	t_{incl}, мсs	R_{op}, Ом	I_l, nAmp	$U_{сом}$, V	f, MHz	P_m, mW	C_e, pF	
1	DG506	16	1,5	400	50	±12	0,3	76,6	5	358,...,213

Continuation of the table 1

2	AV6-4016	16	1,2	200	50	±10	0,4	59,4	10	358,...,213
3	К1104КН1	16	0,2	400	200	±7,5	2,0	6,7	10	408,...,213
4	Б1110КН1-2	32	0,2	400	1	±5	1,0	0,1	5	298,...,77
5	733КН1-2	16	0,5	400	20	±5	0,5	40	5	308,...,203
6	К591КН3	16	0,3	270	70	±15	0,5	7,5	3	358,...,213
7	К590КН6	8	0,3	300	70	±15	0,5	52,5	4	358,...,213
8	Н1506А-2	16	0,3	1200	70	±16	0,5	7,5	5	398,...,218

In Fig. 1 numbers 1-8 correspond to the multichannel switching device type [4].

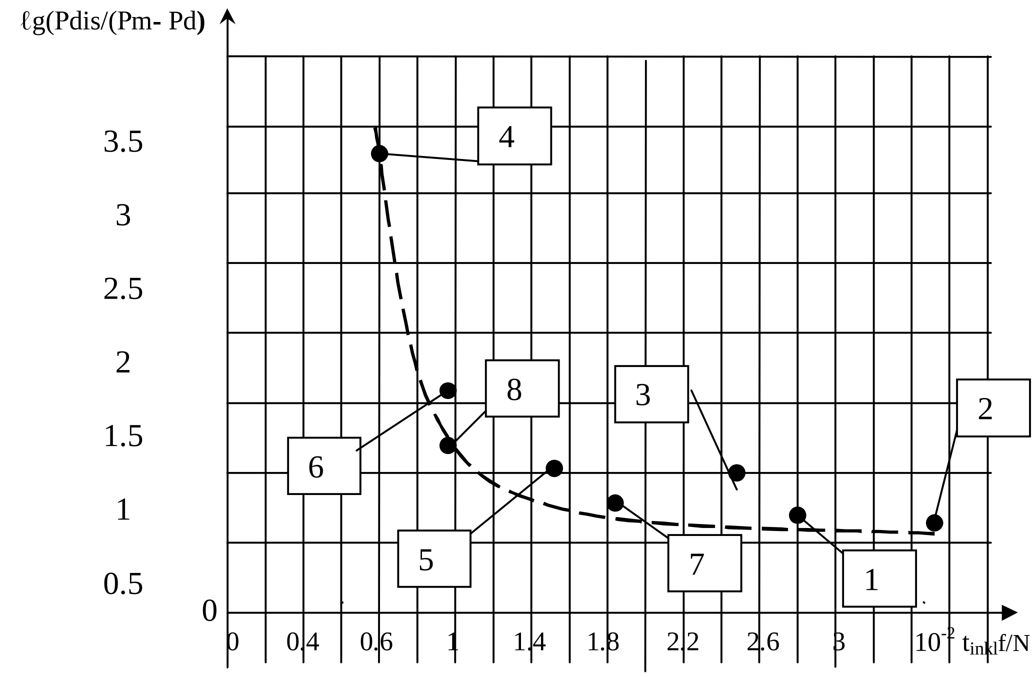

Fig. 1. Dependence of the main technical parameters in dimensionless coordinates (Pdis/(Pm-Pd)) and (t_{incl}f/N)

The figure shows that the provision for the temperature range of the device is 4. Experimental studies have confirmed the above mentioned, i.e. the device 4:

Б1110КН1-2, works on 358 К temperature.

When mathematical model considered for the functional dependence smooth between conditional criteria (Pdis/(Pm-Pd)) and (t_{incl}f/N) we use: Data table 1, figure 1 criteria, the method of least squares, the standard Excel program package MS Office.

Spline-function is the result of approximation and is represented by the formula (2)

$$\lg\left(\frac{P_{\text{dis}}}{P_m - P_d}\right) = -6.55\left(\frac{t_{incl} f}{N}\right)^3 + 26.29\left(\frac{t_{incl} f}{N}\right)^2 - 34.02\left(\frac{t_{incl} f}{N}\right) + 15.59 \quad (2)$$

The mathematical model (2) allows easy forecasting adjustment of settings of the parameters for relevant devices criteria.

Thus, given theoretical basis for the proposed improvements devices with the usage of the conventional complex patterns that differ from the well-known theories of incomplete similarity and dimensional perfection and universality to determine the similarity coefficients for physical models in which the constitutive equation for all the defining device parameters.

The method of parameters reserve definition is absent for devices and elements in control systems of vibrating machines is offered, based on the parameters usage of conditional – complex model.

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