NEW OPPORTUNITIES OBTAINED AT INTEGRATED USE OF SIMILARITY THEORY AND STATISTICAL EXPERIMENT PLANNING METHODS WITH REFERENCE TO ELECTROTECHNICAL PROBLEMS

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ABSTRACT

Issues of joint application of similarity theory and statistical experiment planning methods with reference to electrotechnical problems are considered. It has been shown that such integrated use of these methods significantly develop and enhance potential of each of those as well as permit to obtain new extremely important results with respect of development of effective electrotechnical system investigation methods.

Keywords: similarity theory, experiment planning, similarity criteria, criteria regression equations.

I. INTRODUCTION

This article in view of methodical plan is different from papers on similarity theory, modeling and statistical methods (and experiment planning method in particular) as it is devoted to joint use of these methods.

II. RESULTS AND THEIR DISCUSSION

Such combination significantly enhances potential of each method and permits to solve a number of new, principally important tasks, which are not solved using known methods [1,2]. The following relates to them: determination of the most important and unimportant similarity criteria, their ranking by levels and direction of influence to results' accuracy, assessment of inaccuracy of statement of criterial ratios at probably-given initial factors. Table 1 shows new opportunities for investigation obtained at combination of similarity theory, modeling and statistical methods of experiment planning theory [3].

It should be noted that in connection with probable approach generally accepted structural diagram of physical and mathematical modeling given in Table 2 is changed. The changed structural diagram is entered with operations connected with statistical analysis of criterial ratios and obtaining of criterial regression equiation with subsequent classification of similarity criteria on significance measure. These operations are new and extremely necessary for physical models to be built. It is correct both for determinated and stochastically-determined physical systems. Operations connected with assessment of authenticity of results of modeling with consideration of possible variations of initial data and ambiguity of results of modeling at experiments' repetition are entered [4] as well.

One of most important issues for similarity theory and modeling is assessment of level of influence of similarity criteria variation to investigated process. Almost always there is a certain difference in usefulness degrees of various similarity criteria, number of which can be very big.

Passing on to problem statement, it should be noted that main question is a development of methods of obtaining criterial regression equations in following form :

$$\pi_1 = f(\pi_2,\pi_3,...,\pi_{m-k}) = b_0 + \sum_{i=2}^{m-k} b_i\pi_i + \sum_{i,j=2}^{C^2_{m-k}} b_{ij}\pi_i\pi_j + \sum_{i=2}^{m-k} b_{ii}\pi_i^2 + ..., \quad (1)$$

where b_i, b_{ij}, b_{ii} - asessments of coefficients of criterial regression equation.

Similarity criteria can be generally represented as follows:

$$\pi_j = \prod_{i=1}^{m} x_i^{\pm\alpha_i} \quad (2)$$

where x_i - separate factors included to similarity criteria.

The main feature of synthesis of similarity theory and modeling with statistical experiment planning methods is that actions not with separate factors (like in usual, generally accepted meaning) but with generalized factors (similarity criteria π) are provided for.

A number of questions of integrated use of similarity theory and statistical experiment planning methods require development and its further improvement. The following of them can be indicated: determination of distribution of probabilities of similarity criteria and their numerical characteristics; methods of forming matrixes of criterial planning of experiment; development of methods of obtaining criterial regression equations; assessment of accuracy of modeling and reproducing of similarity criteria.

Development of listed issues enables to represent experiment planning theory in organic connection with

similarity theory and modeling in general view. In such case developed methods do not exclude but add and enhance potential of existing methods of scientific-technical studies. These methods are successfully being applied for a number of tasks [5-7].

Table 1 Comparison of results and assessment of errors

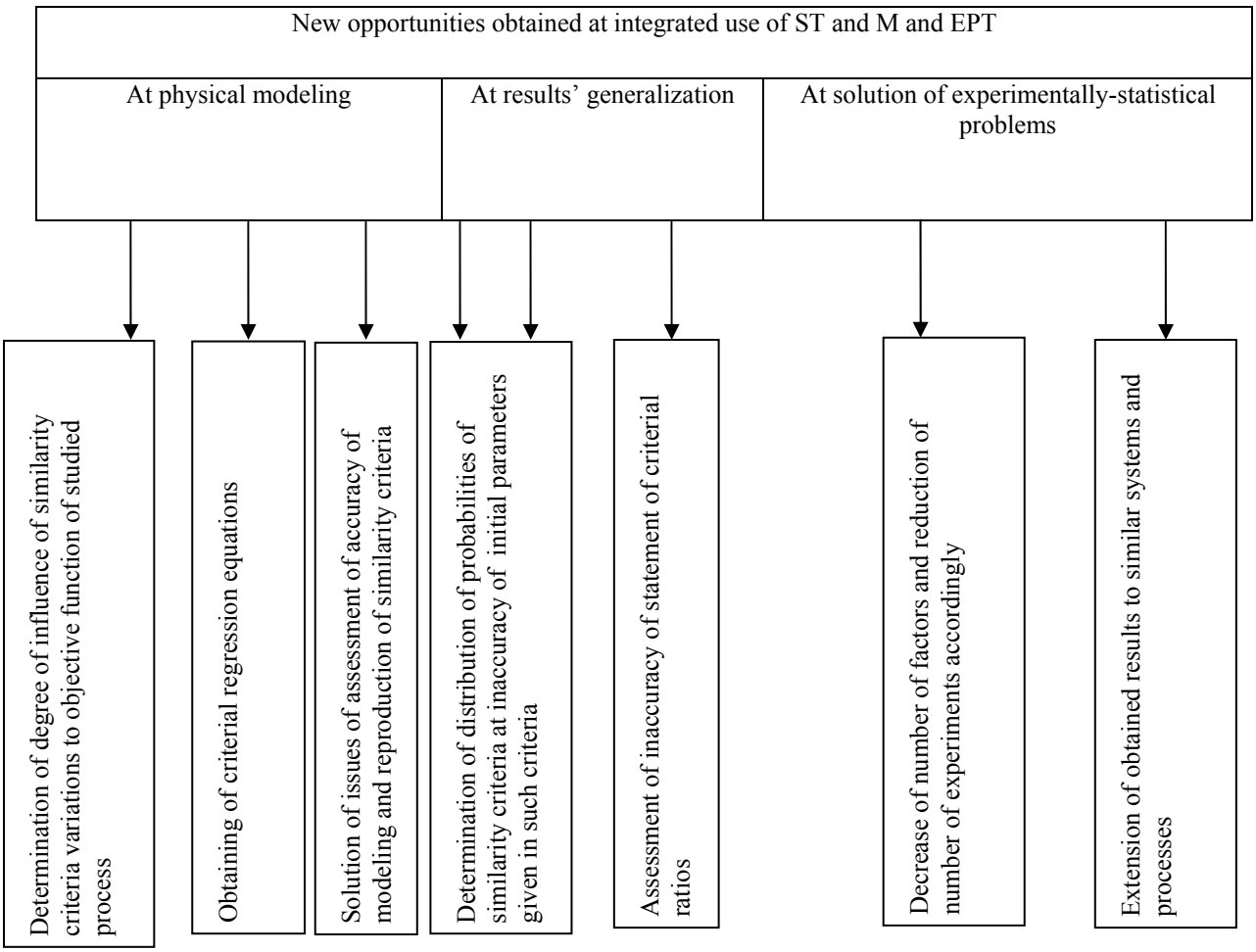
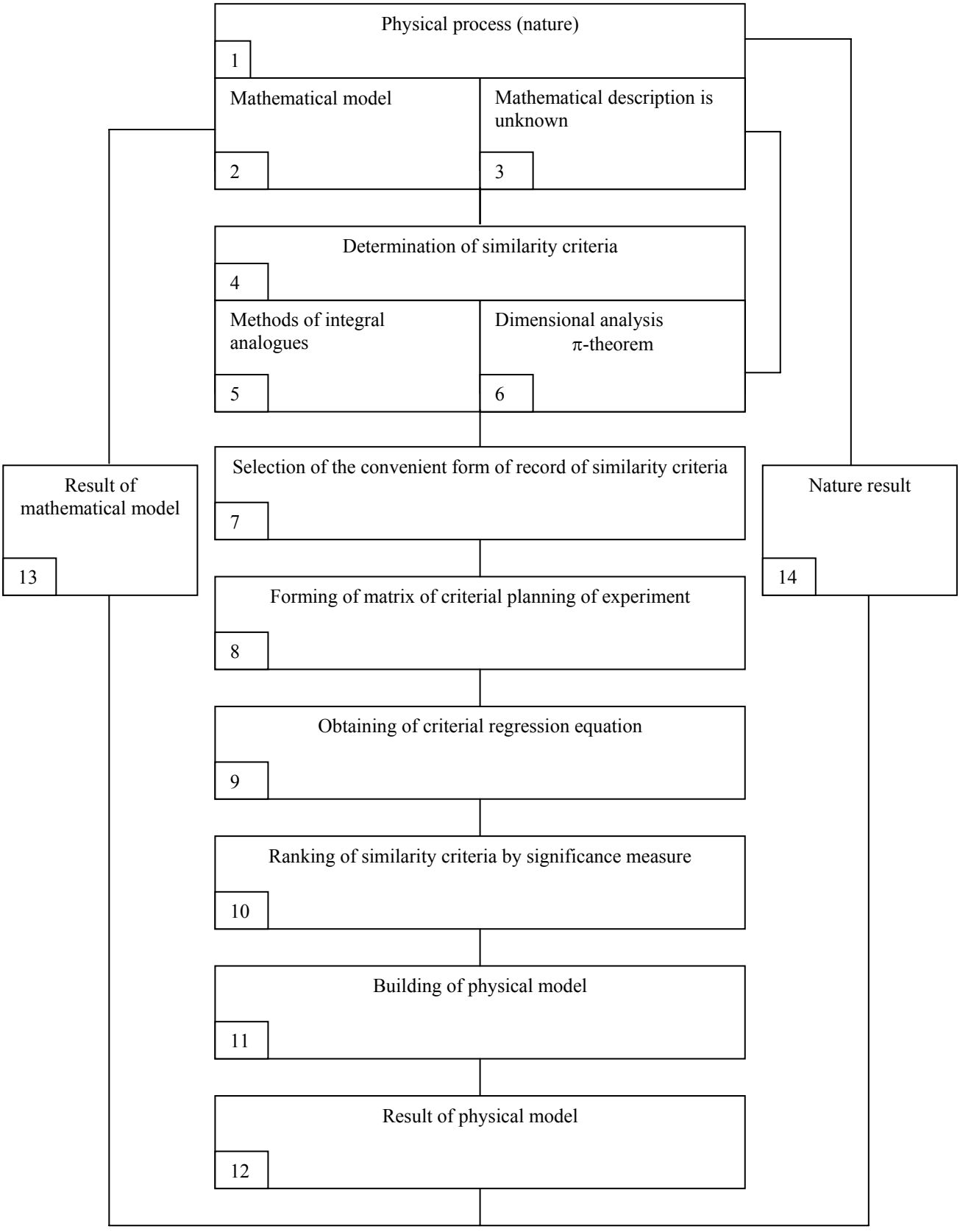


Table 2.Structural diagram of implementation of physical and mathematical modeling



III. CONCLUSION

It has been determined that development of similarity theory and modeling on the basis of statistical experiment planning methods towards their integrated use permits to develop new methods significantly expanding potential and increasing efficiency of processes' studies in electrotechnical systems and their elements.

REFERENCES

1. *Kuliyev A.M*. Development of modeling and similarity methods on the basis of probability. – News of Academy of Sciences of USSR. Energetika i transport, 1971, No.6, p. 45-50 (in Russian).

2. *Venikov V.A., Kuliyev A.M*. On use of similarity theory at experimentally statistical methods of analysis. – Plant laboratory, 1972, No.7, p. 842-843 (in Russian).

3. *Kuliyev A.M*. Analysis of properties of experiment planning matrixes, which contain similarity criteria (with reference to electric systems stability problems) - News of Universities of USSR, Energetika, 1979, No.8, p. 91-93 (in Russian).

4. *Venikov V.A., Kuliyev A.M., Barbier C., Danoyelle F., Davy R.* Les méthodes statiatiques dans les études de stabilité. Bulletin de la Direction les études et Recherches, EDF- Série B, Réseaux Electriques, 1978, №1, p. 61-71.

5. *Abdullayev V.I., Baryudin A.A., Kuliyev A.M*. Criterial-correlational analysis of dymanic characteristics of automated direct-current drive.- News of univerisities, Energetika, 1986, No. 12. p. 47-51 (in Russian).

6. *Kuliyev A.M*. Méthode d'estimation de l'influence de la précision dans la représentation au microreseau des paramètres réduits sur les résultate d'étude. Bulletin de la Direction des études et Recherches, EDF- Série B, Réseaux Electriques, 1980, №2, p. 17-24.

7. *Kuliyev A.M*. Correlational analysis of criterial dependence used at calculation of convective eletric furnaces.- Cheboksary, ChSU, inter-universities collection of scientific papers ; Special matters of electrothermics, 1981, p. 67-68 (in Russian).