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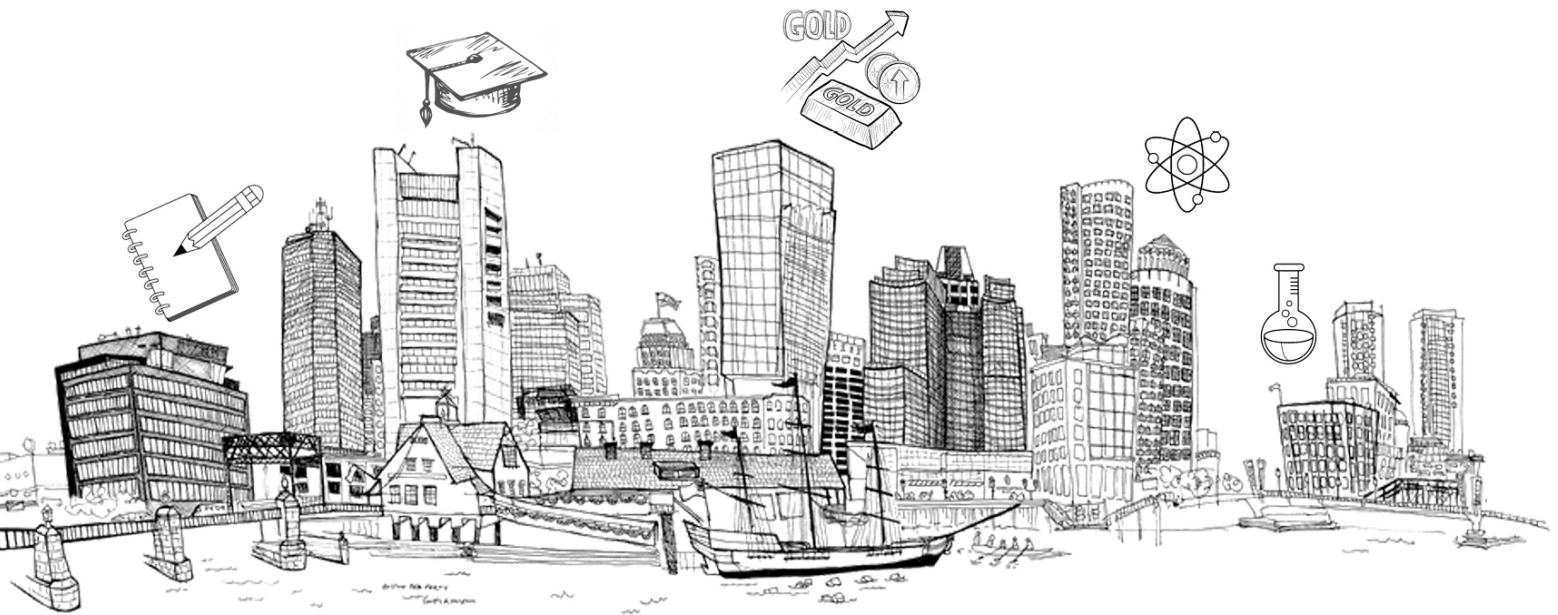
COLLECTION OF SCIENTIFIC PAPERS

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SCIENTIFIC PRACTICE: MODERN AND CLASSICAL RESEARCH METHODS

FEBRUARY 26, 2021 • BOSTON, USA 

VOLUME 1



DOI 10.36074/logos-26.02.2021.v1
ISBN 978-1-63821-672-8 (PDF)

ISBN 978-617-7991-13-6
ISBN 978-617-7991-14-3 (volume 1)



EUROPEAN
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VOLUME 1

Boston, USA
«Primedia eLaunch»
2021

Vinnytsia, Ukraine
«Yevropeiska naukova platforma»
2021

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UDC 001(08)
S 30

<https://doi.org/10.36074/logos-26.02.2021.v1>



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Scientific practice: modern and classical research methods:

Collection of scientific papers «ΛΟΓΟΣ» with Proceedings of the I International Scientific and Practical Conference (Vol. 1), Boston, February 26, 2021. Boston-Vinnitsia: Primedia eLaunch & European Scientific Platform, 2021.

ISBN 978-617-7991-13-6

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«European Scientific Platform», Ukraine

«European Scientific Platform», Ukraine

«Primedia eLaunch», USA

Papers of participants of the I International Scientific and Practical Conference «Scientific practice: modern and classical research methods», held in Boston, February 26, 2021, are presented in the collection of scientific papers.

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ISBN 978-617-7991-13-6

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ЗМЕНШЕННЯ ТЕХНОГЕННОГО НАВАНТАЖЕННЯ НА ДОВКІЛЛЯ ШЛЯХОМ РЕСТРУКТУРИЗАЦІЇ КОМПЛЕКСІВ «ТЕС - ВУГІЛЬНІ ШАХТИ - ШЛАМОСХОВИЩА» В «ЕНЕРГО-ОПРІСНЮВАЛЬНІ-ПРОДОВОЛЬЧІ КОРПОРАЦІЇ»

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DOI 10.36074/logos-26.02.2021.v1.58

SYSTEMOLOGICAL METHOD OF FORECASTING THE ELECTRONIC MODULES PARAMETERS

ORCID ID: 0000-0002-9837-2309

Igor Nevlyudov
Doctor of Engineering Science, Professor, Head of CITAM Department
Kharkiv National University of Radio Electronics

ORCID ID: 0000-0003-1110-9602

Iryna Botsman
Ph.D., Associate Professor
Kharkiv National University of Radio Electronics

ORCID ID: 0000-0002-1158-5089

Viktoriia Nevliudova
Ph.D., Associate Professor
Kharkiv National University of Radio Electronics

UKRAINE

Introduction. A systematic approach to the electronic modules (EM) design allows a comprehensive solving the problem of ensuring their quality at various stages of the life cycle. Thus, one of the methods for predicting the EM state at a certain stage of its operation can be implemented on the systemological approach basis [1]. This approach makes it possible to present the EM state at each moment of time as a set of its most significant operational parameters and to build a model for displaying their changes in order to prevent possible module failures in advance when these parameters reach some critical values.

Research results. The choice of EM parameters to be monitored is based on its purpose, manufacturing technology, and also operating conditions.

When analyzing EM parameters, we have a directed data system, the variables of which are divided into input and output. In this case, the states of the input variables are considered as conditions affecting the output parameters [1].

In this source data system, depending on the task, the data can be obtained from observations or by measurements (for system modeling tasks) or defined as desired states (in the design task).

Behavior prediction of the system under study can be carried out by the behavior function f_B , which determines the actually occurring system states, but does not determine the parameter value at which they take place. Thus, this function is parametrically invariant. The parameters system under study for the investigated object F_B is determined by the relation

$$F_B = (H, K, f_B),$$

where: H is generalized representing system;

K is the mask defined on H ;

f_B is a behavior function, defined by K and N .

Such a system is called a system with behavior [2].

During the EM parameters analysis using a systemological approach, it is necessary to: determine the most important parameter; distinguish the most significant variables with specific values at specific time moments; determine the possible range of variables change; go to the symbol denotation of the processed data according to the ranges in which they are located; tabulate the values of variables, converted according to the previous step, displaying their relationship with the parameter value; determine the methodological type of variables and parameters, i.e. combinations of such data properties as ordering, distance, continuity; define the object system, representing both the original system, as well as the observation channel, the latter can be precise or indistinct; if the data is received through an ambiguous observation channel, then it is necessary to present them by the corresponding precise data; define acceptable masks: the mask should include those variables that are obtained through a precise observation channel and those in the values of which over time it is possible to trace a certain pattern that is no longer dependent on time; define the behavior function.

As an example, consider an EM which contains a flexible printed circuit (FPC). In this case, the variables will be as following: v_1 is amplitude of FPC oscillations; v_2 is the FPC vibration frequency; v_3 is frequency shift relative to the resonant one for the EM based on FPC; v_4 is signal delay for EM with FPC. These ranges can be represented by the states 0, 1, 2, 3 of the sets $V_1 - V_4$ [3].

For example, when vibrations affect the FPC, the following denotation of v_1 can be used: 0 for vibrations amplitude in the low frequency range; 1 for the amplitude within the permissible values; 2 when the vibrations amplitude exceeds the permissible limits; and 3 when vibration amplitudes are critical for the FPC mechanical integrity.

Based on the experiments results for the polyimide FPC exposed to mechanical affects, a systemological model of data display was compiled and the probabilistic function of the system's behavior was calculated, which is shown in Fig. 1.

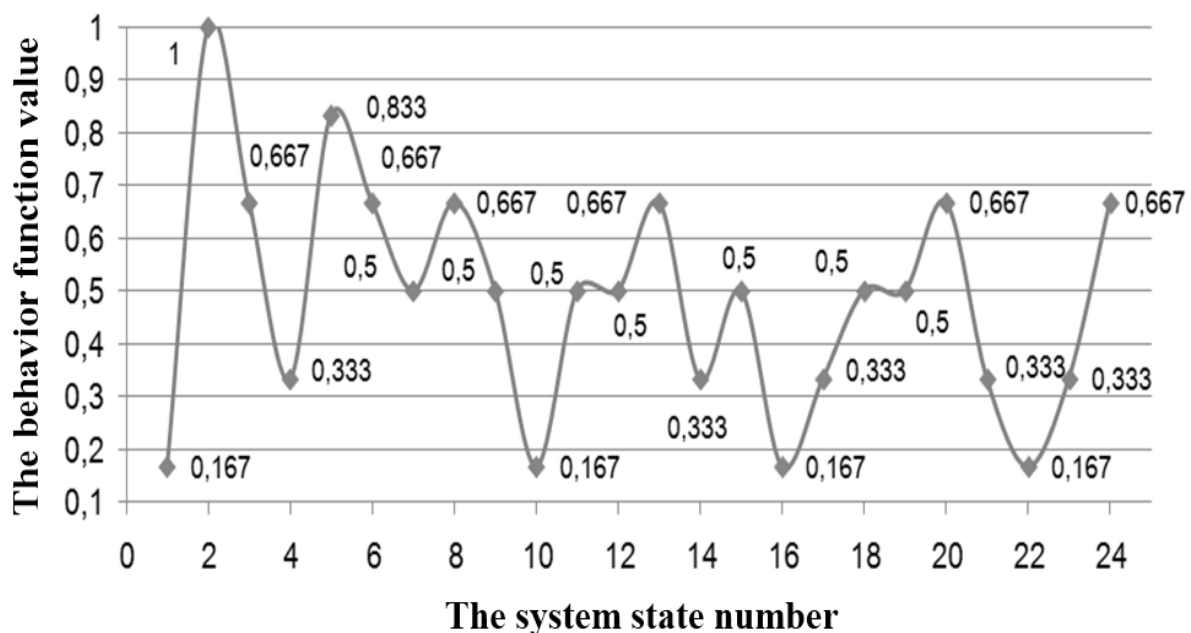


Fig. 1. Graphical representation of the system behavior function

As can be seen from Fig. 1, the behavior function has a harmonic form with local and global critical peaks, which makes it possible to select the most significant system states for their study.

Conclusion. Thus, on the systemology apparatus basis, a method for analyzing electronic modules parameters has been developed, which is applicable to consider their state as a set of the most significant parameters during different test kinds, for example, for vibration resistance test, as well as during their operation. This method can be used to predict EM failures by visualizing the dynamics of changes in system variables over time and the ability to track their oncoming to critical values.

According to the available theoretical and experimental data, using the developed software that implements the EM parameters predicting algorithm over time, the decision maker of the final product design variant can also analyze the time interval that goes beyond the experimental results, but allows one to consider the product state at the stage of its further operation.

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