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Hyper-Random Parameters of Reliability Devices of the Radioelectronic Equipment

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Abstract—There are considered the probability characteristic of parameters of reliability radio electronic equipment (REE), determined on a basis DM- and DN-distributions of a time between failures. Due to uncertainty of limits for factor of a variation of destruction processes, together with for a resource REE, all parameters of reliability are necessary for representing as hyper-random function. There are also offered approximation of the formula for definition of the basic parameters of reliability of electronic components REE.

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INTRODUCTION. PROBLEM STATEMENT

Radio electronic equipment (REE) development process requires provision of such functional parameters, satisfying predefined ones. Devices of radio electronic equipment are related to the most complicated objects by their functional and structural parameters, and their development is carried out by means of computer-aided design (CAD) systems. Ones of the most important (sometimes the main) functional REE parameters are reliability and durability parameters, their values, obtained in development process must be adequate to developed object real properties.

According to the hyper-random theory all processes, appearing in REE are necessary to be considered as probabilistic ones, and they must be characterized by probabilistic parameters [1], taking into account specificities of REE functional characteristics. Reliability parameters represent behaviour of degradation processes, appearing at the construction elements and they must be represented by hyper-random functions with probabilistic characteristics.

In this paper it is proposed a methodology of definition of probabilistic characteristics of REE reliability parameters as hyper-random functions.

HYPER-RANDOM CHARACTERISTICS OF RELIABILITY PARAMETERS

For representation of hyper-random values and functions we use following notifications: $V^{\mathrm{h}}(x)$ is hyper-random value x, $F^{\mathrm{h}}(X)$ is hyper-random scalar function of a set X, $\vec{F}^{\mathrm{h}}(Y)$ is hyper-random vector function of a set Y.

Reliability parameters of load-carrying structures and mechanisms are calculated according to DM-distribution model of mean-time-between-failures [2], where durability of material is defined by basic numbers of cycles N_0, endurance limit σ_{-1}, S-N curve factor m and amount of load cycles N_{c} ; all these parameters must be considered as hyper-random, and they are required to be defined with their probabilistic characteristics.

Mechanical characteristics of construction materials are defined experimentally, and their values are represented in reference books, and they must have definite variance (actually the variance values are not represented). Therefore in standards, defining methods of construction reliability parameters there is defined variation factor ν for degradation processes, resulting in construction elements failure.

For processes, where material fatigue is a main factor, defining failure appearing, limits of each of mentioned parameters (tolerances) are required to be set arbitrary to a certain degree. According to standard [2] for small-cycling fatigue $\nu = 0.2$–0.8, and for multi-cycle one $\nu = 0.4$–0.8.

For definition of probability of nonfailure operation $P(\tau)$ first of all it is necessary to define relative life time (life duration) x of a component: