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The methods and software for computer-based system of statistical impact diagnostics of electrical equipment

Abstract. *The methods and software used for the impact diagnostics of electrical equipment are discussed. These methods are based on the theory of linear stochastic processes and mathematical statistics. The vibrations of electrical equipment caused by impact excitation are considered to be multi-resonance process. Special software has been developed to estimate some parameters of such vibrations and to use this information in the determining of the actual state of electrical equipment.*

Keywords: linear stochastic process, mathematical statistics, electrical equipment, impact diagnostics.

Introduction

The large part of electrical equipment installed in Ukraine has critical technical state. Therefore it is quite important to ensure its reliable operation. It is well known fact that technical diagnostics can be efficiently used to solve this problem.

Between a wide variety of methods and means for technical diagnostics, vibration diagnostic methods (and, in particular, impact excitation vibration diagnostics) have several advantages in application to massive constructions: for example, the relative simplicity of vibration measurements and the ability of the fast detection of different mechanical defects in the constructions.

In the previous researches we elaborated the mathematical model of the response of electrical equipment due to impact excitation [1]. This model is based on the theory of linear stochastic processes [2] and can be written in the following form:

$$(1) \qquad \xi(t) = \int_{-\infty}^{\infty} \varphi(t-\tau)\, d\eta(\tau), \; t \in (-\infty, \infty)$$

where: $\eta(\tau)$ – stochastic process with independent increments (generating process), $\varphi(\tau)$ – non-stochastic function, integrated with square for $\tau \in (-\infty, \infty)$ (kernel of the process).

There is an important feature of the linear stochastic processes, which caused wide usage of such models in the statistical diagnostics – the analytical equations are known [2] for all probabilistic properties of the modelled process. Another important feature of the elaborated model is that it describes the multi-resonance nature of the real process. The former is used in the diagnostics of electrical equipment. In the equation (1), the kernel function represents the multi-resonance properties of the process because it can be written as

$$(2) \qquad \varphi(\tau) = \sum_{j=1}^{n} a_j \varphi_j(\tau), \; \tau \in (-\infty, \infty),$$

where: a_j – weight factors, $\varphi_j(\tau)$ – kernel function of oscillatory system with single resonance. Thus, it is possible to model any desired number of resonances.

For the verification of the above mentioned model, special software had been developed [3]. This software was used to simulate the responses of multi-resonance systems with different parameters. The comparison with signals measured on the real electrical equipment confirmed that the elaborated mathematical model is adequate to the real processes.

During the further researches we derived the equations for estimation of several spectral parameters of vibrations caused by excitation of electrical equipment's massive parts [4]. These equations provide a key to the diagnostics of such equipment.

In this paper we discuss in more details the practical application of these equations, demonstrate their usage on both simulated and measured signals and describe the methods to make decision about the actual technical state of the equipment based on the measured vibrations.

The software was developed to estimate different parameters related to the multi-resonance model (1). The measured vibration signal is processed according to the equations described in [4]. This software was verified with usage of the simulation program [3]. The comparison of the estimated values of the parameters with those defined in the simulation shows good agreement.

REFERENCES

[1] Gorodzha K., Analysis of Response of Power Electrical Equipment Due to Impact Excitation, *Proc. of International Workshop "Computational Problems of Electrical Engineering", Alushta, Ukraine*, 2008. – Pp. 41 – 43.

[2] Марченко Б.Г. Метод стохастических интегральных представлений и его приложения в радиотехнике. – К: Наук. думка. – 1973. – 191 с.

[3] Gorodzha K., Myslovich M., Sysak R., Analysis of Spectral Diagnostic Parameters Based On Mathematical Model of Electrical Equipment's Responses Due To Impact Excitation, *Przegląd Elektrotechniczny*, (2010), nr 1, 38-40.

[4] Gorodzha K., Sysak R., Statistical methods for estimation of spectral diagnostic parameters in electrical equipment diagnostics, *Proc. of International Conference "Computational Problems of Electrical Engineering – 2010". – Sep. 13th – 16th, 2010, Lázně Kynžvart, Czech Republic.*, 2010.

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