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Features of measurement and processing of vibration signals registered on the moving parts of electrical machines

Abstract. *Measurement and processing of vibration signals registered on the moving parts of the electrical machines using the diagnostic information-measuring system that uses Bluetooth wireless standard for the transmission of the measured data from moving parts of electrical machine is discussed.*

Keywords: vibration diagnostics, statistical methods, electrical machines, diagnostic expert systems.

When creating information-measuring systems of diagnostics (IMS) an important task is the adaptation of mathematical model of the object of diagnostic in view features of the technical part IMS.

The purpose of this paper is to investigate vibration signals measured from the moving parts of rotary power machines using IMS of vibrodiagnostics, based on using the Bluetooth standard for transmission of diagnostic information to verify the proposed mathematical model of the investigated signals, as well as experimental validation of diagnostic signs.

Developed mathematical model of mechanical system moving parts of electric machine is presented as a linear system.

The vibrations at the point of placing an accelerometer on a particular node electrical machine, which is diagnosed in steady mode can be considered as the sum of random signals, coming in this point through different channels of distribution, that is:

$$\xi(t)=\sum_{j=1}^{N} a_j \xi_j(t), \quad t\in(-\infty,\infty) \tag{1}$$

where: N- some positive integer, determined by design, technological and operating properties of node, in which distributed vibration wave, aj - weight coefficients, that take into account the attenuation of vibration waves through the appropriate channels. The number N determines the number of resonances in researched node.

Component $\xi_j(t)$, $t\in(-\infty,\infty)$, which is part of (1), is a linear random process. As a result, the process $\xi(t)$ is also a linear random process with certain probabilistic characteristics. The task of diagnostics reduces to the determination diagnostic signs by (1) , calculation and further analysis of statistical estimators and building the solving rules of diagnosing the technical condition and classification of defects in the researched system.

To obtain vibration signals was conducted technical modification of the developed IMS of vibrodiagnostics and adaptation of package of applied programs, which provides statistical processing of diagnostic signals and the construction of resolving rules the diagnosis and classification of possible defects in moving parts of power machines.

Technical part of IMS is constructed as a modular system that allows, after doing of minor changes, adapt the system for measuring and processing of various types of diagnostic signals. In the present work was conducted the improve block of sensors, which increased the frequency range of the measured vibration signal.

Previous researches by IMS of vibrodiagnostics based on the use sensors of type ADXL202 manufactured by Analog Devices with a range of measuring vibration signal within a range from 0.01 Hz to 6 kHz. In this work executed the modification of the sensor unit and the sensor ADXL202 replaced by sensor ADXL001 manufactured by Analog Devices with a measurement range of vibration signal from 0.01 Hz to 22 kHz. Unlike sensor ADXL202, ADXL001 sensor has an analog output signal. Therefore ADXL001 accelerometer output is connected to 10-bit ADC, which is part of the PIC16F873 microcontroller manufactured by Microchip, by which the measured analog vibration signal converted into a digital signal for its further transmission via radiochannel Bluetooth by block of receiving and processing information. To ensure the measurement unit sensors acceleration on two axes of coordinates were used two sensors ADXL001 on each block of sensors.

After the modification block of sensors and block of receiving and processing information, that comprise the IMS, was performed measuring vibration signals from the moving parts of electric DC machine type P-51. Measurement of vibration signal consisted of two phases, which is the difference in the location block sensors on different nodes of electric machines.

With using software of IMS executed the preliminary processing of the vibration signals and performed research of the basic characteristics. The main component the block receiving and processing of information is the computer program based on the methods of correlation, spectral and histogram analysis or vibrations. This software package allows to determine the initial and central moments to the fourth , inclusive,coefficients of asymmetry and kurtosis ,the spacing variation ,construct histograms and smooth their of the system of curves of Pearson and obtain smoothed estimates the power spectrum and mutual amplitude spectrum with evaluation of variance of obtained estimates of spectra .

Results of statistical analysis of diagnostic signals, measured at different operating modes of the object of diagnostics, providing the possibility of using IMS to diagnose faults of windings, bearings, magnetic circuit, mechanical imbalance. Increased frequency range of the measured vibration signal provided an opportunity to more accurately diagnose and expanded the scope of the IMS.

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