PROCESSING OF VIBRODIAGNOSTICS SIGNALS USING SPECIALIZED PORTABLE DEVICES

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Use of a probabilistic model of vibration signals in the form of a periodically correlated random process allows new opportunities for diagnosing defects in rotating mechanisms at the early stages of their occurrence. Importance of multichannel simultaneous acquisition of vibration diagnostic signals for their join analysis grounded. General requirements to specialized portable devices for acquisition and preprocessing of the vibration diagnostic signals are considered.

Keywords: periodically correlated random process, vibration signal, multichannel join signal analysis

One of the important tasks of vibration diagnostics is to assess the technical condition of complex mechanical systems as a whole as well as their individual elements – to detect emerging defects, and to assess the impact of minor deviations of parameters from the steady-state operating mode. For this purpose, it is advisable to use methods of statistical analysis of vibration signals grounded on the theory and methods of periodically correlated random processes (PCRP) [1]. The research was conducted in the department of methods and facilities for acquisition and processing diagnostic signals of Karpenko Physico-mechanical institute showed that the use of a probabilistic model of vibration signals in the form of a PCRP allows a new opportunities for diagnosing defects in rotating mechanisms at the early stages of their occurrence [2]. When vibration diagnostic of a complex mechanical system it is advisable applying a mathematical model of the vibration signal in the form of mixture of the deterministic and random components, while it is necessary to take into account that the actual random component is the sum of the non-stationary component that generates a defective element of the system and stationary background noise. The non-stationary component, which is appearing because of the presence of a defective element in the dynamic system under investigation, is described within the framework of the theory and methods of PCRP [1].

When determining the technical condition of a mechanical system, it is important to determine and analyze the amplitude and phase spectra not only of the selected vibration signal at one measurement point, but also, for example, of the signals of neighboring of the shaft supports, since the phase difference of the vibrations of the supports at the rotor rotation frequency and its harmonics contains information about the nature of the shaft vibrations. Therefore, to solve the

specified diagnostic tasks, it is necessary to use methods of non-stationary analysis of the PCRP. For establishing the types and types of defects, in that conduct correlation and spectral analyses of signals, measured at different control points [1–3]. At present, a reliable, practical and cheap widespread technology of vibration diagnostics is periodic monitoring of vibration intensity at several points at the object under investigation using the simplest portable vibrometers, which determine the levels of vibration intensity, the ratio between their values at different points and their variations in time.

However, practice shows that there are no universal reliable signatures for identifying specific defects, and in many cases, even with a significant increase in the magnitude of a certain significant harmonic of the signal, the overall level of vibration intensity may change insignificantly. However, in most cases, the level of vibration intensity and their growth over time can be used to fairly reliably qualify the defective state of the elements of a mechanical system [4]. It is important to note, that during vibration diagnostics the location of vibration control points is carried out strictly in accordance with the recommendations of the manufacturer of object under investigation, while it is important to ensure the correct choice of location and direction of vibration measurement.

Thus, effective modern specialized portable vibration diagnostics devices are implemented as multi-channel information and measuring systems that combine primary analog signal converters, analog processing circuits, analog to digital convertors with the ability to reconfigure according to the requirements for a specific object and task. It is also necessary to provide them with data transmission channels with the ability to connect to a local digital data transmission network with functions of short-term and long-term storage of registered signals, firmware tools for their pre-processing for obtaining of the preliminary/current signal estimates.

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