1.8.16. THE VIBROUACOUSTIC NOISE COMPENSATION BY THE ADAPTIVE DIGITAL FILTER

Makhov V.E., Borisov E.G., Ivanov A.A., Patrakeev N.V.,
North-West State Technical University, St. Petersburg, Russia

In a number of tasks of remote vibrodiagnostics, the main points of the adaptive digital filtration theory are often used. In a real situations, the diagnostics of the working machines is done when there is a vibroacoustic noise that can be created either by the controlled unit or by other devices in the system.

When the work of pipeline dampers and valves is controlled by vortical hydrodynamic noise, the pipeline vibration is a background hindrance. When vibration of internal-combustion engines, aerodynamic noise of turbine and ventilator blades, acoustic noise of rotors etc. are being detected, background interferences, caused by various factors, may interfere in the measurement process.

Background vibrations may be caused by the working machine basement vibration which is very noticeable in workshops and building sites. These vibrations may be caused by the machine units themselves or by other factors [1].

Let us consider the possibility of the compensation of the hindering effect of the vibroacoustic noise in the adaptive digital filter when parameters of vibrosygnal are measured by the Doppler radar against the background of a vibrating surface when a sensor of environment parameters is used, for example, a pressure sensor, fig. 1.

In order to carry out this method, it is necessary to measure and compensate vibroacoustic noise by creating an additional channel which is the sensor of pressure that measures vibration noise that is the shaper of interference standard. In order to do that, it is possible to use the effect of amplitude-phase modulation (APM) of high-frequent radar signal reflected from the vibrating surface. A reference signal can be formed, for instance, by the sensor of vibrations which uses piezoelectric or any other effect. This sensor is fixed on the bed plate of the controlled machine or is installed in another controlling point if it is necessary.

Since when some controlled machine is irradiated with radar there will be APM, then it is necessary to synthesize such a processing device that will exclude the effect of distortion of analyzed data caused by the influence of the interference. One of the main tasks of adaptive filtration is to separate the data from unstable hindering signals and noises that have a spectrum, overlapping with the spectrum of the valid signals or when the bandwidth of hindering signals is unknown, changeable and cannot be designated a priori for the calculation of parametric filters. Frequency characteristic of adaptive filters is regulated automatically or modified according to a certain criterion that enables filter to adapt to changes of characteristics of the input signal. They are widely used in radiolocation, hydrolocation, navigation systems, detection of biomedical signals, and many other branches of technology. As an example, we will consider the most widely used schemes of adaptive signal filtration [2]. Block diagrams of two types of adaptive filters are presented at fig. 2 and fig. 3.

The process of adaptation without feedback consists of measurements of characteristics of input signals (signals and noises), the addition of this information into the algorithm of filtration, and the use of the results of measurements for the purposeful regulation. When the feedback adaptation is used, in addition, the influence of parameters of regulation on the output signal is automatically estimated. As the main element, we will

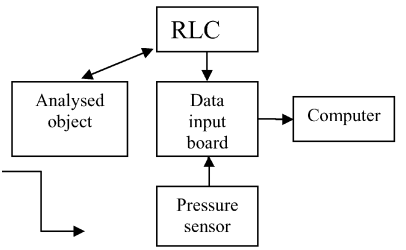

Fig. 1. The block diagram of the remote vibrodiagnostic device

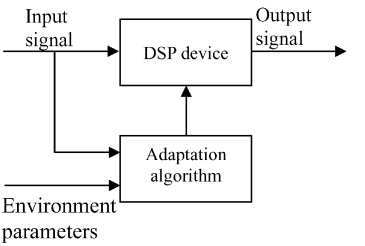

Fig. 2. The block diagram of the adaptive filter without feedback

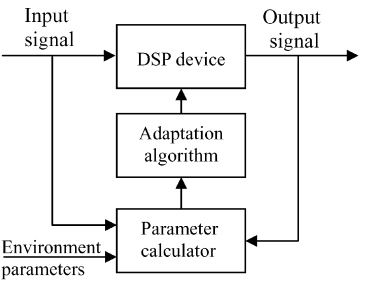

Fig. 3. The feedback block diagram of the adaptive filter

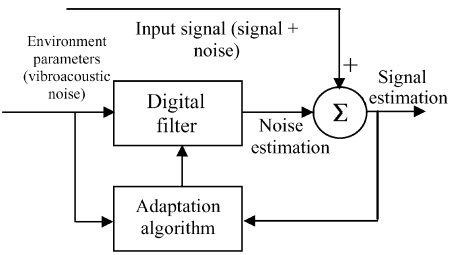

Fig. 4. The adaptive digital filter

use the adaptive noise reducer. The block diagram of the filter is shown in fig. 4. The filter is composed of the block of the digital filter with regulated coefficients and adaptive algorithm for adjustment and change of filter coefficients.

References:

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2. **Solonina A.I.** et al. The Foundations of the Digital Signal Processing. A Course of Lectures. St.-Petersburg: BHV – St.-Petersburg, 2003. – 608 p.