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WORK DIAGNOSTICS OF THE VEHICLE'S ENGINE USING VIBROACOUSTIC CHARACTERISTIC

Abstract. The report presents the essence and necessity of diagnostics of the vehicle's engine using vibroacoustic characteristics. To improve the analysis, we suggest using wavelet transforming signals.

Keywords: vibroacoustic signal, internal combustion engine, technical diagnostics of engines, wavelet-transform.

Nowadays the car has become almost an inalienable attribute of life. With the increase in the number of cars, there is a problem of increasing the reliability and safety of their operation, which depends on timely and properly performed technical diagnostics.

Among the existing, well-known diagnostic methods, one of the most promising methods is the vibroacoustic diagnostics.

The main advantages of this method are: [1]

- ability to diagnose faults;
- detection of the development of defects in the early stages;
- prediction of further operation of engine units;
- planning of maintenance work and repair work;
- efficiency of information collection on the technical condition of the car, qualitative analysis and reliability of the assessment, as well as the mobility of vibration acoustic equipment;

For pre-assessment of the state of the knots and mechanisms of the car's engine, serial vibro converters are used (converts mechanical oscillations into electrical signals), inductive rotor speed sensors, computer sound cards, and professional programs that are designed to record and trim sounds. Sensors are installed in certain places of the engine (fig. 1) to determine the state of the motor units and mechanisms of the car, using the vibration switches and selecting the required engine operating mode and receiving signals to the computer with subsequent recording in real time and further evaluation. Sensors are installed in certain places of the engine (fig. 1) to determine the state of the motor units and mechanisms of the car, using the vibration switches and selecting the required engine operating mode and receiving signals to the computer with subsequent recording in real time and further evaluation. At the same time, with the help of an inductive sensor, the position of the piston of the first cylinder relative to the dead point.[2]

Of course the work of all the functional nodes of any engine is tied. In view of this, one of the important nodes is chosen as the base and all further work is considered in relation to it. In this case, the crankshaft was chosen as the base unit. In order to provide high informativeeness of the analyzed signals in the work the further wavelet transformation of signals is used. Such a transformation allows not only qualitative filtering of signals, but also analyzes and allocates important informative components of them.

An important component of diagnosing automobile engines is the formation of reference (base) databases, which are recorded from new engines of specific brands and modifications of cars. In the future, the wavelet transformation is carried out for both signals, that is, the reference and signal of a particular diagnostic engine.

A comparison of signals is made for the corresponding engine points. In order to improve the assessment of the qualitative characteristics of diagnosing engines in the work, the mutual wavelet transformation between the corresponding points of the base engine and the diagnosed one is calculated. In this case, for the wavelet transform of both signals, the same basic functions are used.

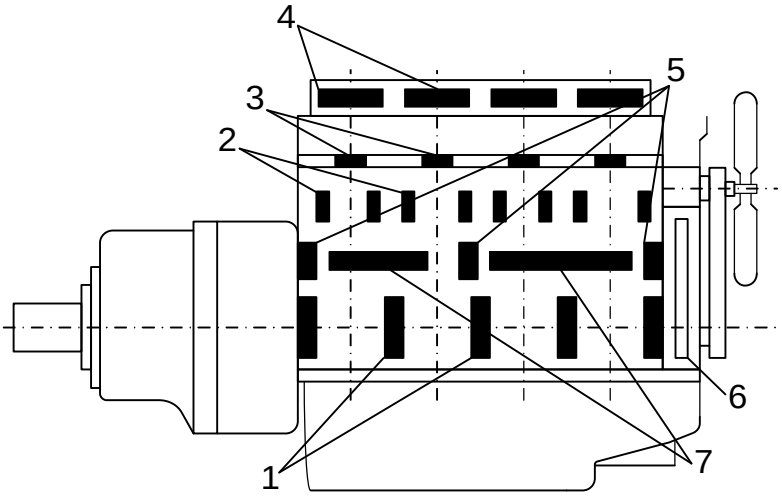

Figure 1 – Places of listening knocking in the engine connections:
1 – crankshaft; 2 –bushing – pusher; 3 –valve–piston crown; 4 -rocker shaft- valve stem;
5 -camshaft bearing; 6 – distribution gears; 7 – camshaft cam – pusher.

The general expression of the mutual wavelet transform for various diagnosed points has the following form: [3]

$$W_k r_1\left(\frac{1}{S_m},\frac{t_n}{S_m}\right)=\frac{1}{c_g}\int_{-\infty}^{\infty}\frac{da}{a^2}\int_{-\infty}^{\infty}\left[W_g\, r_1(a,b)\right]\left[W_g{}^{*} r_1(S_m a, S_m b - t_n)\right]db$$

In the course of research, a computer simulation of the proposed diagnostic process was carried out. The obtained results allow us to assert that with this diagnosis, it is possible to successfully detect not only engine malfunctions, but also insignificant places of it's wear.

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