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«Research of daubechies wavelet spectrum of vibroacoustic signals for diagnostic of diesel engines of combine harvesters»

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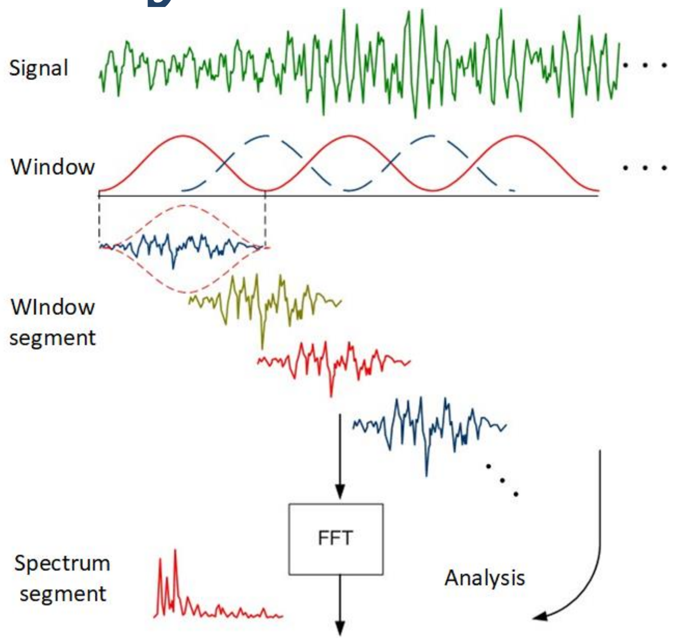
Актуальность



Schematic algorithm of STFT analysis

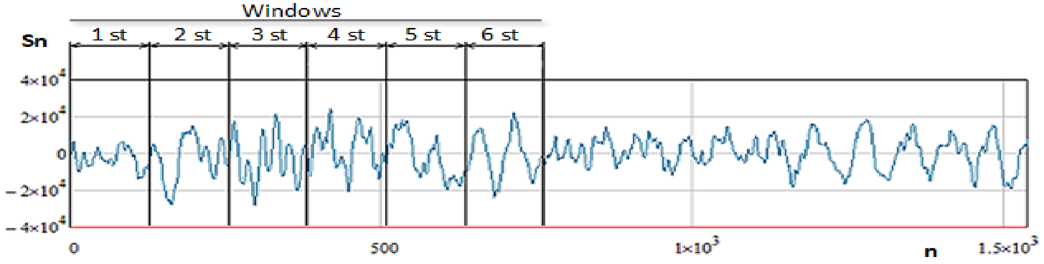
Fourier transform is the most widely used in vibration diagnostics of diesel for spectral analysis. It decomposes the signal into orthogonal basis functions (sines and cosines), determining its constituent frequencies. This method is strictly mathematically being appropriate for stationary signals (bearings, turbines) and improper for non-stationary signals (piston transfer, gas distribution mechanism, nozzles, etc.). Particularly, the Fourier transform does not make it possible, for example, to determine either a certain frequency was in a signal at all times or it appeared there at a given time (a defect occurrence) .

Commonly, they consist of short-term high-frequency elements , accompanied by low-frequency components superimposed on the former. Such a method should be used to analyse those signals, should show good frequency distribution along with excellent time distribution .

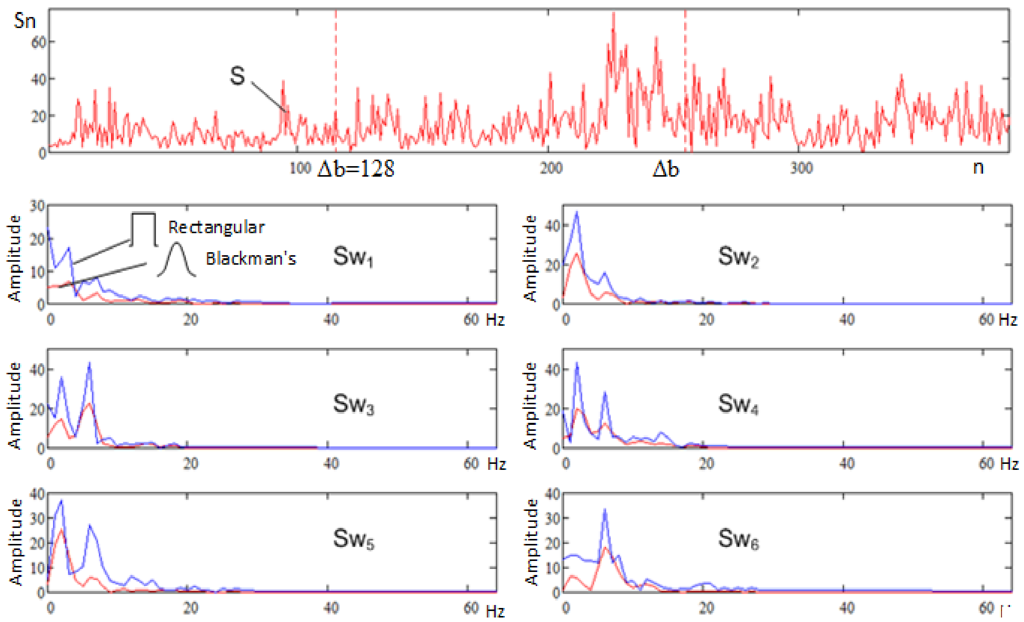
The first is to localize the low frequency components and the second is to allow the high frequency components . This method is found in the literature for the analysis of non-stationary signals and is called the Short-time Fourier transform (Short-time Fourier transform (STFT)

Методы решения

Briefly, STFT can be characterized by the following algorithm: define an analysis window (e.g., a 30 ms narrowband, 5 ms broadband); determine the overlap magnitude between windows (e.g. 30%); select a window function (e.g., Hann, Gauss, Blackman); create a window segment (signal multiplication by the window function); employ a fast Fourier transform (FFT) to each window segment.



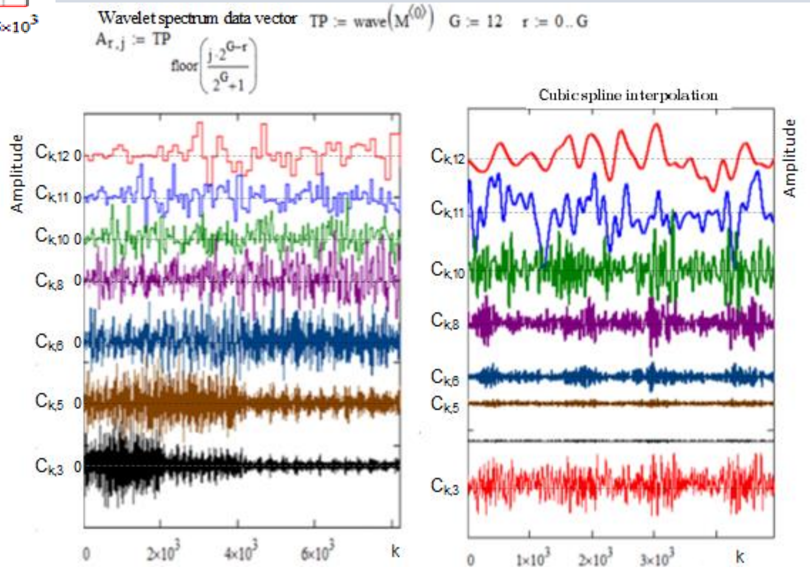
Vibroacoustic signal of the internal combustion engine and its arrangement on the windows of transformation



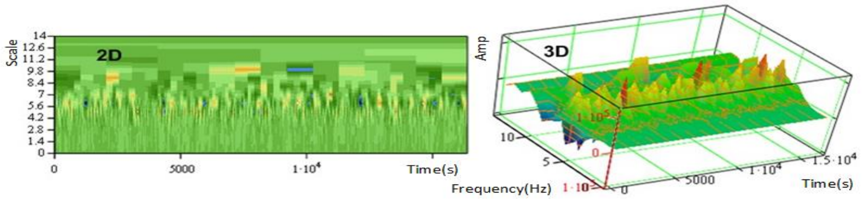
Implementation of window conversion using two types of windows

$$Ur := ceil\left(\frac{\ln(j)}{\ln(2)}\right) = ceil\left(\frac{\ln(16380)}{\ln(2)}\right) = 14$$

where: j – is the number of counting (points) of the recorded vibration signal



The Daubechies wavelets spectrum (right – interpolated form)



2D and 3D form of the Daubechies wavelets spectrum of the ICE

Выводы

Результаты, внедрение

1. The use of the Dobeshi wavelet spectra and the Fourier window transform for the analysis of the vibroacoustic signal makes, it possible to recognize changes in the state of the engine mechanisms and the location of the source of the change itself. The decomposition of the signal by all decomposition equations makes it possible to find the level, at which the signal is less than the noise, through approximating coefficients that exceed the set thresholds ub:=-3σ and ut:=+3σ noise distribution.
2. This study established the 5th level of decomposition in applied nature of vibration diagnostics of the combine engine. It is proved that the value of the constant scale factor should be in range d = 2..1.0.

Контакты

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