Abstract

Fault detection is one of crucial tasks of modern condition monitoring. Constant improvement in terms of speed and precision of algorithms allows one to detect damage earlier and maintain scheduled inspections and repairs. In case of the real world signals one needs to take into account that different types of noise will affect effectiveness of methods in various level.

The aim of this research was to develop methods that are robust to non-Gaussian noise. Such noise can disrupt efficiency of the classical methods that are based on simple statistics such as kurtosis (spectral kurtosis or kurtogram). Author has included these two methods in the dissertation as they are commonly used in the field as benchmark for new, developed algorithms.

The research problem, namely fault detection in non-Gaussian noise environment is fixed through analysis of the simulated signals or real, acquired on belt conveyor drive unit and copper ore crusher. Author in his work has developed algorithms which are basing on the time-frequency decomposition of the vibration signal and analysis of sub-signals (extracted time series from subsequent frequency bins of the absolute value of Short-Time Fourier Transform) or time slices (extracted energy densities from the absolute value of STFT). In analysis there was used α-stable distribution which parameters can describe impulsivity of the data or serve as a filter characteristic. Another developed tools include novel lag-frequency maps in which one can track informative frequency band (IFB) and indicators of impulsive behavior. Furthermore, there were developed tools for the selection of IFB through statistical means and measures of similarity to detect change of energy distribution in time slices. All methods were tested on both simulated and real world signals.

Keywords: *Signal processing, time series, time-frequency decomposition, heavy-tailed distribution, non-Gaussian noise, fault detection, bearings, gearboxes, mining machines.*