

# Statistical methods for processing and signals modelling in application to technical diagnostics

Agnieszka Wyłomańska

Faculty of Pure and Applied Mathematics

Wrocław University of Science and Technology, Wrocław, Poland

Problem of selection of informative frequency band (IFB) for local damage detection using vibration signal is often discussed in the literature. One of the approach used in this context is based on the analysis of sub-signals obtained in time-frequency representation (spectrogram) of the vibration signal. Mentioned sub-signals are analyzed using appropriate statistics (called selectors). Till now, the most popular statistic was kurtosis, one of the measure that can point out these frequency bins on time-frequency map that reveal the most impulsive nature. However for many real signals the spectral kurtosis does not give expected results because it can be sensitive for impulses not related to damage (i.e. artifacts). In our study we extend the idea of spectral kurtosis. We propose a set of selectors that are constructed on the basis of the approach that distribution of sub-signals that does not correspond to the IFB is closer to Gaussian than for sub-signals related to IFB (because of the impulsive nature of those sub-signals). The mentioned selectors mostly are calculated as the distance between the empirical distribution of given sub-signals and the theoretical Gaussian distribution. The approach based on the modelling of sub-signals from time-frequency map by Gaussian distribution can be extended to more general class of distributions, namely stable one. The stable distributions in the literature are considered as an extension of the classical Gaussian one. The class of this distributions is especially important in the context of modelling of data with impulsive nature but it should be mentioned that for stability parameter (called  $\alpha$  parameter) equal to 2 the stable distribution reduces to Gaussian one. Therefore they can be used also for sub-signals corresponding to IFB as well as not related to informative frequency band. Similar as in case of spectral kurtosis or Gaussian distribution based approach also here after application of  $\alpha$ -based selector we obtain distribution of the stability parameter versus frequency, that provides similar picture as spectral kurtosis or Gaussian-based selectors. This talk is a synthesis of few years research activity related to development of new mathematical methods and applications of existing advanced mathematical modeling techniques for technical diagnostics of mining machines.