Ball bearing diagnostics based on statistical metrics of cyclostationarity

Fabrizio Pancaldi[1], Riccardo Rubini[1], Marco Cocconcelli[1]

[1]DISMI, University of Modena and Reggio Emilia
Via G. Amendola 2 – Pad. Morselli, 42123 Reggio Emilia, Italy
{fabrizio.pancaldi, riccardo.rubini, marco.cocconcelli}@unimore.it

The mathematical model of faulted ball bearings has been extensively investigated in the last decades and the most recent results can even consider the kinematics of their components. So far, it is widely accepted that a faulted bearing is subject to an unwanted slippery in working conditions and this leads to a cyclostationary vibration signal [1]. Several works available in the technical literature are devoted to early detection of faults on the basis of the cyclostationary signature of the ball bearing [2]. This paper compares different approach to the ball bearing diagnostics based on the statistical definition of cyclostationarity [3]. In particular, few metrics have been devised to track the cyclic frequencies of the vibration signal. These metrics are: time-varying variance, time-varying kurtosis, time-varying Kolmogorov-Smirnov test. As reference, spectral kurtosis demodulation and autocorrelation are also included in the comparison since they are among the most used techniques in condition monitoring so far. The performance of the proposed algorithms has been assessed on experimental measurements (Figure 1). The comparison is completely automatized, avoiding subjective judgment of the technician. Numerical results have shown that the simplicity of the proposed algorithms leads to an intrinsic robustness against the mechanical noise typical of practical scenarios; nonetheless the computational complexity is very limited and is compatible with low end electronic equipment.

Keywords: Condition monitoring, Ball bearing, Variance, Kurtosis, Kolmogorov-Smirnov

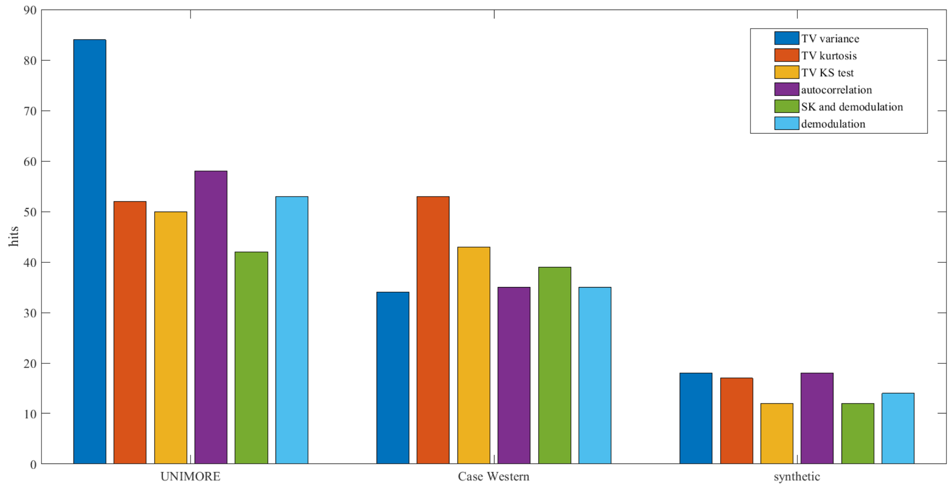

Figure 1: Performance achieved by the considered metrics in terms of number of hits (provided that no miss is identified) on different bearing datasets.

References

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