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NORMALIZED INDICATORS FOR MONITORING A SPALLING BEARING DEFECT IN VARIABLE SPEED REGIME

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ABSTRACT

In industrial applications, rolling element bearings are present in the majority of the rotating machines and are considered among the most critical components. Therefore their monitoring is crucial. The vibration analysis approach is the most used for detection and diagnosis of bearing defects. Under steady-state regime (load and speed constant), number of indicators have been proposed to monitor the bearing state. The most used are classical indicators; we find time indicators such as RMS value or spectral indicators. However, the bearing defects monitoring is more complicated when the operating parameters of systems are variable especially for the speed and for the load. This kind of operating regime is prevalent in industry, for example the tramway, plane motors, wind turbine etc. Under this non-stationary regime the amplitude and frequency components are always changing because of speed variation (or load variation). This affects clearly the classical diagnostic tools, which are not suitable for non-stationary analysis, and therefore a potential fault can be masked. To overcome this problem, this paper presents two new indicators; RMS value and spectral indicator normalized by the active power. To do that, the vibration signal is acquired simultaneous with the current and voltage signals, and then these signals are divided into segments. For each segment the RMS value (resp. the spectral indicator) and the power active are calculated, then the RMS (resp. the spectral indicator) is divided by the active power. A simulation model signal is used to investigate the proposed indicators. To experimental validation, a test rig is performed to extract signals (vibration, current and voltage signals) of different degradation states of bearings in variable speed regime. Two varieties of bearings are used; the thrust bearings (SKF 51207) and rolling element bearings (double row SKF 1206 ETN9) with different states of degradation: free fault and faults created with different sizes. Several operating parameters are considered: variable speed (50-1000 rpm) and different loads. The experimental tests show a linear relationship between the classical RMS value (resp. the spectral indicator) and the active power. The results show a correlation between the proposed indicators and the bearings state in variable regime. The proposed indicators are very simple and may be implemented in real time for wide large industrial applications.