Development of a high precision algorithm for predictive maintenance of industrial belt conveyors

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Belt conveyors are commonly used as continuous transport equipment in industries, since they present a high efficiency, large capacity, simple construction, and do not require intense maintenance works. Moreover, they constitute a key element of the entire industrial process; and a severe failure of one conveyor may result into a stop of production. On the other hand, one of the most frequent reasons for rotating machinery breakdown is deterioration of the rolling element bearings (REB) [1].

Traditional maintenance techniques (*e.g.*, corrective maintenance, preventive maintenance) generally involve substantially higher costs and may even reduce the production capacity in case that a critical failure occurs. In this context, predictive maintenance techniques based on a continuous monitoring of each component, arise as a more efficient and cost-effective solution (*i.e.*, maintenance tasks are performed only when necessary).

Among such techniques, those based on a vibrational analysis of the conveyor components (*e.g.*, FFT and envelope demodulation) permit a real-time, simple and accurate detection of a wide variety of failure typologies [2]. However, REB vibratory signals are non-stationary, non-linear and relatively weak, which makes them susceptible of being masked by stronger signals, such as the noise generated by other components. Consequently, the aim of this research project is to develop a high precision system for early prediction of failures and deterioration of industrial conveyor bearings. For this purpose, an algorithm has been developed with two different modules (see Fig. 1).

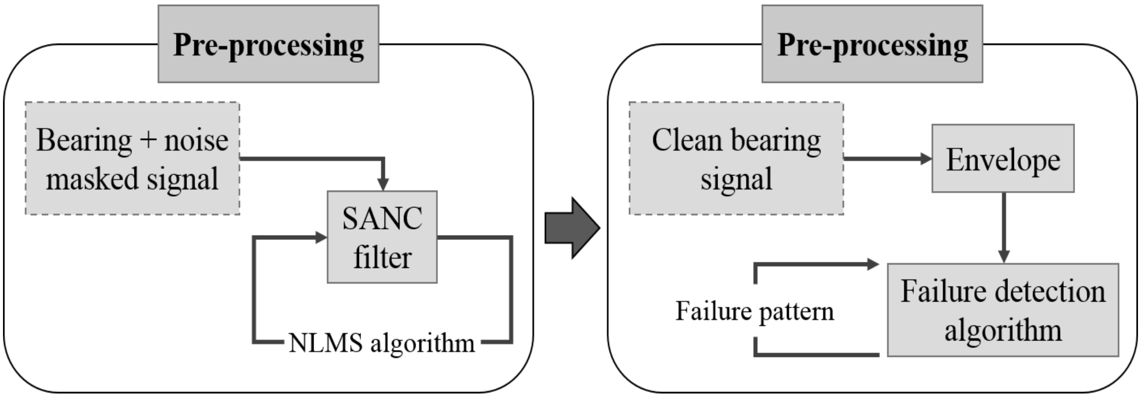

Fig. 1. Scheme of the proposed algorithm

First, the pre-processing module, which consists of a SANC filter in the form of a normalised least mean square (NLMS) algorithm, separates and eliminates the noise from the bearing vibratory signal. The SANC (self-adaptive noise cancellation) filter permits the separation of two signals as long as one of them is deterministic (in this case, the noise) and the other is random (the bearings vibrational response) [3].

In a second phase, the processing module, which is based on the envelope method, analyses the signal and determines the bearing deterioration. To this aim, the algorithm compares the acceleration pattern of the monitored bearing with that of a bearing with a certain failure, contained in a pattern catalogue to be introduced in the system prior to operation phase.

References

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