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Rolling element bearings localized fault diagnosis using signal differencing and median filtration
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Abstract
With the increase complexity of bearings' processing algorithms and the growing trend of using computationally demanding algorithms, it is advantageous to provide analysts with a simple to use and implement algorithm. In this spirit, this paper combines simple functions to provide machine condition analysts with the capacity to diagnose bearing faults without all the complexity and jargon that comes with existing methods. The paper proposes a simplified surveillance and diagnostic algorithm for diagnosing localized faults in rolling element bearings using measured raw vibration signals. The proposed algorithm is based on analyzing the frequency content obtained from applying a median filter on the squared derivative signal (first or higher derivatives) of the vibration signal. The combination of signal differencing and median filters provides a squared envelope signal, which can be used directly to diagnose faults. Signal differencing gives a measure of jerk forces and lifts the high frequency content of the signal. To select the optimum order of differentiation, Kurtosis and maximum correlated kurtosis (MCK) are proposed. Median filter usage represents a better alternative of normal low pass filtration. This completely suppresses impulses with large magnitudes, which may interfere with the diagnosis. The length of the median filter (odd number 3, 5, 7 etc.) is selected as such to include the first 10 harmonics of the defect frequency. Simulated signals are used to demonstrate the efficiency of the proposed algorithm and give insights into the choices of the differentiation and smoothening orders. The proposed processing algorithm gives a first measure (surveillance) for detecting localized faults in rolling element bearings in a very simple way and can be employed in online learning and diagnosis systems. Results obtained from applying the algorithm on complex vibration signals from two types of gearboxes are compared with a well-established semi-automated technique with good correspondence. © 2018 Nader Sawalhi.

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