Motor current signature analysis for gearbox health monitoring: Experiment, signal analysis and classification

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Abstract

Preventing downtimes in machinery operation is becoming fundamental in industrial standards. The most common strategy to avoid costly production stoppages is the preventive maintenance, combining it with reactive maintenance in detected malfunctions. Condition-based maintenance can reduce costs, and help maintaining the quality of the produced goods. Gearboxes, as crucial elements in industrial machinery, are conventionally monitored using accelerometers, which are expensive and can be hard to install in place to provide useful information.

Motor current signature analysis overcomes these inconveniences. This analysis technique provides a non-intrusive method, and it is based on readily available signals. Changes in the input voltages are related with variations of the speed and/or load of the electric motor. The health state of the gearbox can be examined through an exhaustive analysis of the input currents.

A gear prognosis simulator (GPS) test bench has been used to perform an extensive experimentation campaign. This test bench is particularly convenient due to the flexibility it provides. Different sets of sensors can be placed in different positions, and multiple combinations of speeds and loads can be established. Three damage categories in the gears have been analyzed, high damage, moderate damage and little damage. The test parameters have been selected to simulate the working conditions of electromechanical actuators and machine tools. Constant speed and transient tests have been performed. In the transient tests, fast speed changes are performed to produce acceleration, to investigate the concomitant changes produced in the signal. The analysis has been performed in both the time and the frequency domain, and complementarily, using the wavelet decomposition. The results obtained allow discerning the different type of defects on the gears, thus allowing detecting the different fault conditions and enabling the assessment of the health state of the gearbox.

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