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Two stage helical gearbox fault detection and diagnosis based on continuous wavelet transformation of time synchronous averaged vibration signals

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ABSTRACT

To find reliable symptoms of a fault in a multistage gearbox.

• Explores the use of time synchronous average (TSA) to suppress the noise and Continue Wavelet Transformation (CWT).

The results obtained in diagnosis an incipient gear breakage show that fault

diagnosis results can be improved by using an appropriate wavelet.

THEORETICAL BACKGROUND

Continuous Wavelet Transform:

Continuous Wavelet transform is to perform the Following equation:

$$CWT\{x(t);a,b\} = \int x(t)\psi_{a,b}^*(t)dt$$

Where : x(t) is the vibration signal, a is scale (dilation) factor, b is time location (translation) factor and $\psi_{a,b}^{*}(t)$ represents the complex conjugate of wavelet function.

•Time Synchronous Averaging:

Assuming a signal x(t) consists of a periodic signal $x_T(t)$ and a noisy component n(t), the period of $x_T(t)$ is T_o whose corresponding frequency is f_o . The synchronous average of the signal x(t) by using TSA can be expressed as :

$$y(t) = \frac{1}{M} \sum_{i=0}^{M-1} x(t+iT_o)$$

Where M is the number of average segments and y(t) is the average signal.











Two Stage Helical Gearbox Fault Detection and Diagnosis based on Continuous Wavelet Transformation of Time Synchronous Averaged Vibration Signals University of HUDDERSFIELD

Figure 2 Schematic diagram of test rig

Figure 3 Gear faults: (a) 20% tooth damage (b) 100% tooth damage

RESULTS







CONCLUSION

detection and diagnosis. accurate feature extraction.

FUTURE WORK

healthy and faulty gear condition upon the experiments data.

Figure 5 Gear with one complete tooth removed case plot of continuous coefficient map of the test signal

□ CWT has been shown to be an effective tool for rotating machinery fault

TSA allows the noisy components to be removed significantly and hence highlights the fault related impulse components which paves the basis for

□ three types of wavelets: db1, sym2 and coif3 were explored to find the optimal wavelet for separating the small fault.

The results have shown that wavelet db1 produces the best fault separation whereas the coif3 wavelet fails to do the separation.

Drive a mathematical model for vibration signal characterisation under

□Validate the modelling results and hence the developed algorithms based

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