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Different Signal Processing Techniques for Predicting the Condition of Journal Bearings



ABSTRACT

- Journal bearings are used to support shafts.
- Vibration condition monitoring is to detect, diagnose and prognoses faults [1].
- Show the differences between the time domain, frequency domain and time-frequency analysis (STFT) of Journal bearing vibration signal.

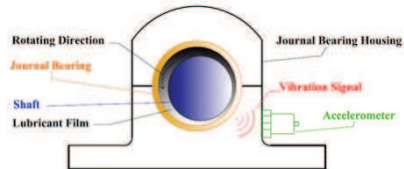


Figure 1: Journal Bearing Vibration Generation



Figure 2: Self-aligning Journal Bearing

THEORETICAL BACKGROUND

- Time domain analysis gives the behaviour of the signal over time which allows predictions and regression models for the signal [2].
- Frequency-domain data are obtained by converting time-domain data using a mathematical technique referred to as Fast Fourier Transform (FFT) [2]

- Time–frequency analysis is short-time Fourier Transform (STFT) investigates waveform signals in both time and frequency domain at same time [2].

$$STFT(t', u) = \int_t [f(t) \cdot W(t - t')] \cdot e^{-i2\pi ut} dt$$

Window should be narrow enough to make sure that the portion of the signal falling within the window is stationary.

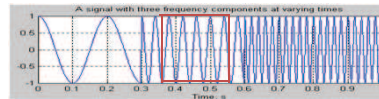


Figure 3: explain how STFT window is stationary portion of the signal [3]

Test Rig Facility

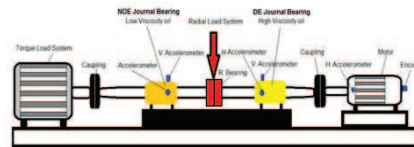


Figure 4: Schematic diagram of test rig

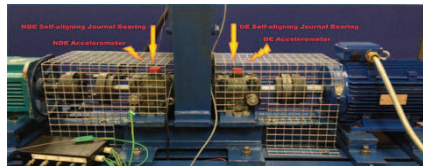


Figure 5: Journal Bearing Rig

Results and Discussion

- The time domain and frequency domain of journal bearings at high speed, high radial load and low viscosity oil

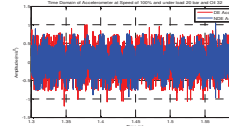


Figure 6: time domain

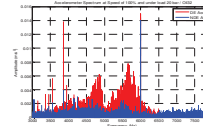


Figure 7: frequency domain

- Time-frequency STFT presentation

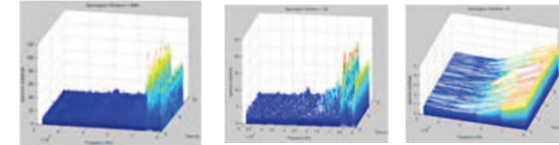


Figure 8: Different STFT window (2048,128,8)

Conclusion

- Time-frequency not only presents the frequency content of the signal but also shows when it occurs.
- STFT Narrow window means good time resolution, poor frequency resolution.
- STFT wide window means good frequency resolution, poor time resolution.

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- 1.Laakso, K., T. Rosqvist, and J.L. Paulsen, The use of condition monitoring information for maintenance planning and decision-making2002: Technical Report. NKS-80.
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- 3.Anonymous, Vibration Analysis and Signal Processing in LabVIEW, 2012, National Instruments.