Different Signal Processing Techniques for Predicting the Condition of Journal Bearings

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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].

Test Rig Facility

Figure 4: Schematic diagram of test rig

Figure 5: Journal Bearing Rig

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

\[ STFT(t',u) = \int f(t') \cdot W(t-t') \cdot e^{-j2\pi\nu t} \, dt \]

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]

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

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.

References