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Hassin, Osama

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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.

![Journal Bearing Vibration Generation](image1)

Figure 1: Journal Bearing Vibration Generation

![Self-aligning Journal Bearing](image2)

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].

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

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

![STFT window](image3)

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

![Test Rig Facility](image4)

Figure 4: Schematic diagram of test rig

![Journal Bearing Rig](image5)

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

![Time domain](image6)

Figure 6: time domain

![Frequency domain](image7)

Figure 7: frequency domain

![Different STFT window](image8)

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


Osama.hassin@hud.ac.uk