STI Vibration Monitoring Inc.

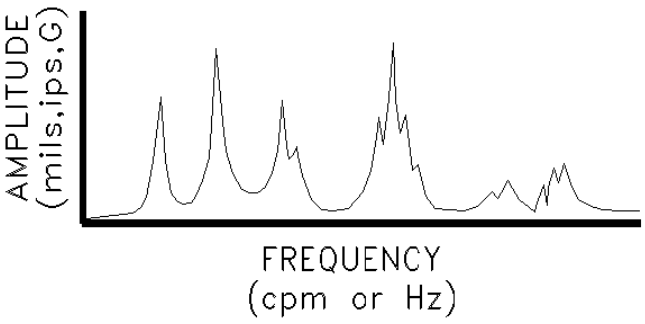
Field Application Note

Diagnostic Techniques-Part 2 Frequency Domain

FREQ

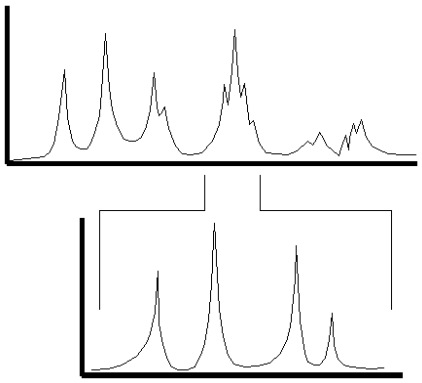
Frequency domain measurements and analysis have become increasingly popular to diagnose a particular machine fault. This measurement mode relies on processing the transducer output signal using Fast Fourier Transform (FFT) algorithms to display the signal amplitudes as a function of frequency. FFT processing essentially separates complex signals into individual components having single frequency content. This type of display is commonly termed a spectrum.

An enhancement of spectral analysis is to define specific frequency ranges to perform band analysis. Conceptually, band analysis is similar to filtering a signal. The "filter" searches for frequencies only within its frequency range. Certain permanently installed machine monitoring systems offer this capability. This feature is quite effective, once the particular spectral range and resolution has been determined, to rapidly diagnose machine faults.



A spectrum display is a display of signal amplitudes on the vertical axis and the signal frequencies on the horizontal axis. The frequency axis units may be in hertz (Hz) or in cycles per minute (CPM). Hertz or cycles per second may be converted into CPM by multiplying by 60. For example: 10 Hz = 600 CPM. The horizontal axis is scaled from 0 to some maximum frequency (Fmax). Individual signal frequencies will appear as peaks or spikes, each having specific amplitude. Properly setting the Fmax will ensure that the entire input signal is being analyzed. This setting can be verified mathematically by summing the square of each amplitude peak. The square root of this summation should approximate the overall amplitude level obtained directly from the transducer's output.

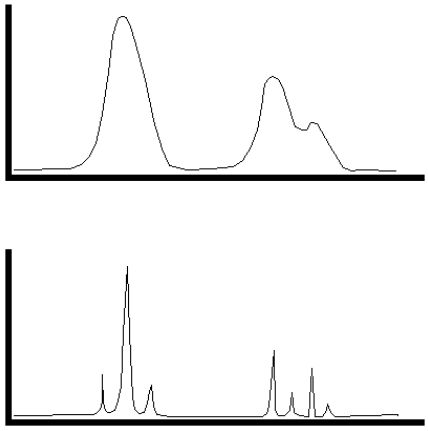
BAND ANALYSIS



Band analysis involves selecting frequency ranges of interest to allow rapid determination of a machine's condition. Generally, each machine fault will generate a specific, unique frequency as the condition deteriorates. A band is essentially a band pass filter allowing only the frequencies with the selected range to be measured. All other frequencies are excluded from analysis. Many modern machine monitor systems are capable of monitoring specific frequency ranges using band analysis.

RESOLUTION

Frequency resolution is an area requiring considerable attention. If the resolution is inadequate the entire analysis process could be meaningless or incorrect. Some instrument specifications list the spectral resolution as lines. A high resolution would be 3200 lines per spectrum and a low resolution would be 100 lines per spectrum.



1010 East Main Street, League City, TX 77573 Phone: 281.334.0766 Fax: 281.334.4255
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Each line of resolution can be viewed as a bucket or pail of a specific size. The signal frequencies can be viewed as a tennis ball. If a tennis ball's frequency matches the frequency range of the bucket, it is placed in the bucket. As the bucket fills with tennis balls the peaks on the spectrum display rise. Should the frequency range of the buckets be too large, the tennis balls will not be adequately separated to detect individual frequencies. This would lead to always using the highest resolution for spectral or band analysis. Higher resolutions require greater amounts of time to display the spectrum, thus a balance must be reached between the capture time and the spectral resolution.

Frequency Domain Checklist

1. Overall Amplitude
2. Time Base Waveform
3. Orbits