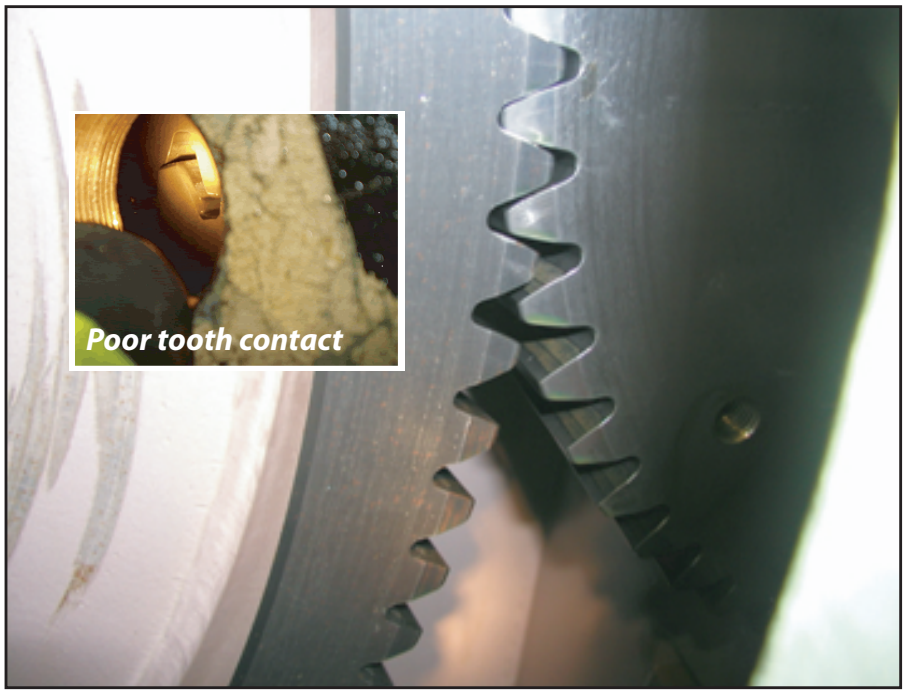
Application Note: DP-AN05-002

Demodulation Analysis of Gear Vibration



Applications

Amplitude Demodulation

Phase and Frequency Demodulation

Bearing Vibration Analysis

Gear Vibration Analysis

Departments

Predictive Maintenance

Engineering Test

Research and Development

Description

Gear mesh vibration is a natural occurrence in most mechanical drives and geared transmissions. While the amplitude of gear mesh frequency (GMF) vibration is of importance, determining the source of increased GMF levels often requires more sophisticated analysis. The root cause of the problem is usually one or more gears whose rotational frequency modulates the amplitude of the GMF energy.

Problem

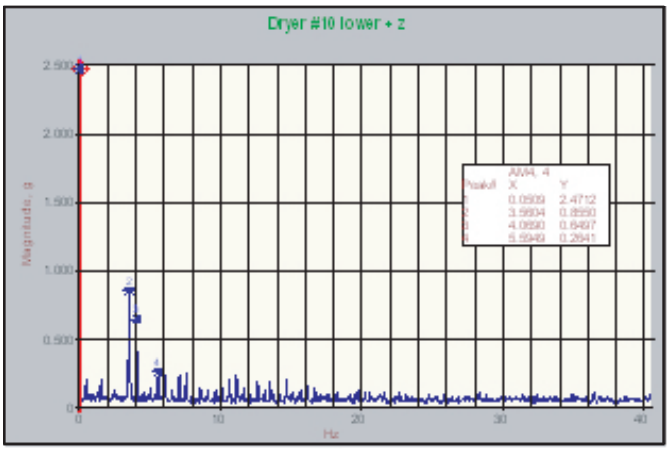
Using auto power spectrum measurements, the bandwidth in the vicinity of the GMF vibration can be analyzed to show the modulating frequencies as sidebands. However, this analysis is useful when there is only amplitude modulation at play and then only if there is a single source of amplitude modulation. Traditional envelope analysis techniques are very useful in exposing the amplitude modulating frequencies, but the mechanism used does not retain information about the phase or frequency modulating components in a given signal.

Solution

The Demodulation option for SignalCalc analyzers offers amplitude and frequency/phase demodulation along with analytic (envelope) signals. Demodulation can be combined with zoom or synchronous averaging analysis in order to concentrate the analysis on the events of interest. It is useful when signals of interest are mixed in with other signals as modulations of frequency or amplitude (thus the mix is a multiplication, not merely an addition) and when signals are obscured by noise or harmonics of the other signal components.

Implementation

Underlying this analysis is the analytic signal, sometimes called the envelope. The analytic signal is composed of the original signal plus a 90-degree phase-shifted version of itself (the Hilbert transform), and the magnitude of the analytic signal is the envelope of the original signal, giving an outline of low-frequency events that modulate the main signal. Accelerometers situated around the drive train are connected to the analyzer and a baseband auto power spectrum measurement is first carried out to determine the general characteristics of the signals. Zoom analysis is then used as a band pass filter around the carrier frequency. The measurements may also be combined with synchronous averaging, with a once per rev tachometer providing a trigger for linear averaging. Synchronous averaging ties the analysis to a particular event such as the period of rotation of a shaft, and allows signal characteristics that happen at fixed times relative to the triggering event to reinforce each other in the average while incoherent events average out. The resultant amplitude modulation and phase modulation spectra allow analysis of the frequency and amplitude of the various modulating components in the signal.

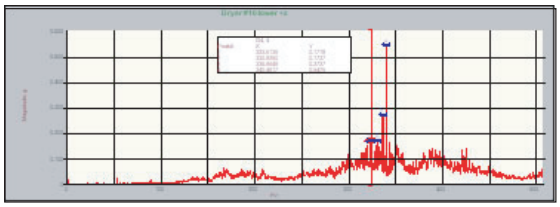


Amplitude Modulation Spectrum

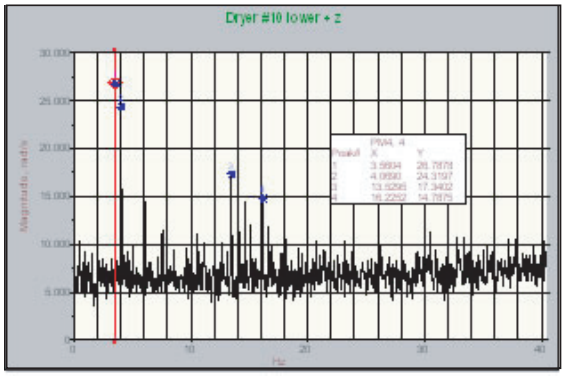
Key System Features

- Envelope Analysis
- Amplitude Demodulation
- Phase and Frequency Demodulation
- Unlimited Display Layouts
- Intuitive Graphical User Interface
- Throughput to Disk Recording and Playback Analysis
- RPM based Measurements

Part Number and Description	Qty
Hardware	
DP700-30-A1 Network Peripheral	1
DP700-30-8C DSPCentric Signal Processing Hardware - 8 Channels	1
DP730-10 Windows Based Dynamic Signal Analyzer Software	1
DP730-101 Rotating Machinery Package (includes RPM based analysis, disk throughput, waterfall analysis and order tracking)	1
DP730-18 Demodulation	1



0-500 Hz Baseband Analysis



Phase Modulation Spectrum