Realtime Order Tracking Option for RT Pro

Order Analysis Software Module Providing Speed Related Analysis for Rotating Equipment

Main Features

- Digital resampling for accurate order normalization
- From 1st to up to 320th order
- Fractional order resolution
- Up to 55 orders in realtime
- Run-up and run-down measurements with rpm direction change gating
- Waterfall plots with 3D cursor
- Slice plots along Order or RPM axes
- Spectrogram and color contour plots
- Automatic report generation in Microsoft Word

Powerful Order Analysis Tool

Dactron’s Realtime Order Tracking Option for RT Pro provides high performance digital processing methods together with flexible displays in an easy to use package. It offers you the measurement and analysis tools to troubleshoot or analyze vibration or noise problems related to the speed characteristics of all kinds of rotating equipment. This software can meet the day to day requirements for rotating machinery analysis of engines, transmissions, gearboxes, electric motors, turbines, compressors, fans, etc.

Order analysis is a valuable tool for understanding the operational characteristics of variable speed rotating equipment. By normalizing all measurements to the shaft speed, vibration related to shaft rotation appears stationary on the order axis of the spectrum. Also, since each harmonic is an integer multiple, or order of the shaft speed, responses related harmonics of the shaft speed occur at constant order lines on the spectrum.
To capture data for certain operational conditions you can program the software to acquire data over a specified RPM range. The delta RPM specified sets precision of the analysis.

All measurements in the order domain are derived from an advanced digital resampling method. High speed DSP processing allows synchronization of the analyzer’s sampling rate to a tachometer signal. The analyzer’s sampling rate continuously adjusts to track variation in shaft speed. After data sampling, a non-power-of-two FFT converts the time data into the frequency domain for extraction of the order amplitude values as a function of RPM.

Realtime order tracking offers advantages over fixed sample rate techniques. It provides better tracking performance when the RPM varies quickly. Additionally, it provides precise control over the order resolution of the measurement. For instance, you can specify that the order resolution be 1/40 of an order for all measurements.

There are also significant benefits in order amplitude estimation for the realtime order tracking method. Since the sampling rate is synched to the tachometer signal, the data in each frame is always periodic with respect to the fundamental speed. That is, there are always an integer number of cycles for the fundamental and its harmonics in each data frame. Because of this periodicity, there is no need to use a spectral window, such as a Hanning window, in the FFT calculation. This results in a more accurate estimate of the amplitude for each order.

Advanced Digital Processing

Measurement Modes

To capture data for certain operational conditions you can program the software to acquire data over a specified RPM range. The delta RPM specified sets precision of the analysis.

To optimize measurements a number of modes are offered:

**Free run** is used when the shaft RPM varies and the direction and change of RPM is uncertain or deliberately varied. This mode is useful for continuous measurements or manual start/stop operation.

**Run-down** is used when the shaft RPM decreases over time. The measurement starts when the RPM falls below the High RPM level and stops when the RPM falls below the Low RPM level.

**Run-up** is used when the shaft RPM increases over time. The measurement starts when the RPM rises above the Low RPM level and stops when the RPM rises above the High RPM level.

Another valuable analysis tool is the order track display. This display characterizes a machine’s operational response by showing the level of vibration or noise as a function of the shaft speed.
Averaging techniques are available to help suppress background noise and improve the overall quality of the measurement. Linear, exponential and peak-hold averaging methods are offered.

For the Run-down and Run-up measurement modes two additional choices are available. One selection enables definition of the number of cycles to measure. For example, three run-down events could be measured and averaged. A second selection gates the measurement process to limit data acquisition to only when the RPM is changing in the direction specified. The run-down mode, for instance, acquires data only when the RPM is decreasing and this mode ignores data for any RPM direction reversals.

A parameter for the number of pulses per revolution the tachometer signal to RPM. This setup parameter provides easy adaptation to a variety of tachometer signals. To handle RPM changes through gearboxes, transmissions, etc., the Tach setup includes a Gear Ratio entry field. This parameter specifies the gear ratio in terms of the ratio of a denominator and numerator. Entered as floating point numbers, these values support a wide variety of gear mechanisms.

Very Flexible selections for the maximum order and order resolution accommodate a wide range of needs for the extent and detail of the order analysis. The Order Span is selectable up to 320 orders. While measuring the 320th order the delta Order can be as fine as 0.25 orders. An order resolution as fine as 0.025 of an order can be used for measurements with a maximum order of 20 or less. Also impressive is the capability to simultaneously collect 55 orders in realtime.

Measurements can be viewed in realtime as the data is acquired and analyzed. On-line displays include the time histories, orbit plots, spectra, order tracks, waterfalls, spectrograms, and contour plots. You can also view the RPM as a function of time.

Waterfall displays provide a good overview look at the entire run-up or run-down measurement. To better understand the measurement results, you can easily change the viewing angle to the waterfall axes so that the influence of order related excitation and structural resonance excitation is immediately obvious.
One of the great time saving features of the Realtime Order Tracking Option is the automatic report generation capability. This feature provides quick yet comprehensive reporting capabilities. Data and results are inserted into Microsoft Word at a single mouse click. Reports can be easily customized to suit your requirements. Since reports are automatically generated in Word, the inconvenience and time consuming task of cutting and pasting is eliminated.

Data acquired using the Order Tracking Option can be saved and exported in a variety of data formats thus providing a means of seamless integration with other application solutions. Supported data formats include Dactron Binary, ASCII, UFF (binary or text), Wave Audio Formats, Agilent SDF, and MTS ATI/AFU.

A full complement of cursors – single, dual, peak, valley, harmonic and sideband provide precise quantitative data on critical data features. You also have complete and easy control of orientation, scaling, colors, etc. to create insightful visualizations.

Spectrograms provide additional insight into rotating equipment behavior.

Waterfall displays include a “slice” mode that gives a plot based on a cut across the Order or RPM axes. To view a particular slice, simply position the 3D cursor. You can view the Order Track for a given order, or fractional order, or view the amplitude versus order spectrum at a given RPM. This capability allows you to quickly zero in on the root cause of vibration or noise problems.

Color map presentations further enhance problem diagnosis capabilities. For example, spectrograms, or color intensity plots, make it easy to differentiate order-related responses from excitation due to structural resonances. Color contour, or topographic maps, also provide added insight into vibration or acoustic dynamics.

The variation of RPM with time can be viewed online.
Dactron offers additional software options that work with, and complement, the Realtime Order Tracking for RT Pro. These options include Long Waveform Recording, Analyze Anywhere, and Automated Test. The Long Waveform Recording option provides a means of capturing time waveforms of acoustic signals with duration as short as a few microseconds to many hours. These signals can be saved in binary, ASCII, UFF, or WAV formats for integration with other software packages, or they can be played back and processed, offline, using the Dactron Analyze Anywhere software.

The Automated Test Option is well suited for production line and quality control testing where vibration data is used as the pass/fail criteria. Upper and lower limit checks are easily created for flagging out of tolerance signals.
Realtime Order Tracking Option

Method
Realtime digital resampling technique

Order span
1st up to 320th order tracked; 1 < RPM < 300000
(Maximum usable RPM limited by resolution, tach
pulse rate, pulses/rev and averaging used)

Order resolution
0.025, 0.05, 0.1, 0.125, 0.25, 0.5, and 1.0

Max Order | Order Resolution
---|---
20 | 0.025 to 1
40 | 0.050 to 1
80 | 0.1 to 1
160 | 0.125 to 1
320 | 0.25 to 1

Number of orders
Up to 55 orders simultaneously tracked online.

Amplitude extraction
Based on DFT frequency domain extraction of
order amplitudes.

Waterfall plots
Amplitude vs Order vs RPM; all other attributes
as per the Advanced Graphics Option.

*RPM accuracy depends on the number waterfall spectra, order tracks
defined, and channels active.

Advanced Graphics Option

 INCLUDED WITH REALTIME ORDER TRACKING OPTION

Quantities
Spectra and time histories versus time

Plot formats
Waterfall (3D display) and spectrograms or color
contour (2D plots)

Waterfall Analysis

Cursors
3D cursor Dual axis cursor (RPM and frequency) with trace
color highlighted in both axes

Syncing
Synchronized cursor positioning for all cursors in
all Windows.

Display axes
X axis Hertz or CPM; linear or log scale
Y axis Engineering units (EU), EU
Z axis Seconds

3D orientation
Viewing angle interactively set using the mouse

Slice Plot
Selectable as X slice or Z slice

Data Export

Binary file formats
Dactron Binary, UFF, MATLAB™, WAV, Agilent
SDF, MTS ATi/AFU

ASCII file formats
X-Y pair, Y only, UFF

Supported Hardware and Operating Systems

Photon™ 2 to 4 channel Dynamic Signal Analyzer

Operating System
Windows 95/98/Me/2000

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