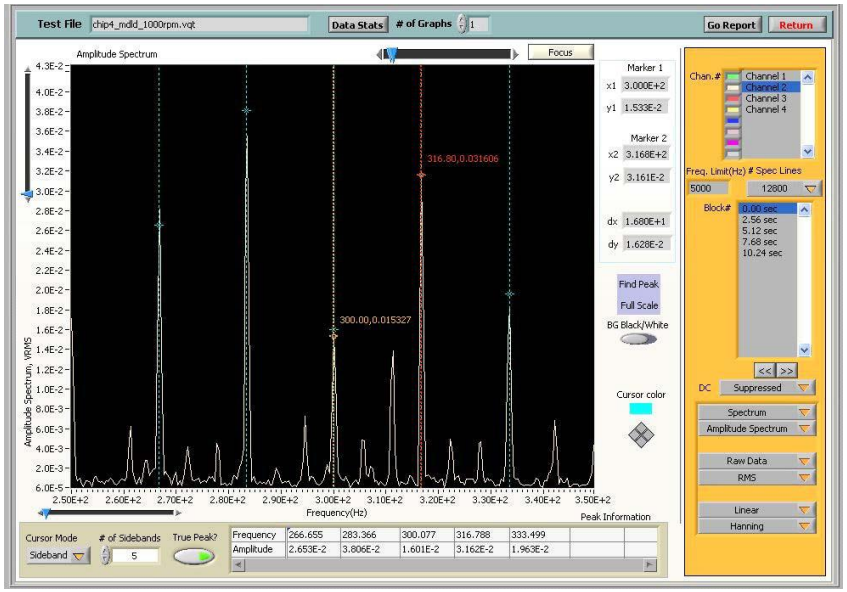
VibraQuest



An innovative data acquisition and analysis solution for noise and vibration

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VibraQuest Overview

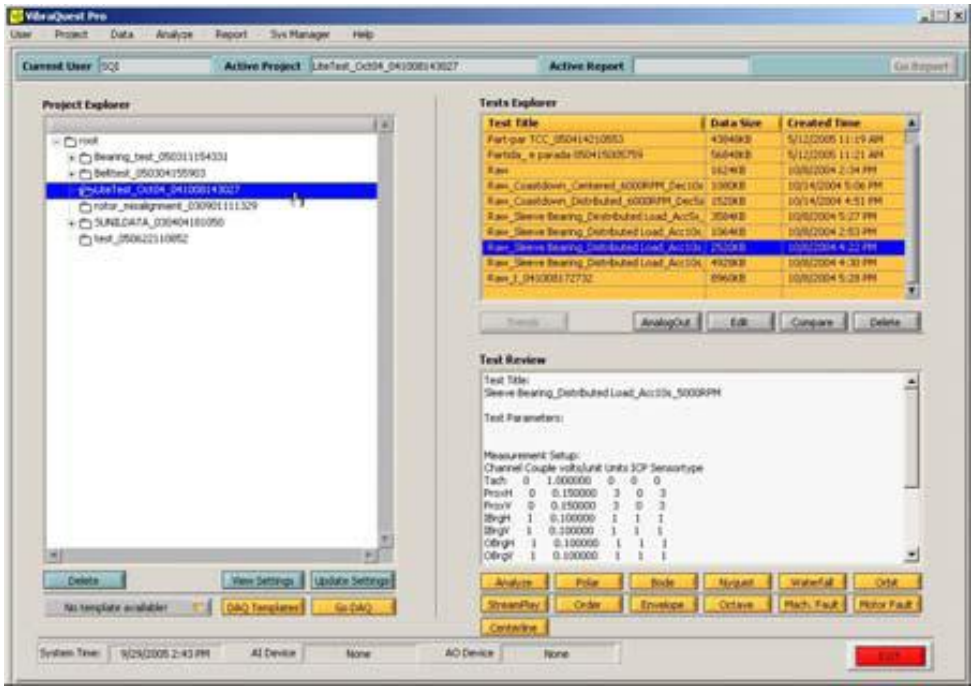
- VibraQuest (VQ) is an integrated solutions package for rotating/reciprocating machinery fault diagnosis, structural dynamics analysis and design, and acoustical analysis. It provides tools to solve noise and vibration problems, from experimental design to solution strategy development.

VibraQuest Features and Benefits

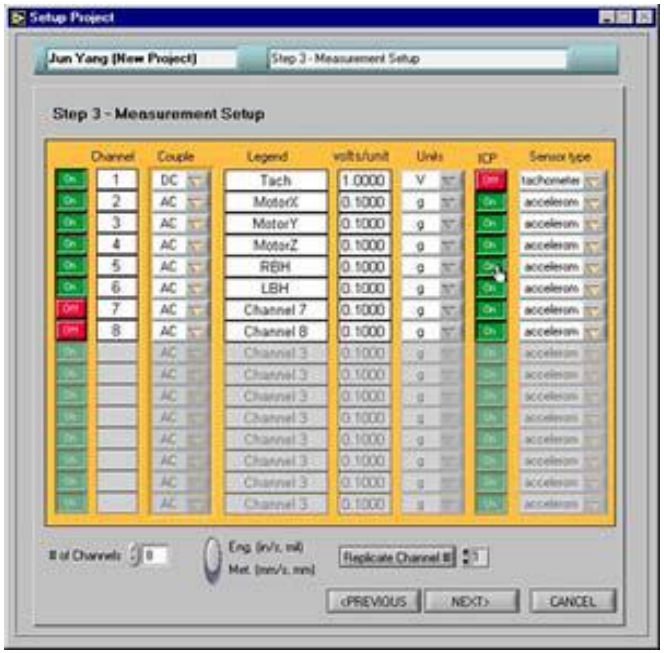
- Multi-channel data acquisition, analysis, and modeling system at an affordable price.
- All-inclusive noise and vibration problem solution from definition to resolution.
- Features time and spectrum analysis, statistical analysis, rotating/reciprocating machinery fault diagnosis, induction motor current signature analysis (MCSA), order analysis, long duration data recording, modal testing, and acoustic analysis.
- Automatic data reductions, analyses, and modeling to reveal root causes.
- Export directly to ME'scope for modeling and modal analysis.
- Simple intuitive user interface for fast and easy operation.
- Rotating machinery and induction motor fault frequency calculations and display for quick diagnostics.
- Experimental design with over thirty built-in templates to organize and document testing.
- Real-time operating deflection shape (ODS) analysis using ME'scope.
- Structured for developing predictive models to reveal root causes.
- Simple procedure for project and user management.
- Capability to incorporate non-linear sensor behavior.

Experimental Design and Project Management

- Easy to use wizards guide you through experimental templates that define the test variables and parameters
- Custom or 30+ built-in templates
- Retains important information and helps to eliminate errors.
- Built-in templates allow you to set up pre-stored parameters for specific tasks.
- Parameters help organizing the tests and simplifying further automated analysis.
- Organizes tests, assures consistency, and saves time



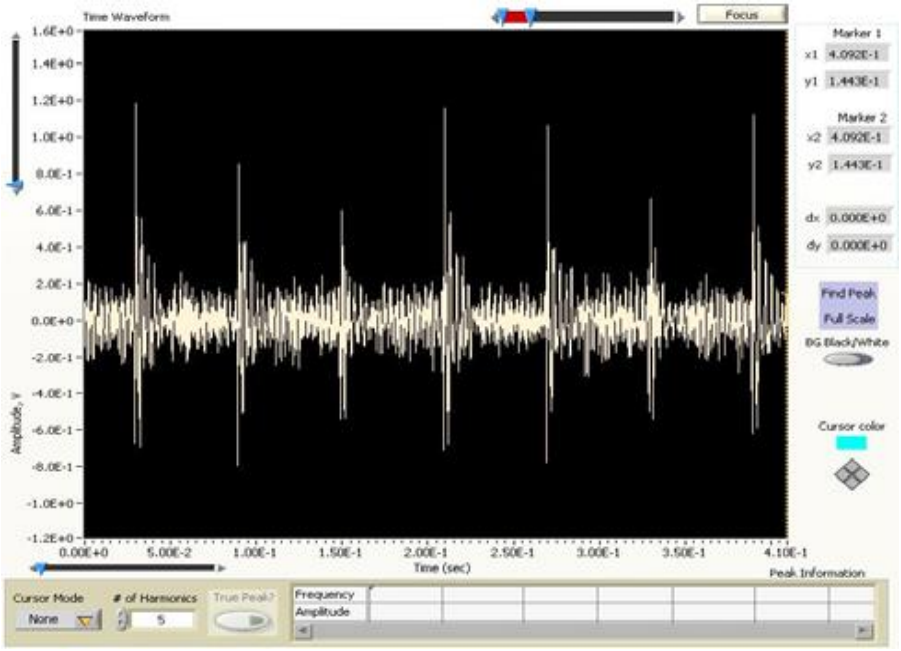
Data Acquisition



- Four steps to data acquisition:
  - Choose project and specify parameters.
  - Define measurement environment.
  - Define acquisition parameters.
  - Acquire, review, and save data.
- Specialized DAQ Setups:
  - Steady state test
  - Hammer/bump test
  - Accelerometer calibration
  - Order tracking and start-up/coast down test
  - Time synchronous averaging
  - Data streaming to a file
  - Internal signal generation to verify analysis function and system operation

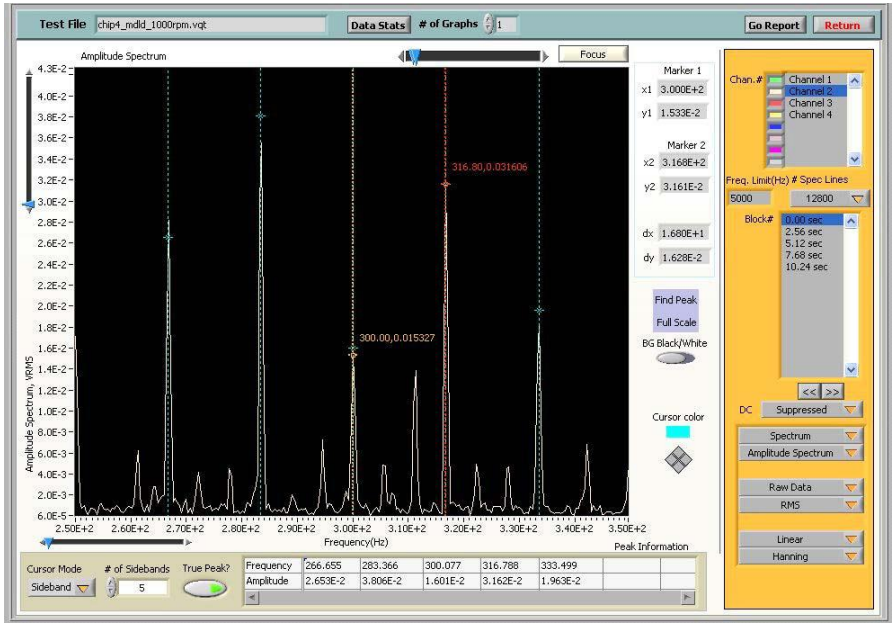
Time Domain Analysis

- Time domain graphs show the raw data. A full screen of data is often unintelligible. Zooming shows details. The graphics have many options, including zooming, changing scales and moving graph. Features include:
- Waveform playback and analysis of selected data sets.
- Detailed statistical analysis to include, average, min/max, RMS, variance, skewness, kurtosis.
- Comparison analysis among unlimited wave forms.
- Comparison analysis among unlimited data sets (channels).
- Waveform power and correlation functions.
- Advanced cursoring to identify spikes with fault sets.



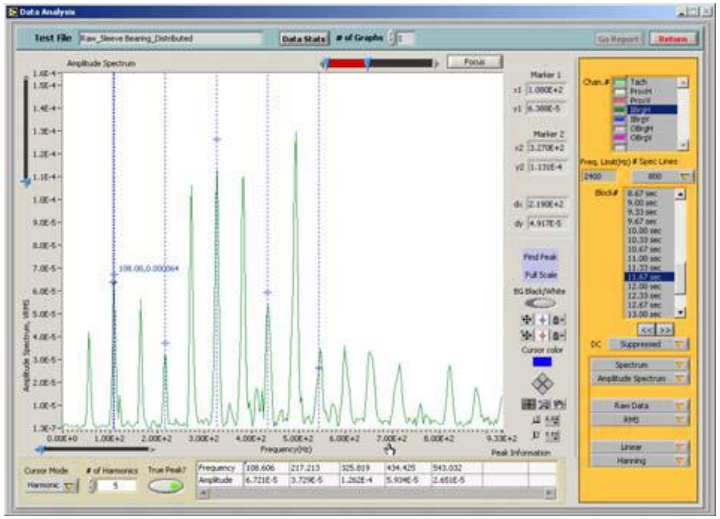
Frequency Domain Analysis

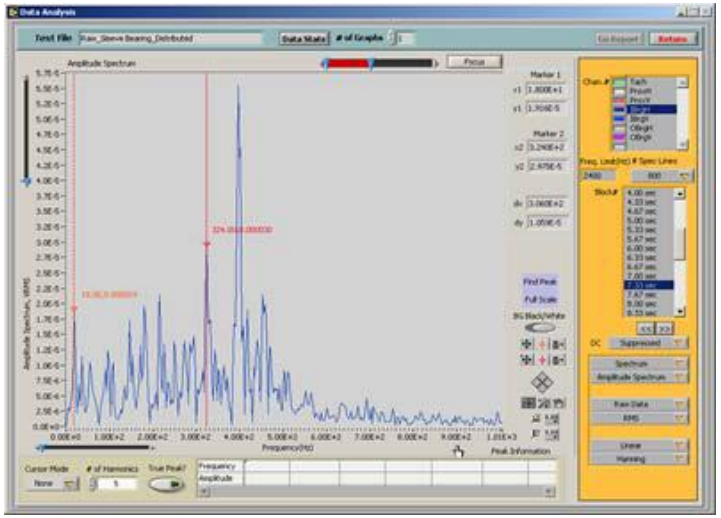
- FFT may be applied to individual data blocks or averaged.
- Data can be displayed to see the variation from block-to-block.
- Select linear, logarithmic, or dB amplitude scales.
- Variety of averages are available including RMS, vector, sum and difference, and exponential.
- Any channel can serve as a reference for transfer function analysis.
- Nine window options available to enhance the data analysis.
- CData blocks can be resized to examine the results with different spectral resolutions.



Dynamic Signal Analysis

- VibraQuest provides tools for a comprehensive dynamic signal analysis for structural problems, rotating machinery analysis, induction motor analysis, and general noise and vibration solutions.
- Data can be analyzed with the ultra-high resolution of 102.4 k spectral lines. In-depth analysis can be performed using time-synchronous averaging technique.
- Rotating machinery can be analyzed using the built-in fault frequency calculators.



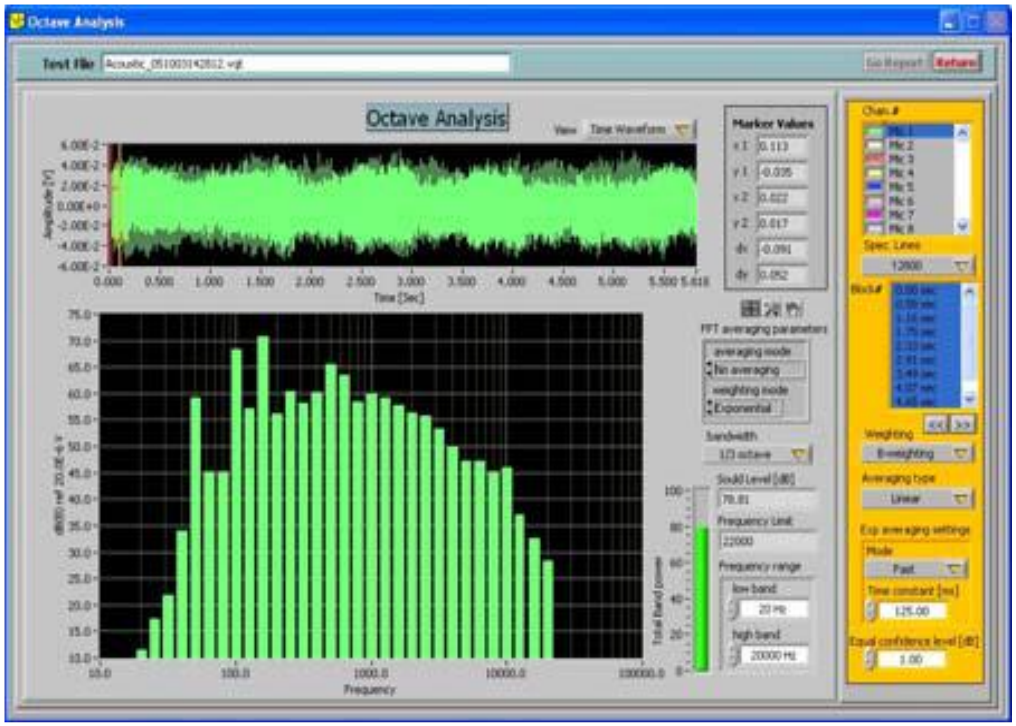


Dynamic Signal Analysis

- Analysis functions:
  - Auto power spectrum
  - Cross power spectrum
  - Power spectral density
  - Amplitude spectral density
  - Frequency response
  - Impulse response
  - Coherence
  - Bode plot
  - Polar plot
  - Nyquest plot
  - Orbit plot
  - Waterfall plot
- Statistical functions:
  - Mean
  - RMS
  - Standard deviation
  - Variance
  - Kurtosis
  - Median
  - Mode
  - Skewness
  - Covariance
  - Correlation
  - MSE

Acoustic Analysis

- Full, 1/3, 1/6, 1/12, or 1/24 octave spectrum
- A-, B-, C- or flat weighting options
- Selectable display bands
- Selectable averaging modes of Linear, Exponential, Equal confidence, and Peak hold
- Band power table
- Simple, cost-effective acoustic analysis functions
- Related acoustic signals to vibration problems



Reporting

- Import/export data files to and from many common formats
- Capabilities for browsing, viewing, copying, and pasting data to ActiveX applications
- Simple wizards for automatic report generation
- Reports are completely customizable

VibraQuest Lite vs. Pro

- VibraQuest comes in two variants: Lite and Pro.
  - VibraQuest Lite provides all the functions for basic data acquisition and analysis
  - VibraQuest Pro adds impulse data acquisition and additional, more advanced data analysis functions.

VibraQuest Lite

- Multi-channel data acquisition and analysis system.
- Powerful signal processing and data presentations of time waveform, FFT spectrum, and frequency response function.
- Hanning, flat top and Kaiser-Bessel window functions
- Linear, log or dB scale.
- Magnitude, phase, real, or imaginary FRF.
- Two active cursors with delta values.
- Data statistics (mean, median, RMS, deviation, variance, correlation, covariance, etc)
- Two graphs can be used to compare between different files or channels.
- Simple project management, including experimental design with over thirty built-in templates to organize and document testing.
- User defined project and test templates for repetitive experiments.
- Capability to incorporate user-defined non-linear sensor behavior.

VibraQuest Pro adds

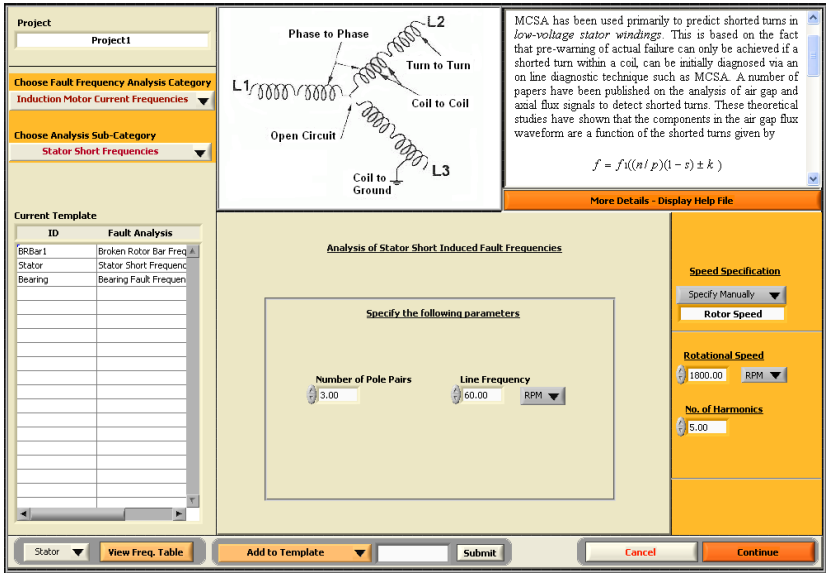
- Impulse and hammer test data acquisition.
- Polar, Bode, Nyquist, orbit and waterfall plots.
- Cross power spectrum, coherence, and impulse response signal analysis.
- Additional window functions (Hamming, Blackman-Harris, exact Blackman, Blackman, 4 term Blackman, 7 term Blackman, force, and exponential).
- Octave analysis, 1 to 1/24 octave, linear, A, B, C weighting.
- Harmonics and sideband cursors.
- Up to eight graphs can be used to compare between different files or channels.
- Digital filtering.
- Multiple user management.
- Data import and export, including ME'scope for modeling and modal analysis.
- Data reporting.

Advanced Data Analysis Modules

- For more advance analyses, a choice five modules can be added to VibraQuest Pro.
  - Induction Motor Fault Diagnosis
  - Rotating Machinery
  - Data Streaming
  - Transient Analysis
  - Order Analysis

Induction Motor Fault Diagnosis Module

- Automatically identify induction motor fault frequencies and map on the spectrum
- Choice of shorted turns, phase imbalance, single phasing, broken rotor bars, airgap eccentricity, and bearing defects
- Multi-selection of different components
- Extensive database of over 25,000 bearings for fault frequency calculation
- Illustrated explanation of selected faults
- Tacho-less RPM finder
- Enveloping function for fault detection of rolling element and gearbox
- Ultra-high resolution with up to 100,000 line FFT
- Easy report generation



Rotating Machinery Module

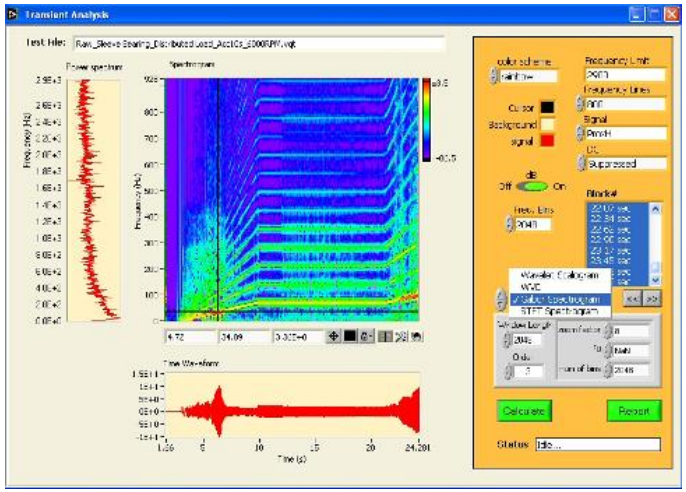
- Automatic machine fault frequency identification and spectrum mapping
- Choice of bearing, gearbox, fan, belt, pump, and user-defined frequencies
- Available gearbox types: two-element, four-element, epicyclic gearbox (with Planetary, Star, and Solar configuration)
- Enveloping function for fault detection of rolling element and gearbox
- Ultra-high resolution with up to 100,000 line FFT
- Illustrated explanation of selected frequencies
- Built-in template for calculating fault frequencies caused by various sources
- Excellent tool for diagnosis of local faults in rolling element bearings, gearbox, and turbine blades
- Insight of operating machines without shutting them down
- Designed for all four types of bearing faults for any particular bearing: BPFO, BPFI, BFF, and FTF
- Identification of vibration signatures of a machine

Data Streaming Module

- High-speed multi-channel data streaming to hard disk
- Record long records of gap-free data for future in-depth analysis
- Indication of disk volume and maximum recording time
- Turn on/off display while recording
- Choice of buffer drive
- Play back any gap-free data
- Control of display length and data block size
- Playback buttons include: back to beginning, fast rewind, last block, next block, fast forward, forward to the end.
- User can drag cursors to any position to get the data segment for analysis
- Convenient tool to view the overall characteristics of data
- Unique playback functions allow flexible data view
- Easy report generation

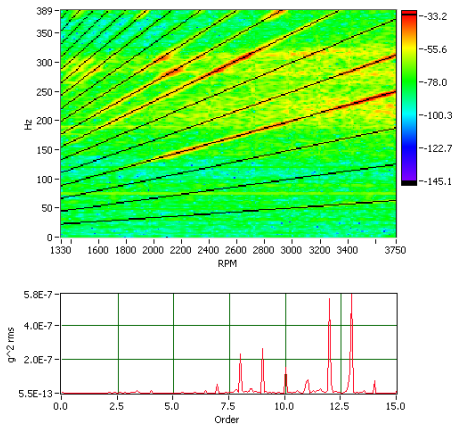
Transient Analysis Module

- Joint time-frequency spectragram shows how the frequency components evolve with time
- Time-varying filter allows you to filter out component whose frequency changes
- Short-time signal characterization
- Transient feature detection: time varying harmonics, peaks, discontinuity
- Time signals reconstructed from time-frequency analysis have better SNR than the FFT method
- Gabor analysis
- Short-time Fourier transform
- Time-varying filter
- Order control smoothes Gabor spectragram
- Analytic wavelet scalogram
- Mean instantaneous frequency
- Wavelet-based noise reduction
- Easy report generation



Order Analysis Module

- Accurate RPM estimation leads to robust order spectrum calculation and order extraction
- Useful tool to reveal critical speeds, resonances, oil whirl/whip, instability, and load fluctuation effects
- Amplitude and phase of first order for balancing and foundation diagnoses of industrial rotors
- Isolation of order interaction
- Versatile and colorful data presentation allows better interpreting data
- Measure power distribution in terms of RPM/time/frequency
- On-line order tracking and spectral map
- Digital and analog tachometer processing
- Real-Time data resampling and order spectrum
- Order extraction without tachometer
- Slow roll compensation
- Fast and easy report generation



VibraQuest Specifications

Data Acquisition Software	
Steady State Mode	On-line time waveform, spectra, averaging, with assigned frequency limit, spectral lines, and number of blocks
Hammer Test Mode[1]	On-line analyzer with double-hit rejection, trigger setting, pre-trigger sampling and force/exponential windows
Transient Test Mode[2]	On-line order tracking with assigned start RPM, end RPM and RPM increment step
System Management	
Project management	Each project is deigned for a kind of test, which can be reused to simplify operation, assure consistency and same time. More than 30 built-in test templates are provided.
Reporting[1]	Customize report into Microsoft Word, Excel, or HTML format
User management[1]	Administrator manages multiple users who have individual tests and reports
Sensors and units	Common sensors and units are included. User can add/edit sensor type, sensitivity and unit. Non-linear sensitivity curve can be defined for polynomial curve-fitting routine. Both metric and English units are available.
Export formats[1]	ASCII, ME'scope

1: available in VibraQuest Pro, 2 available through add-on module

VibraQuest Specifications

Analysis Functions	
Time domain analysis	Time waveform, windowing (Hanning, flat top, Hamming[1], Blackman[1], Blackman-Harris[1], exact Blackman[1], 4 term B-Harris[1], 7 term B-Harris[1], force[1], exponential[1])
Frequency domain analysis	Amplitude spectrum, power spectrum, spectral density, frequency response function, impulse response function[1], coherence[1], cross spectrum[1], averaging (RMS/vector/peak), linear and exponential weighting, linear/log/dB scaling
Cursor modes	Main cursor, secondary cursor, harmonic cursor[1], sideband cursor[1], true peak
Statistical analysis	Mean, RMS, standard deviation, variance, Kurtosis, median, mode, skewness, covariance, correlation, MSE
Data presentation	1/2/4[1]/8[1] window analysis, Bode, Nyquist, orbit plot, waterfall and polar plots[1]
Acoustic analysis[1]	Octave analysis, fractional octave analysis, frequency weighting (linear/A/B/C weighting), averaging (linear/exponential/equal confidence/peak), sound level meter
Digital Filter Design[1]	Classical filter (Butterworth/ Chebyshev/ inverse Chebyshev/ Elliptic/ Kaiser window/ Dolph-Chebyshev window/ Equi-Ripple FIR), narrow band filter, notch/peak filter, comb filter

1: available in VibraQuest Pro, 2 available through add-on module

Module Specifications

Add-on Modules	
Induction Motor Fault Diagnosis[2]	Automatically identify induction motor fault frequencies and map on the spectrum; Choice of shorted turns, phase imbalance, single phasing, broken rotor bars, air gap eccentricity, and bearing defects
Rotating Machinery[2]	Built-in template for calculating fault frequencies of bearing, gearbox, fan, belt, pump, and user-defined frequencies; database of over 25,000 bearings from major manufacturers; enveloping analysis
Data Streaming[2]	High-speed multi-channel data streaming to hard disk; playback features include: back to beginning, fast rewind, last block, next block, fast forward, forward to the end; throughput rate: 5 mega-samples/second
Transient Analysis[2]	Gabor analysis; short-time Fourier transform and reassigned STFT; analytic signal reduces cross-term interference in Wigner-Ville distribution; analytic wavelet scalogram; time-variant filter
Order Analysis[2]	On-line order tracking; waterfall, color maps, orbit, centerline, Bode plot, polar plot; slow roll compensation
Balancing[2]	Influence coefficient method, for-run method, trim balance method, for 1-plane and 2-plane balancing; interactive step-by-step operation provide on screen; maintain machine data and balancing history; slow-roll compensation

1: available in VibraQuest Pro, 2 available through add-on module