DIGITLINE

BALANCING USING THE INFLUENCE COEFFICIENTS METHOD

The influence coefficients method calculates the balancing solution based on the amplitude and phase measurements resulted from the initial and two calibration start-ups. In parallel with the balancing operation, the machine influence coefficients are being determined and they may be further used for a balancing based on the measurement of the initial imbalance only.

One of the main characteristics of the analysis equipment is the sensitivity to the imbalance signal. This depends on the dynamic range, sampling rate and processing and analysis functions.

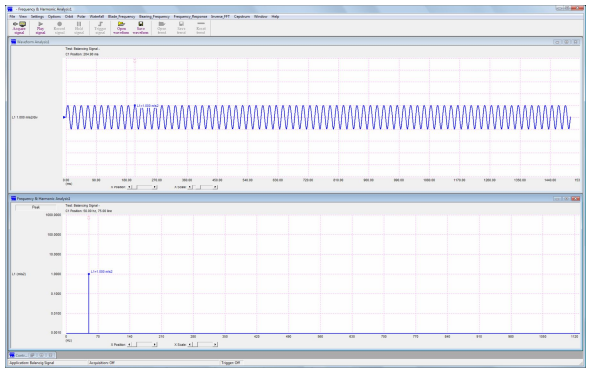
The most modern imbalance measuring technique is the FFT.

To increase the quality of the results, a range of additional functions are being utilized.

FFT Leakage

The FFT Leakage phenomenon may influence the imbalance measurement through the energy exchange between the fundamental component and the other spectral components.

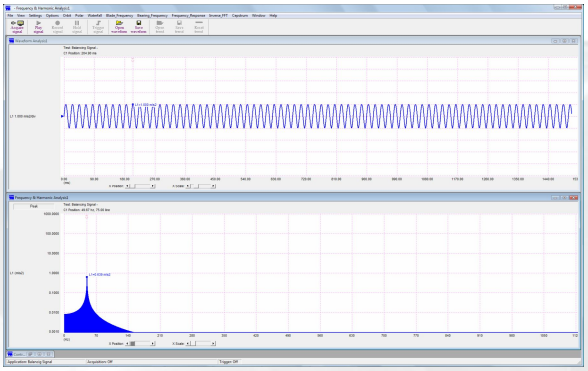
The FFT analysis over an integer number of cycles is not influenced by the FFT leakage.



FFT analysis over an integer number of cycles. The fundamental component has just the waveform amplitude.

If the waveform does not feature an integer number of cycles, the fundamental component's energy is being lost through the adjacent frequency lines.

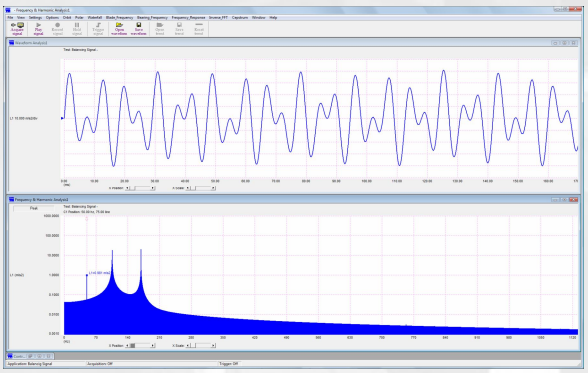
Solution: *Utilization of synchronous FFT for the analysis over an integer number of cycles of the fundamental component.*



The losing of the fundamental component's energy when the waveform does not include an integer number of cycles

The information alteration can also occur through the energy exchange with the leakage-influenced harmonics.

Solution: *Time-domain filtering with band-pass FIR filters for the elimination of the components outside the speed variation range.*
The filtering operation must not alter the phase relationship between the vibration and speed signals.

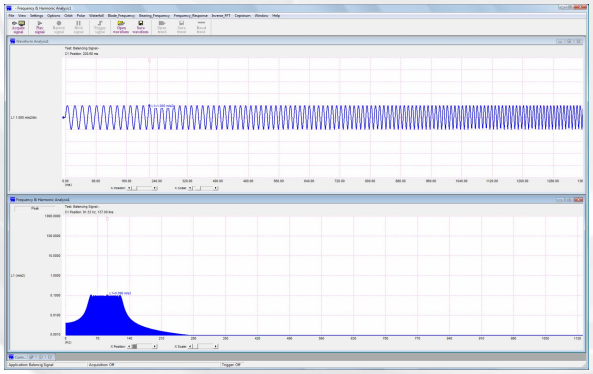


Energy exchange between the fundamental component and the leakage-influenced harmonics.

Speed variation

Most of the operational regimes feature speed variations. In such conditions, the energy of the imbalance signal spreads over multiple spectral lines and thus diminishes the measurement accuracy.

Solution: *Harmonic order analysis with run-up and run-down functions to turn the vibrations from a time-domain unstationary signal into an angular-domain stationary signal.*

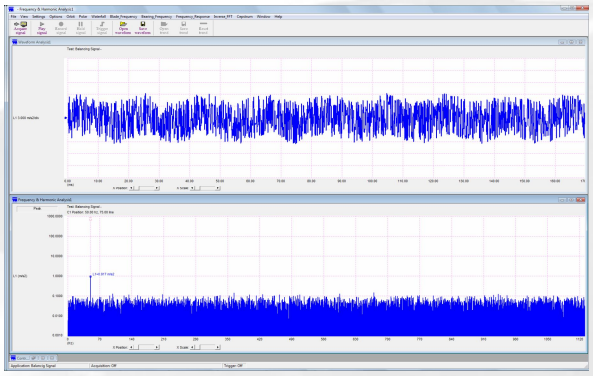


Energy spread because of speed variations

Background noise

The multitude of the vibration sources received in the measuring points (imbalances, friction forces, electromagnetic forces, shocks) generates a background noise within the frequency spectrum. While it occurs in all of the frequency bands, it may not be filtered out.

Solution: *Vector averaging to cancel out random spectral components.*



Background noise influence on the fundamental component

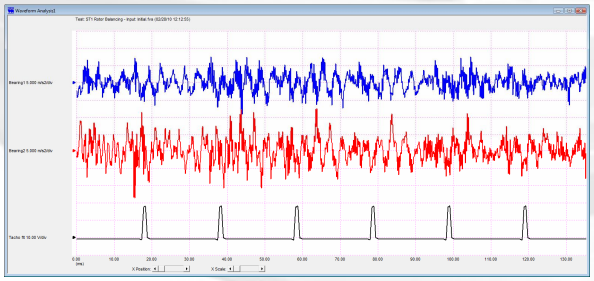
Rotor balancing using the DSA500 analyzer

DSA500 is a 5 measurement channels, 24-bit resolution, and 100kS/s/ch sampling rate handheld analyzer.

Balancing functionalities

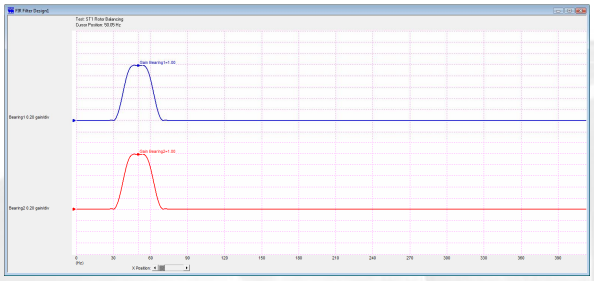
- Time-domain continuous filtering and integration with keeping the phase between the signals and spectral components
- Order analysis: synchronous FFT, run-up/run-down functions, vector averaging
- Calculation based on the influence coefficients method
- Static, static-couple and dynamic balancing
- IS or British measuring units
- Radius change and weight split options
- Balancing tolerances for each plane
- Limit exceeding warning
- Excel format export
- Balancing report

The accelerometers signal increase directly with the vibration frequency. As a result, the acceleration signal displays rather the high frequencies and not the lower ones corresponding to speed and displacement.



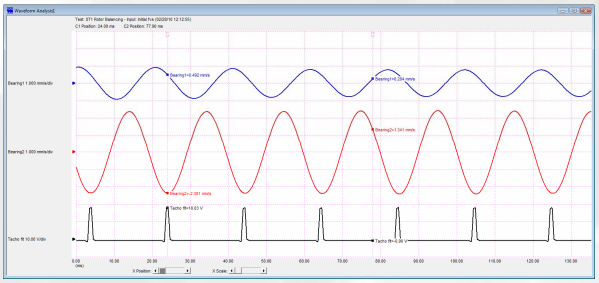
Input signal corresponding to the vibrations acceleration and tacho signal

The band-pass filtering provides for the conditions of an optimal integration operation and reduces the FFT leakage.



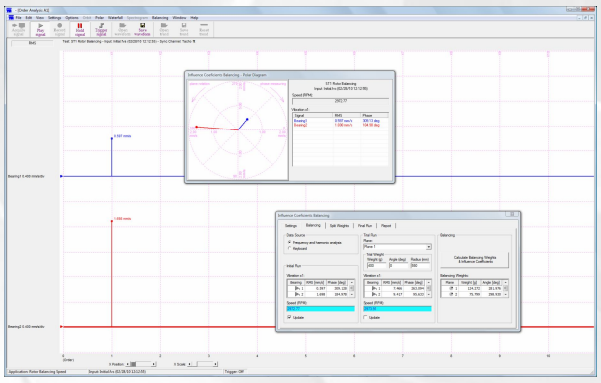
Response of the filters applied to the acceleration signals

The velocity signals are being obtained upon the band-pass filtering and continuous integration of the acceleration signals.



Waveforms of the vibrations velocity and tacho signals

The order analysis processes the signal through run-up/run-down functions, calculates the harmonics spectrum and performs a programmable number of vector averages. The results are being used to calculate the balancing solution.



Harmonic order analysis, balancing solution calculation

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