

Performing Order Analysis with SpectraPLUS-DT

Order Analysis is a technique used for spectral analysis of rotating machinery. Order is defined as the normalized rotational speed. The first order is the basic rotational speed and order M is N times the rotational speed. Order components are harmonically related to the rotational speed.

Order Analysis:

- Converts Frequency into Orders
- Reveals which spectral components are related to the rotational speed of the machine because all the shaft related peaks line up
- Allows you to separate structural resonances (fixed frequencies) from rotational ones (variable frequencies)
- Requires a tachometer (Data Translation DT9826, DT9837, DT9839 or DT9857)

With rotating machinery, many vibrational properties change with speed. You only can observe some mechanical faults, such as resonance, as the rotational speed approaches or passes the critical speed. For this reason, machinery tests often require run up or coast down tests.

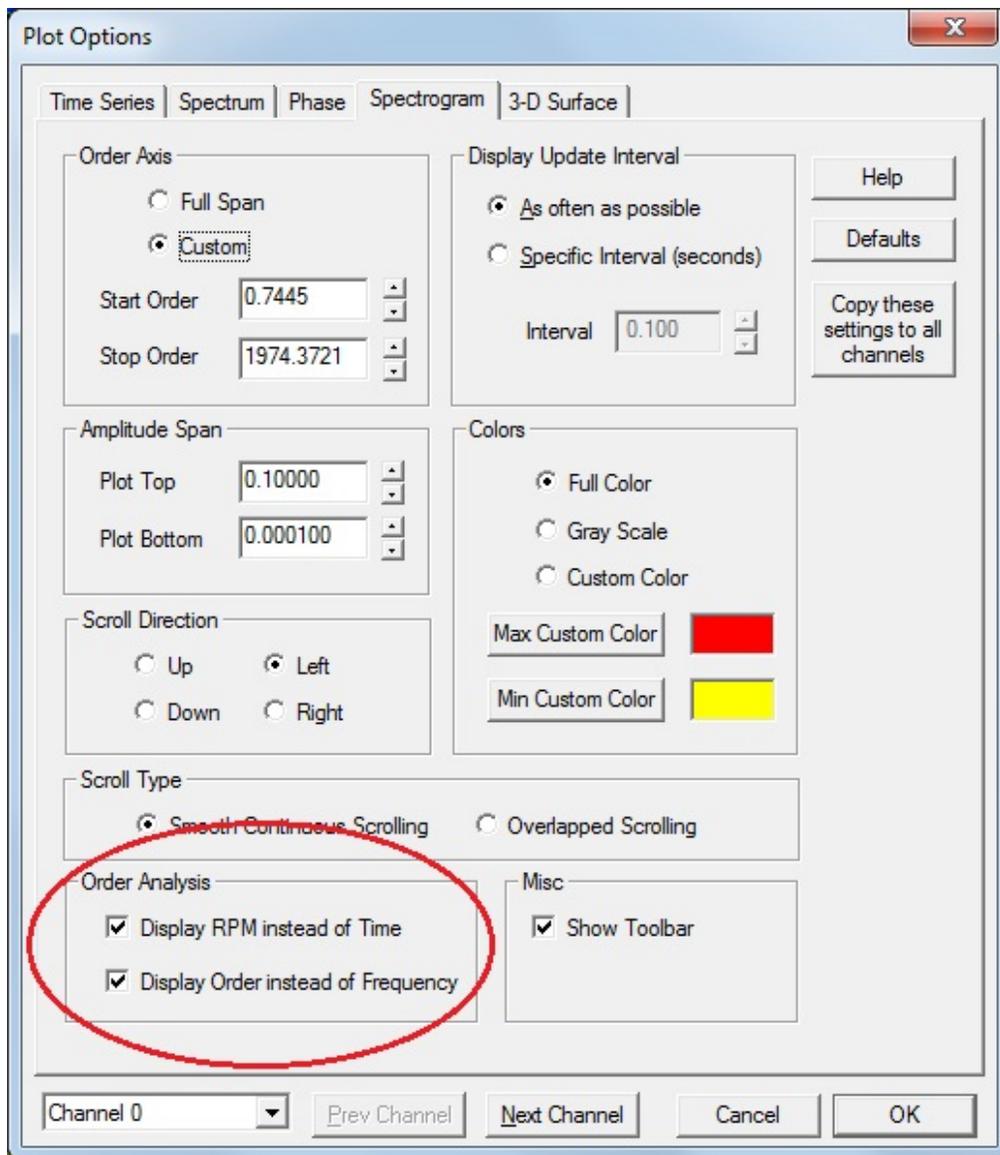
Order Analysis is supported by SpectraPLUS-DT and can be used in any of the modes (Realtime, Recorder or Post Processing).

Connect a tachometer to the Data Translation module and enable the tachometer channel and one or more input channels under the Options - Processing Settings - Device Input menu. Also connect the accelerometers or microphones to their respective input channels.

Order Analysis is performed primarily using the Spectrogram plot. This plot normally displays Frequency vs Time with the Amplitude in color. If tachometer data is available the spectrogram can be configured to display RPM instead of Time and Order instead of Frequency.

This is configured under the Spectrogram plot options dialog box. To access this dialog box right click on the spectrogram plot and choose the "Properties" menu or click on the Options - Plot Options – Spectrogram menu command. You can also click on the properties button on the spectrogram toolbar.

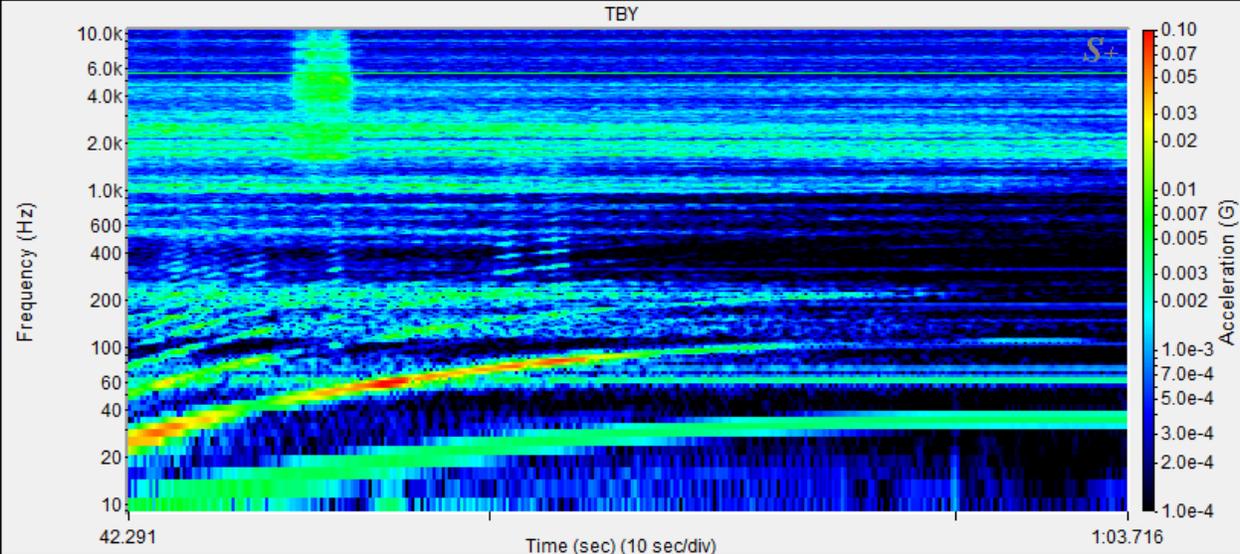
Here is a screen shot of the Spectrogram Plot options dialog box:



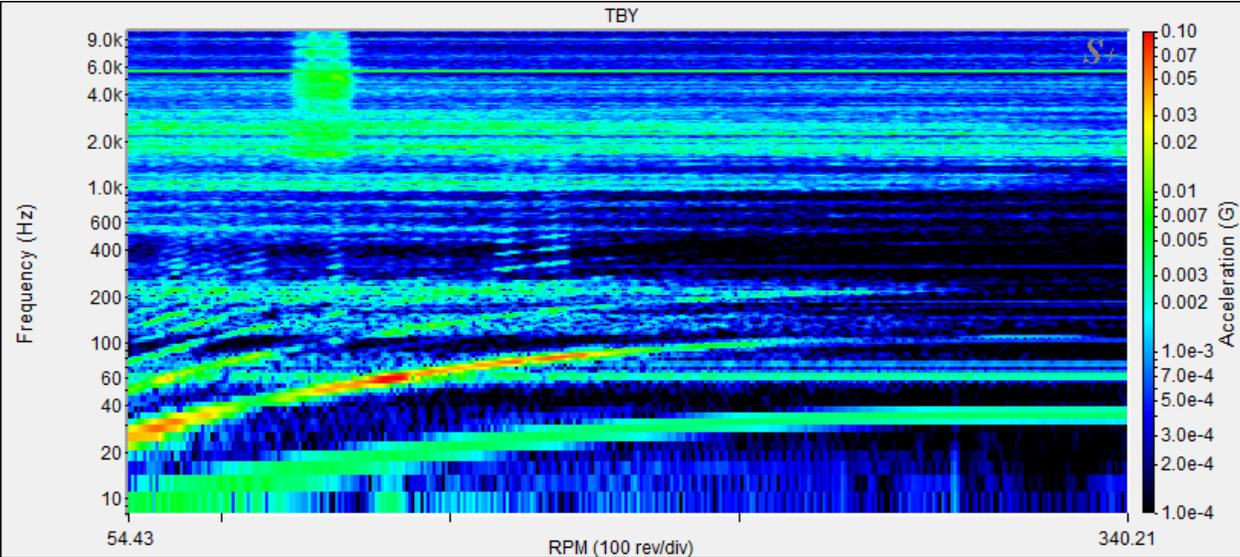
The Order Analysis options allow you to configure the spectrogram in any of the following formats:

- Frequency vs Time (normal configuration)
- Frequency vs RPM
- Order vs RPM

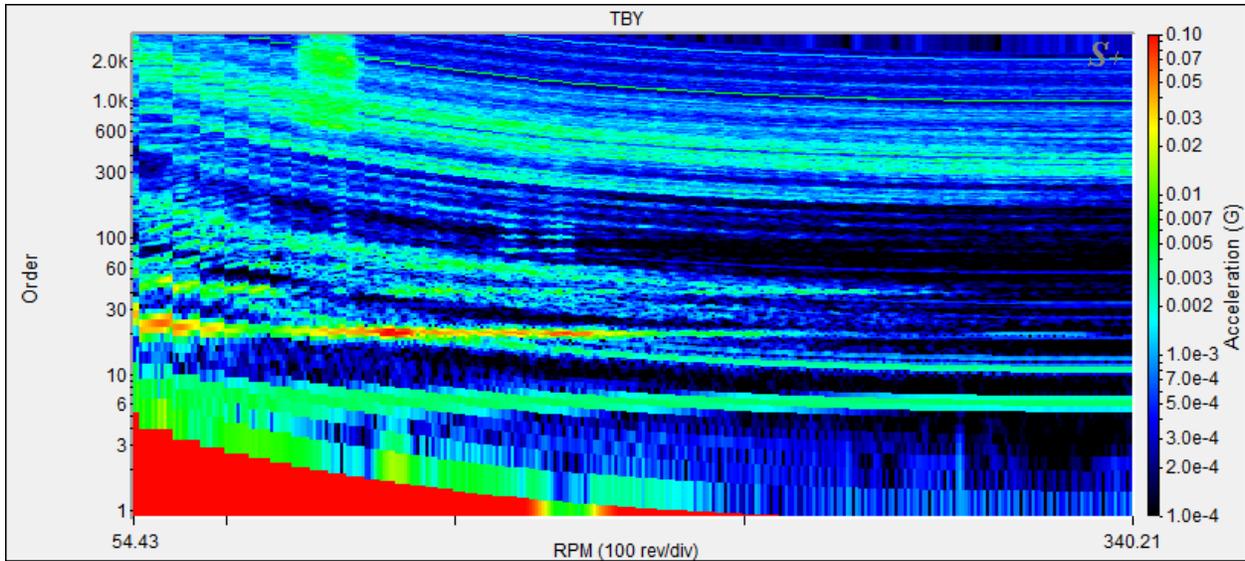
The sample plots below are from a vibration test on a turbine as the machine was starting up.



This is the normal spectrogram configuration which shows Frequency vs Time (amplitude is color).



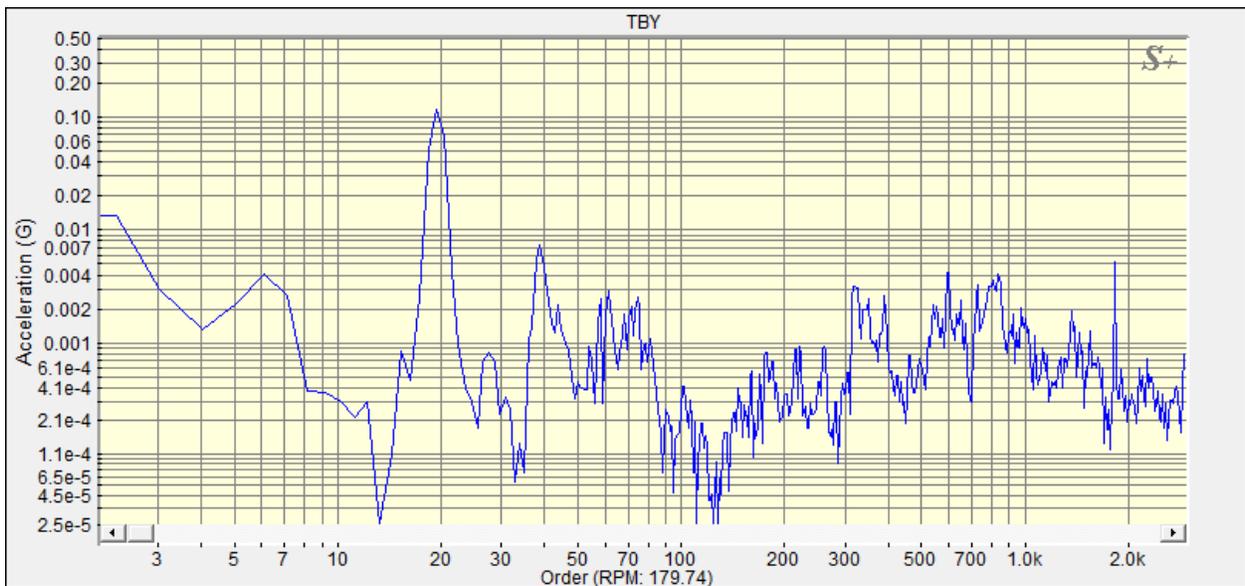
This is the same plot but with the “Display RPM instead of Time” option enabled. The time values have simply been replaced with RPM values.



This is the same underlying data but the “Display Order instead of Frequency” option has been enabled. The frequency has been converted to orders and the display has been redrawn.

Notice that there is a strong vibrational component at order 20 (this is occurring at 20 times the shaft speed of the turbine). This vibration is present throughout the RPM range of the turbine. Noise unrelated to the rotational speed does not line up along the order axis.

If you double click on the spectrogram, the Order Spectrum plot will be displayed at the RPM corresponding to the mouse position. This shows the vibration amplitude vs shaft order at a particular RPM (in this example the RPM is 179).



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