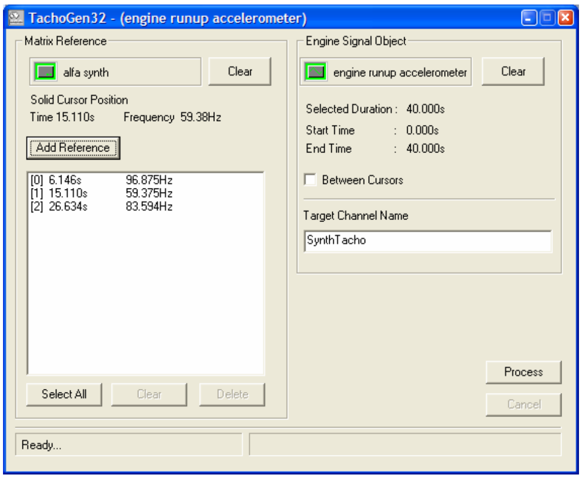
TachoGen32 Documentation V1.0

TachoGen32



TachoGen is a single panel application that can generate a synthesised tacho trace from an input signal. The approach uses the noise signature of the power unit and its associated firing orders to produce a synthesised tacho trace.

The panel is divided into two groups – “Matrix Reference” and “Engine Signal Object”. When a signal object is dropped on the module the “Signal” group will be enabled. When a matrix object is dropped the “Matrix Reference” panel will be enabled.

SIGNAL GROUP OPTIONS

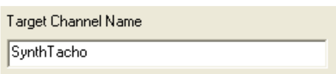
Channel Cursor Duration

If the “Between Cursors” checkbox is checked then the Start and End times will reflect the time interval set between the dotted and solid cursors for the selected object. This will represent the interval over which the Synthesised Tacho will be calculated. The duration can be changed by using the “Trace” module.

If the “Between Cursors” is unchecked then the full signal channel duration will be used irrespective of cursor position.

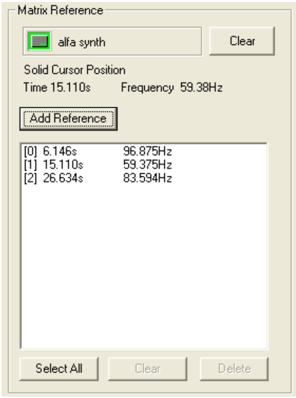
NOTE: The actual processed signal duration will also be constrained by the data points selected on the engine firing order within the matrix object.

Target Channel Name



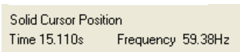
Specify the name of the synthesised tacho trace that will be added to the signal object

MATRIX GROUP OPTIONS



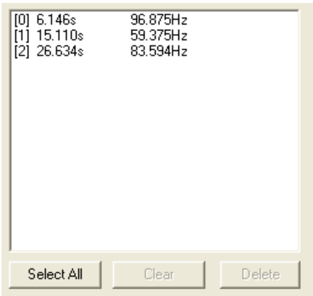
The TachoGen module accepts matrix objects that are the result of FFT processing. The object must contain a TIME and FREQ and LINE channels. The LINE channel results from FFT analysis performed through DSP or DSPTools.

Add Reference



Select a time-frequency point from the matrix object that lies on the selected engine order line. Use the solid cursor only. The current cursor postion will be displayed on the TachGen panel. Channel. When a suitable point has been chosen click on “Add Reference” to add it the the list of processing points that will be used for the tacho synthesis.

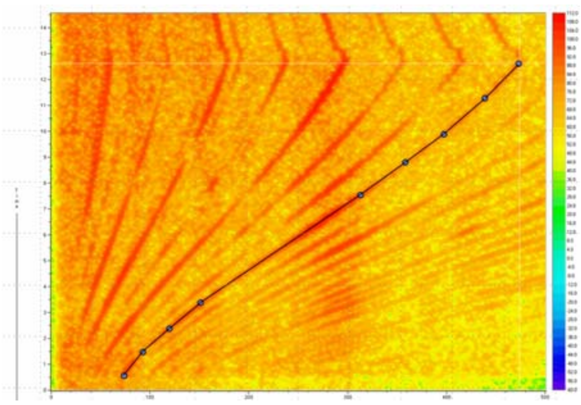
Managing the Synthesis time-frequency points



Tacho synthesis relies on a series of data points from a particular order line to enable a synthesised pulse train to be generated. The points used in this synthesis can be added and removed from this list. The TachoGen module will automatically sort the list into ascending time order.

Entries in the process list can be selected using either the “Select All” or by clicking on the entries you wish to work with. When entries have been selected the “Clear” and “Delete” buttons will be enabled.

When selecting points to be used in the synthesis process it is important to try and approximate the order track as a series of linear sections. This is will produce a more accurate synthesised tacho trace. Try to cluster additional data points in sections of the order line that changes in a non-linear manner.



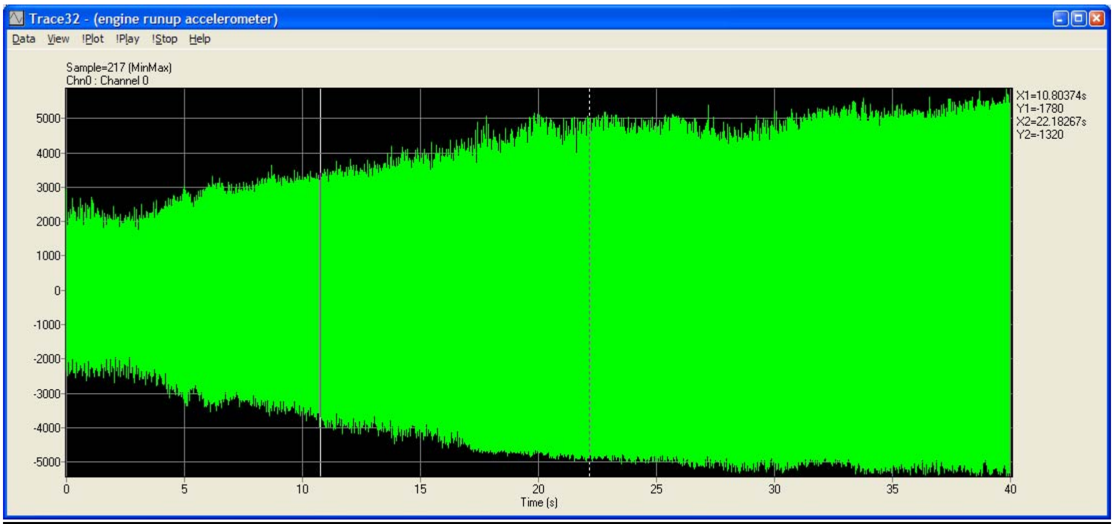
PROCESSING DATA

When the data points describing an order line have been added to the TachoGen module the “Process” button will be enabled. Click on the button to generate the Synthesised tacho trace. The resulting signal will be added to the signal object as a new channel and can then be processed with existing nVision module.

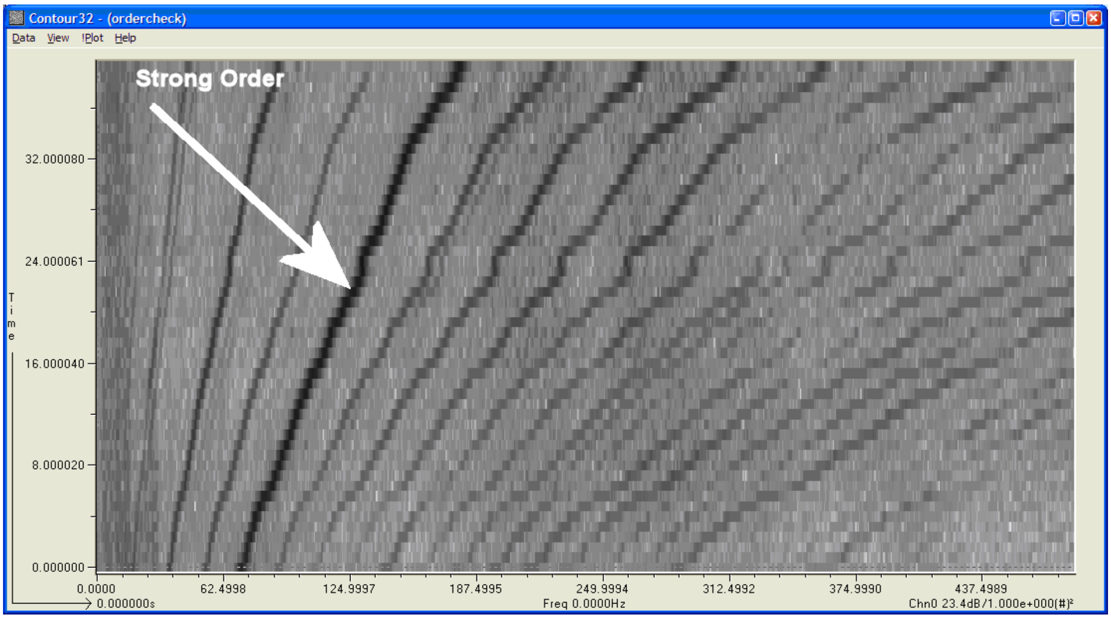
The list of data points used to generate the synthesised tacho will be added to the note field.

EXAMPLE PROCESSING RUN

Assume we have a engine run-up using an accelerometer but no measured tach signal.



The signal is processed using DSP32 to produce a time-frequency plot. At this stage the DSP settings are not critical. This plot will be used to determine a suitable engine order that will be used for the synthesis process.



With simple knowledge of the measurement, it should be possible to identify a strong order and to understand which order number it relates to. In this case this is the 4th order.

The signal needs to be reprocessed to give a resolution that will result in good time-frequency extraction of the synthesised tach trace.

We know that the example runup had a max RPM of approx 2700RPM. The signal is sampled at 5120Hz. This results in a frequency of 180Hz for the 4th Order.

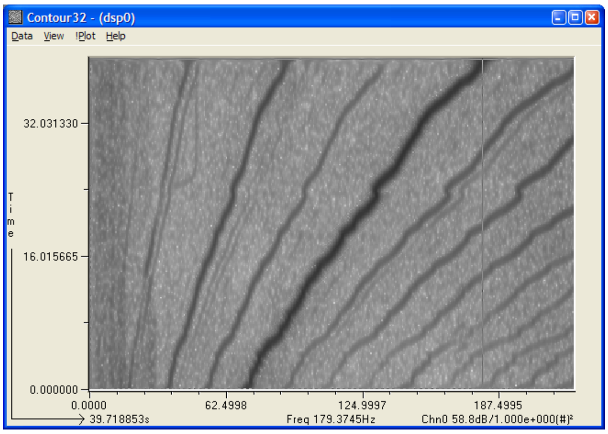
We need to reprocess the main runup to give us a time-frequency resolution that is sufficient to perform the order extract at the upper frequency. It is usual to obtain measurements at least every 50RPM so we also need to ensure that the FFT size and overlap is set accordingly.

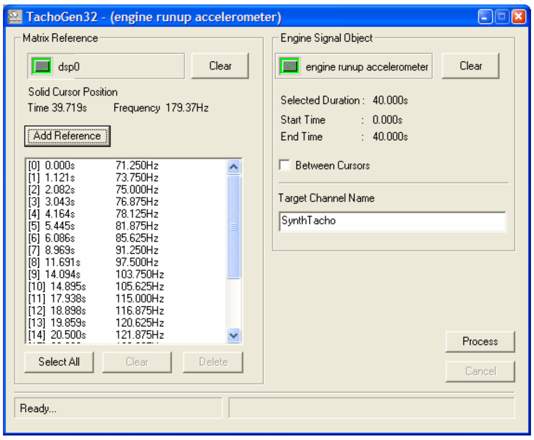
Given a sample rate of 5120Hz, and a required RPM resolution of 10RPM would require a frequency resolution of ((RPM * Order Number)/60) = F = ((10*4)/(60)) = 0.6Hz. We therefore require an FFT Size of N = (SampleRate/Resolution) = (5120/0.6) = 8533 = 8192 points.

A 8192 point FFT will give us a FFT window length of (8192/5120) = 1.6s = 0.625 FFT/s

With the long sample size required to get the frequency resolution the FFT needs to be “overlap” processed so that one row occurs at least every 10 RPM. Our run-up from 1000 to 2700 Rev/min takes 40 seconds so the speed changes at approx 42 RPM / Sec (or 2.8Hz /second). We therefore require (42/10) FFTs/s = 4.2FFT/s. Overlap is therefore defined as (1.6 - (1/4.2))/1.6 = 86%

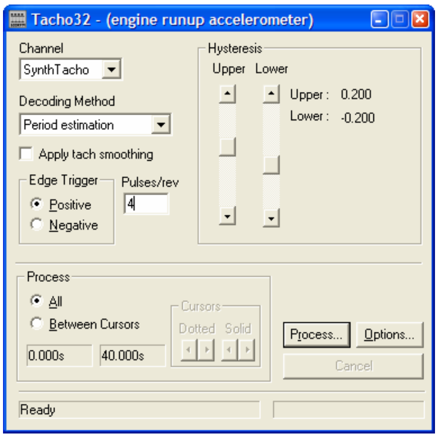
Reprocess the source signal using the FFT size and overlap and select a series of points along the 4th order.



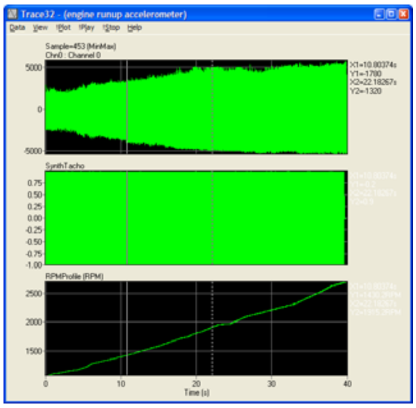


Click on Process on the TachGen32 module to produce the synthesised tach trace.

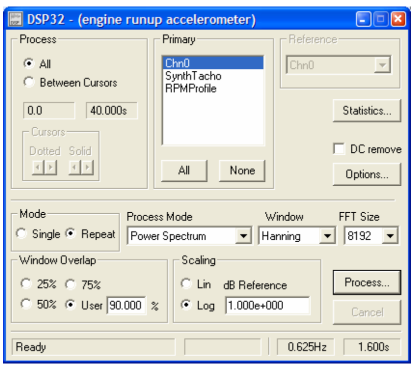
Drop the resulting signal object into the nVision Tach32 module

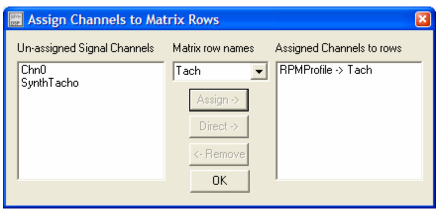


1. Select the SynthTacho channel
2. Set the Pulses/rev to 4
3. Process the pulse train

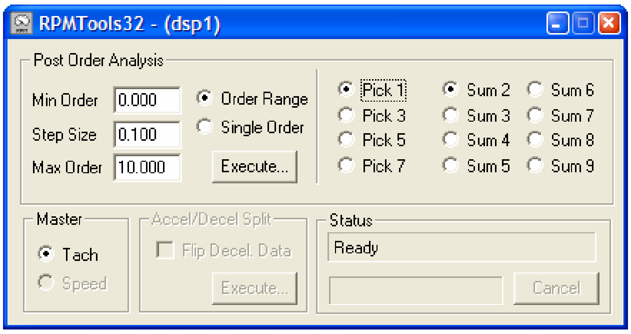


The signal can now be reprocessed in DSP to include a tacho channel. Use the same FFT size and overlap as before. Select the RPMProfile so that we obtain a tach channels in the resulting matrix object.





Now drop the resulting matrix object into the RPMTools module.



Select Pick1, Sum2, Min Order = 0, Max Order = 10, Step Size = 0.1

Process the signal to extract the orders from the signal.

If the tach trace is accurate then distinct order lines should be visible and the strong 4th order should be visible.