ORDER CALCULATION

Different methods are available in Pak in order to calculate an order. This aim to explain the differences between the 3 possibilities. The next tip in april will completed the information regarding orders with a focus on the display ("Graphics").

1. INTRODUCTION

In PAK, you will find the 3 following orders calculations:
- Order from the FFT (License: P_Signature)
- Digital order tracking by means of rotationally synchronous resampling (License: P_Order)
- Kalman Filters (License: P_Order)

2. ORDER FROM THE FFT

The order is calculated based Classical Fourier based spectrum analysis. Thanks to the rpm channel, we can define the order to extract. However, the energy of the selected order is generally spread over several FFT lines.

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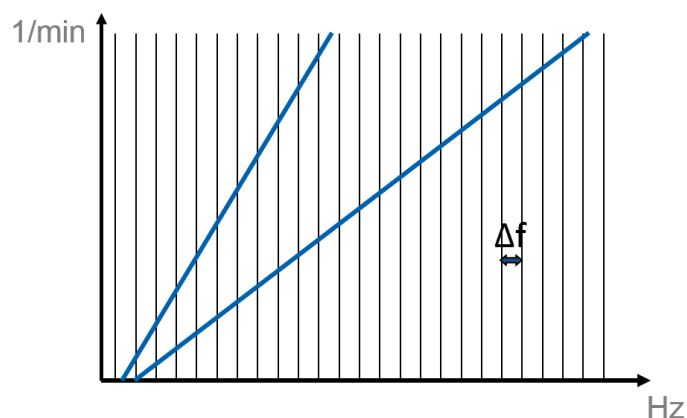
The idea is the take into account several lines arround the theoritical order. The area to take is difficult to define.Tow methods are available in PAK :

- Percent method : the bandwith is calculated as a percentage of the order frequency. It increses with the order number and the engine speed.

- Line method : The bandwith is constant and related with the frequency resolution.
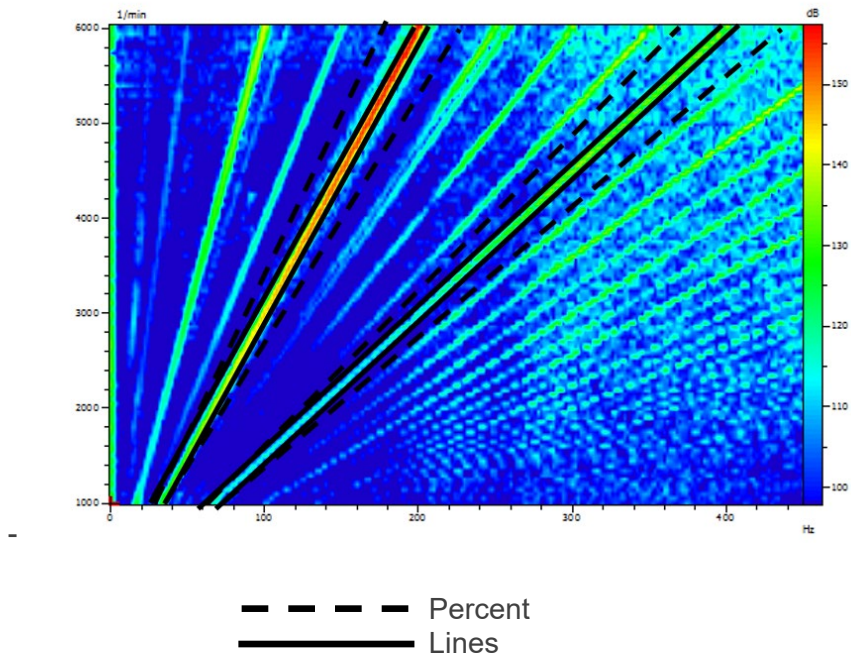
- - - - Percent
———— Lines

Above, the graphics shows the main disadvantage of the 2 methods.

In percent, the bandwith in high rotational speed can be very wide and include some noise.

The number of line choice is difficult : if this number is too high, we will have several orders taken in account in low rotational speed. If this number is to low, we will miss some energy on the high rotational speed.

The order calculation from FFT is delicate. We have to be careful with the frequency resolution and adapt the FFT parameters with the run-up type, the rotational speed and the order number.

In PAK, the orders from the FFT are not saved during the measurement. They can only be displayed with the « Graphic definition ».

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3. DIGITAL ORDER TRACKING

The digital order tracking is made by means of rotationally synchronous resampling. The throughput is resampled in the angular domain, the obtained signal will have different "Delta T" steps but a constant angle steps .
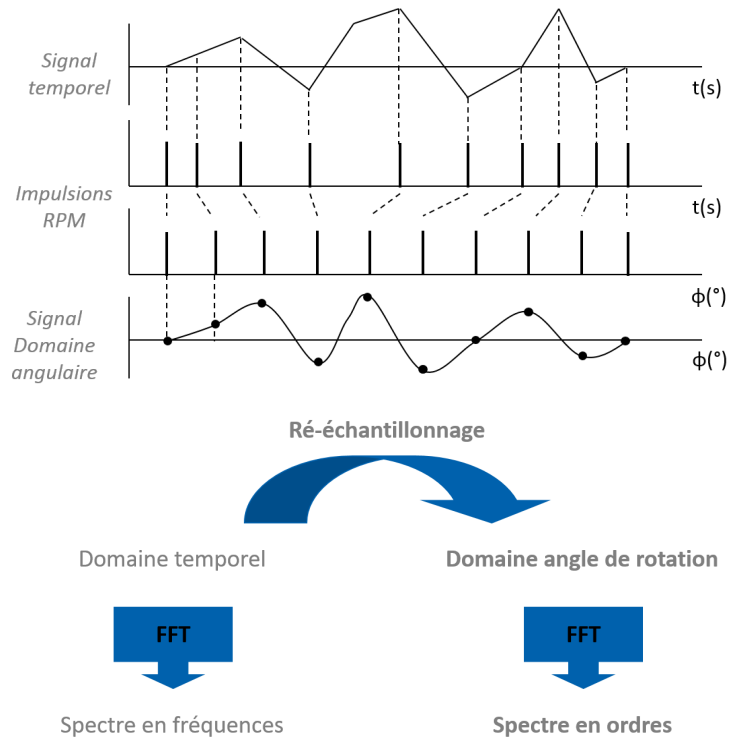
It allows to aply a FFT analysis with te sampling frquency and a time bloc adapted to the rotational speed. Δf increases with the rpm / the bloc duration dicreases when the reotational speed increases / the order resolution is constant
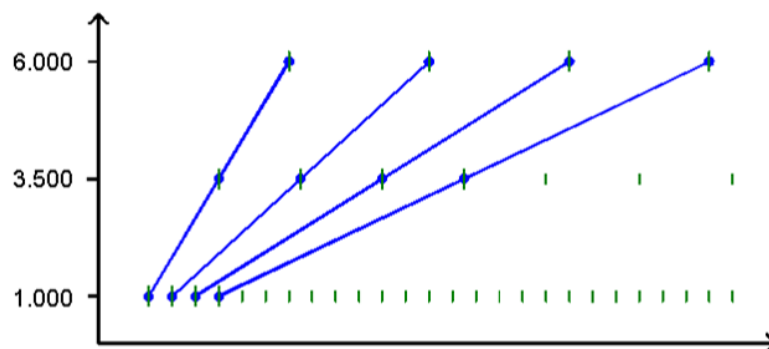
In PAK, these orders can be calculated during the measurement with the section « Orders » of the setup or in the graphic definition.

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4. KALMAN FILTERS

With the assistance of the rpm signal, the Kalman filter enables the course of the various orders to be calculated directly from the time behavior of the measurement signal.

The princip is :

- ▪ Sine formed comparison signals are emitted from the rpm signal
- ▪ We etablished the difference between the comparison signals and the measurement signal
- ▪ An iterative gradient method changes the comparison signals so that the difference is minimized.
- ▪ The rate and phase of the order process is established from the course of the comparison signals over time

The Kalman filter is able to track orders which change in amplitude and are dominant in the signal very fast. Rapid temporal variations in rotational speed are better accommodated, resulting in more accurate order magnitude information in comparison to digital order tracking.

In PAK, the si,gle orders calculated with the Kalman filters are avaliable during the measurement. We have to select the box « Single orders » of the « orders » area in the setup.

Orders
☑ Single Orders
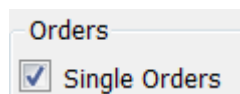
The Kalman method is chosen in the "Orders Parameters" .

Single Order Mode   Kalman Filters ▼
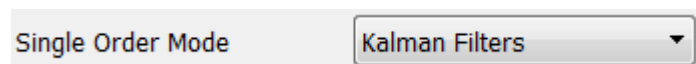
PREVIEW

In the next April issue of your PAK Tip: *« Order display ».*

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