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measurement innovation

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## *VibroKit applications*

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## 1. Revision history

*Table 1: Revision history*

Revision	Author	Date	Comment
1.0	Jernej Sirk	25/04/2018	Initial version



## 2. Introduction

The new VIBRO-KIT is a small, compact tool for simulating rotating machinery measurements. It is meant for educational purposes, such as in lab or university. It provides a playground for almost unlimited experiments.

It's made of solid aluminium. It consists of a small electric motor, two bearings, two optical strip-tape angle sensors, two encoders and a spring on one side.

The RPM can be controlled manually by a turn knob, or you can completely define ramps, cycles, etc. with the built-in display.

Furthermore an external analog voltage (or even PWM signal) can be used to control the RPM.

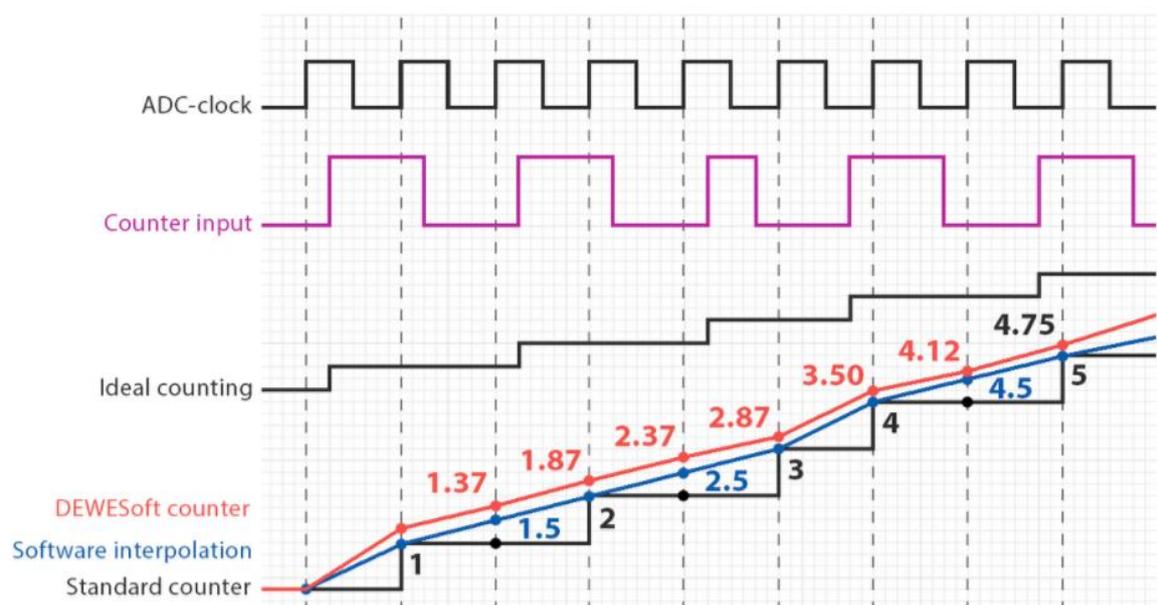
Functionalities:

- Manual RPM control (turn knob, display)
- Definable ramps (runup, coast down, hold time and multiple cycles)
- RPM control by external voltage (e.g. step curve)
- External PWM input
- Different angle sensors (2 optical strip tape, 2 Encoders)

## 3. Super-counters

**Additional equipment:** SIRIUS with at least one CNT module (ACC+, ...).

DEWESoft super-counters work on a 102.4 MHz internal time base, always, independent of the current sample rate. In comparison to standard counter, which only output whole numbers like 1,1,2,2,3,4, ... one sample later, DEWESoft is able to extract the accurate values like 1.37, 1.87, 2.37, ... fully time- and amplitude-synchronized. This is done by measuring the exact time of the rising edge of the signal with an additional counter.

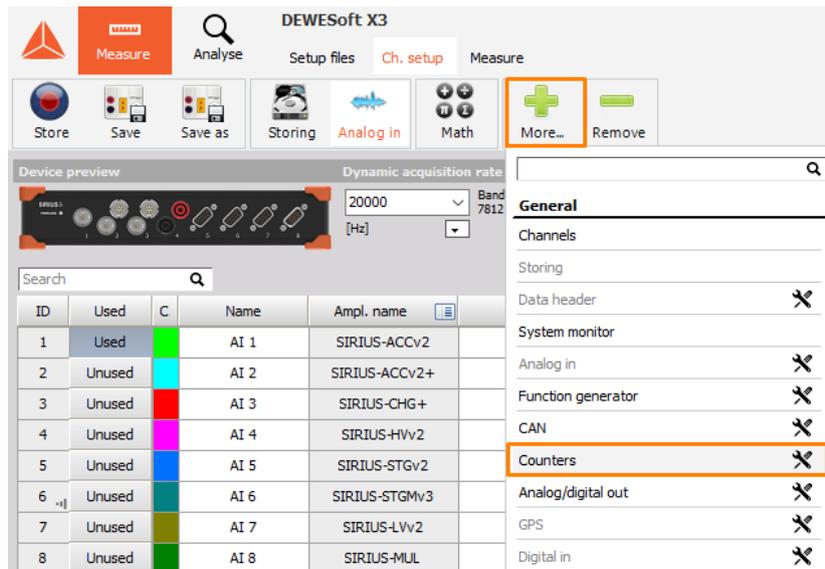


Frequency/super-counter mode has many advantages over traditional counter measurements.



The problem with traditional counters is that the value of the counter is latched only at a sample rate interval. Therefore, we only have discrete values on each sample. Since the counters can measure exactly where the position of the pulse is between two samples, we can calculate two things out of this: the exact interpolated position of the counter at the sample point, as well as the exact frequency of the pulses.

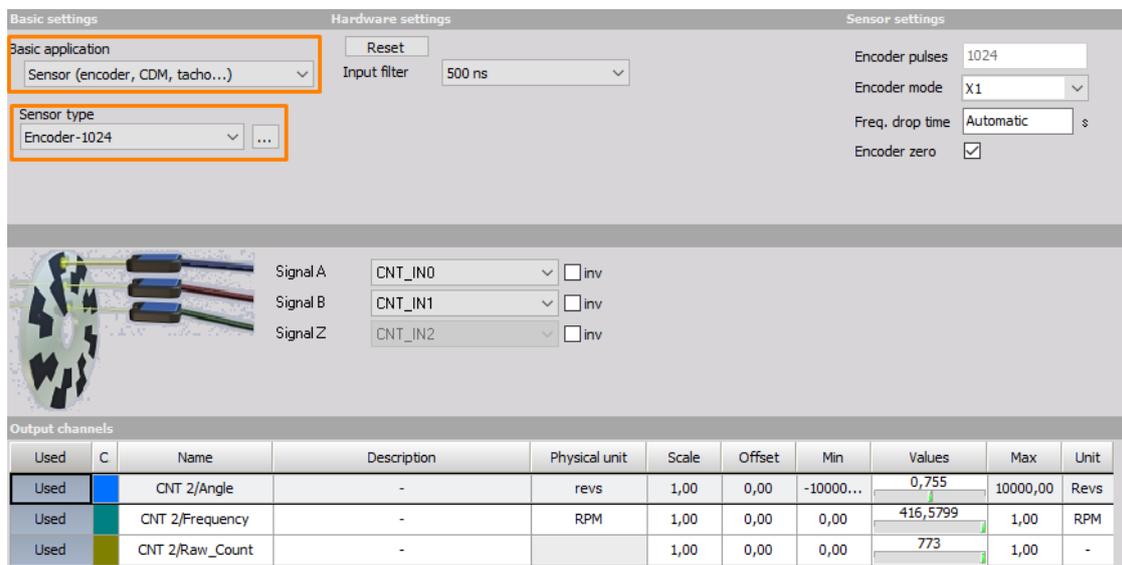
We connect the encoder to the CNT module. In DEWESoft software, we add the Counters.



In the Counter menu, you will see all the available counter channels. Enter the setup, of the channel where your encoder is connected.

Change the Basic application to Sensor and choose the correct sensor from the dropdown list. If your sensor is not on the list, you can add it in the counter sensor editor.

Select the output channels, that you want to show (angle, frequency, raw count).





Enter the Measure mode and add a recorder visual control. Display the Angle and Raw count on the same recorder. When the Vibro Kit is running, press Freeze and zoom into the signal. You can see how DEWESoft interpolates the angle values and is not updated only when new pulse comes from the angle sensor. The raw count value is increased every time a new pulse comes from the sensor.



For more detailed explanation of the parameters, please visit: <https://www.dewesoft.com/pro/course/digital-counters-13>

## 4. FFT analyser

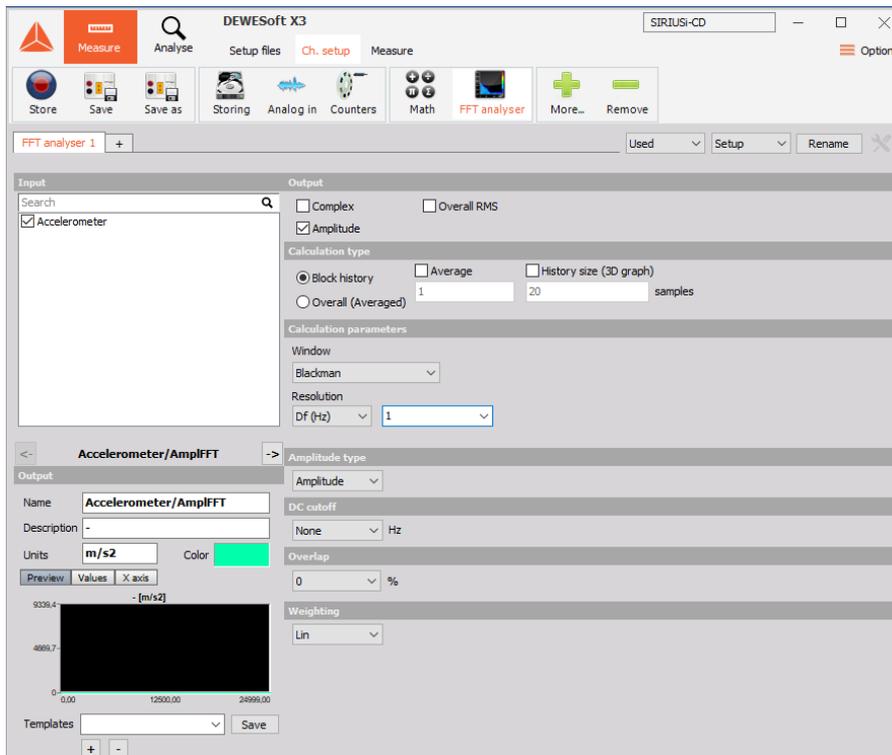
**Additional needed equipment:** SIRIUS with one ACC, accelerometer.

Glue the accelerometer on the Vibro Kit. Connect the accelerometer to SIRIUS ACC module, and enter the channel setup. Select the IEPE mode – if the sensor has TEDS chip, the sensitivity will be recognized. Otherwise, enter the setup and change the sensitivity of the sensor manually.

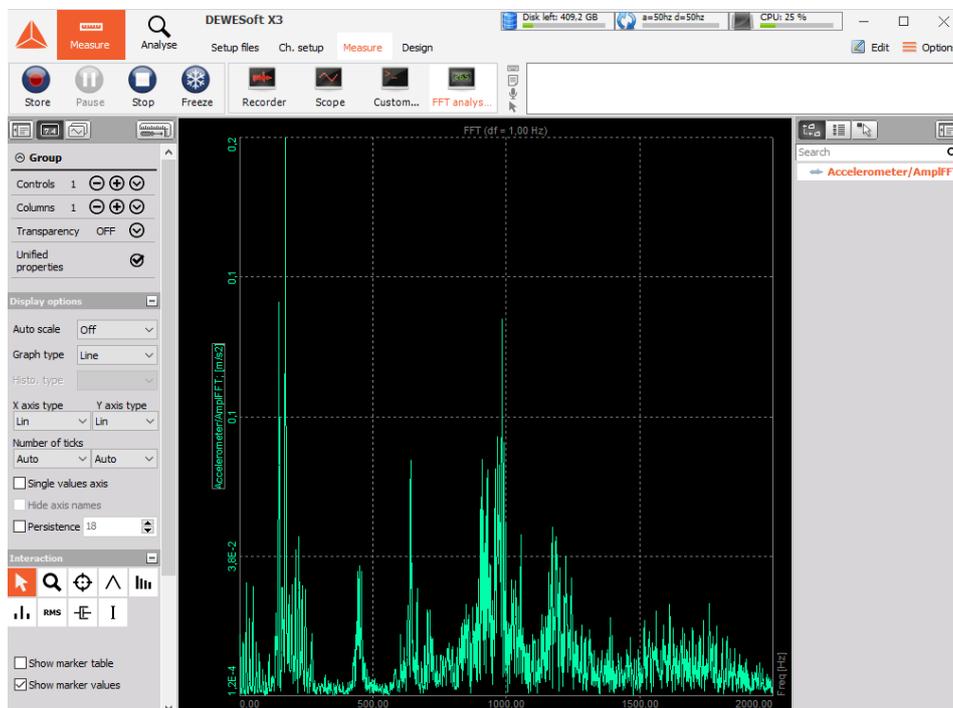
The screenshot shows the DEWESoft X3 interface in Channel setup mode. The 'Channel actions' section shows 'Dynamic acquisition rate' set to 50000 and 'Bandwidth' set to 19531 Hz. Below is a table with channel configuration details:

ID	Used	C	Name	Ampl. name	Range	Measurement	Min	Values	Max	Physical quantity	Units	Zero	Setup
1	Used		Accelerometer	SIRIUS-ACCv2	10000 mV	IEPE	-9339,36	0,0	9339,36	Acceleration	m/s <sup>2</sup>	Zero	Setup
2	Unused		AI 2	SIRIUS-ACCv2+	10 V	Voltage	-10,00	0,002	10,00		V	Zero	Setup

Add the FFT analyser math module (with the click on the plus button More). Select the input channel (accelerometer) and set up the math.



Enter the measure mode and add FFT channel on a 2D graph. Run the machine and observe the FFT.



On the FFT graph you can show the markers and how FFT behaves with different parameters in the setup. For explanation of all the parameter visit: <https://www.dewesoft.com/pro/course/spectral-analysis-using-the-fft-29>



## 5. Order tracking

**Additional needed equipment:** SIRIUS with one ACC and one CNT module, accelerometer.

Glue the accelerometer on the Vibro Kit and connect it to the ACC module. Connect encoder to the CNT module. Open channel setup and set the acceleration sensor to IEPE mode and enter the correct sensitivity. Add an Order tracking module.

The screenshot displays the DEWESoft X3 software interface for configuring an Order tracking module. The window title is "SIRIUSI-CD". The main menu includes "Measure", "Analyse", "Setup files", "Ch. setup", and "Measure". The toolbar contains icons for "Store", "Save", "Save as", "Storing", "Analog in", "Counters", "Math", "FFT analyser", "OT", "More...", and "Remove".

The "Order tracking 1" module is selected, showing the following configuration:

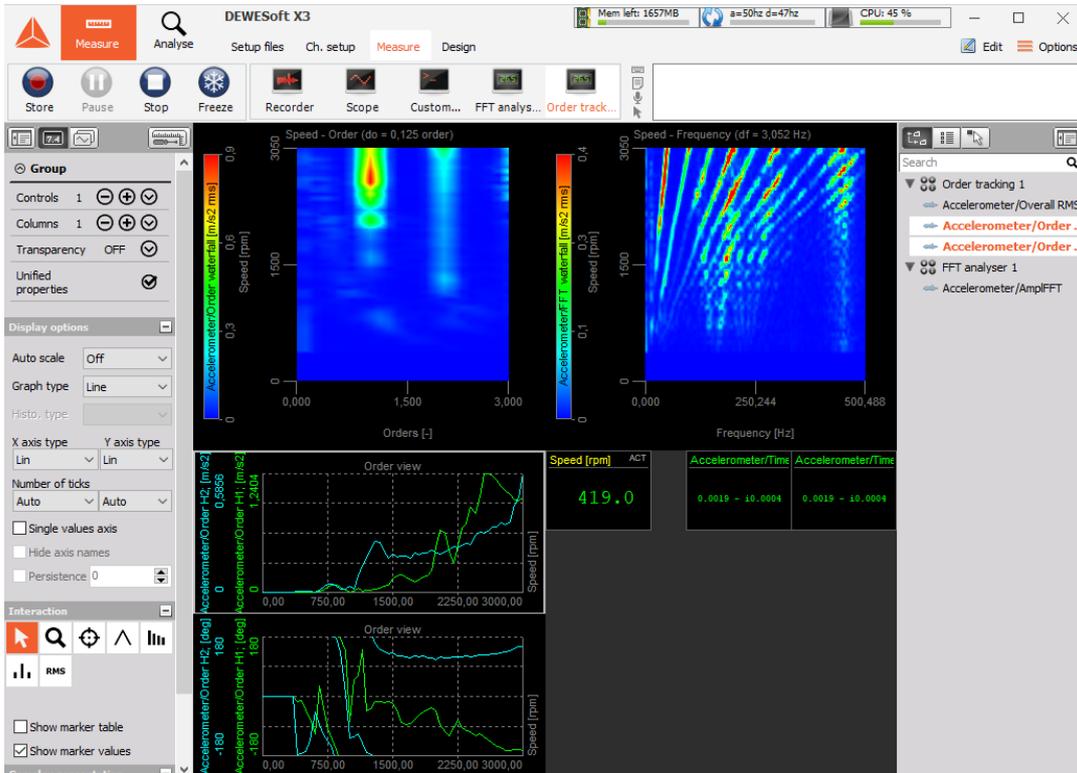
- Input:** Accelerometer (checked)
- Frequency channel setup:** Frequency source: Counters; Sensor: Encoder-1024; Frequency channel: CNT 2; Filter: 500 ns
- Calculation criteria - frequency limits:** Direction: Both; Delta RPM: 50; Upper RPM limit: 3000; Lower RPM limit: 0
- Order FFT setup:** Order domain harmonics (checked); Order waterfall vs. RPM (checked); Order resolution: 1/8 (0.125); Maximum order: 32; Order waterfall vs. time (unchecked); Overlap: 0 %
- Common properties:** Harmonic list: 1; 2; FFT window: Blackman; Data averaging: Average between classes; Update criteria: Always; Skip missing RPM class (unchecked); Overall RMS vs. RPM (checked)
- Time FFT setup:** Time domain harmonics (checked); FFT waterfall vs. RPM (checked); Auto (df = 3,052 Hz); update on RPM change (Delta RPM) (checked); update on: 0,5 sec

The output section shows the name "Accelerometer/Overall RMS", units "m/s<sup>2</sup>", and a preview graph of acceleration over time.

Select the vibration and the frequency input channel. Detailed description of all the parameters can be found here: <https://www.dewesoft.com/pro/course/order-tracking-31>

Enter the measure mode, and run the machine slowly from 0 RPM to 3000 RPM.

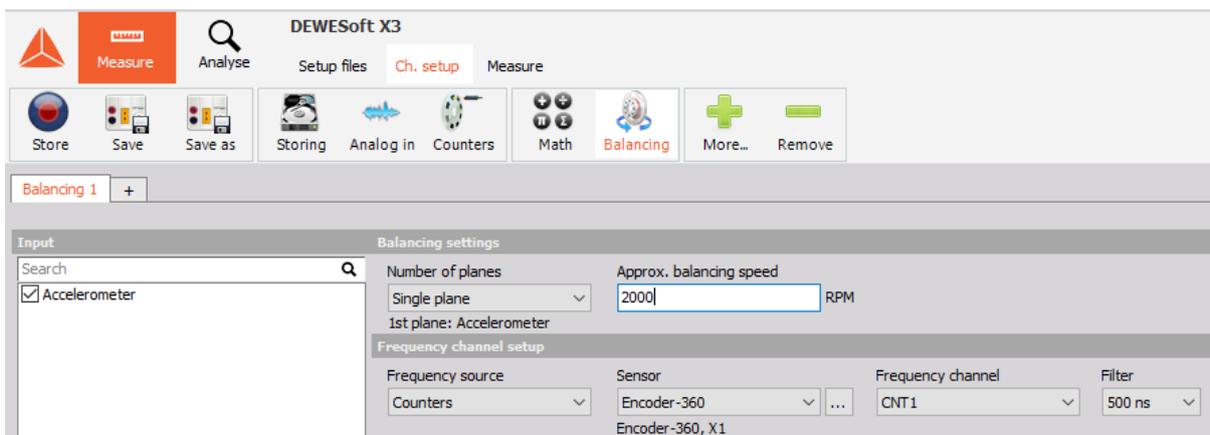
Order tracking module creates a display with two 3D graphs to show order and FFT waterfalls, two 2D graphs to show the order harmonics and phase of the harmonics and a digital meter to monitor the RPMs of the machine.



## 6. Balancing

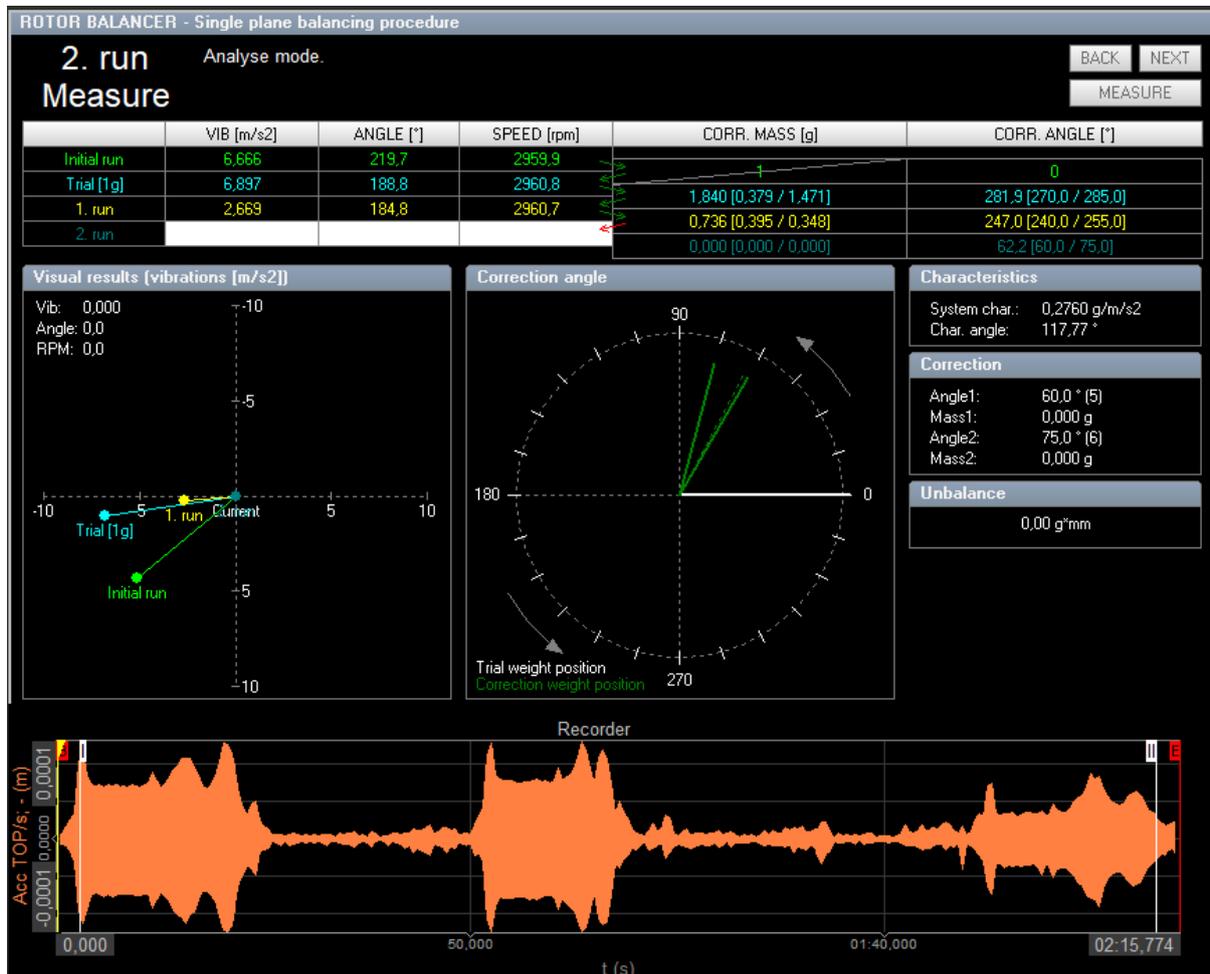
**Additional needed equipment:** SIRIUS with one ACC (single plane balancing) or two ACC modules (dual plane balancing), accelerometer (single plane balancing) or two accelerometers (dual plane balancing), additional screws for balancing the rotor.

Select the input channel (vibration) and define the frequency source (counters, analog sensor, RPM channel). Balancing procedure should be done at constant RPMs.





The balancing is a step-by-step procedure. First you need to perform the initial run, to get the initial unbalance vector. After that, you attach trial weight, perform trial run to get another unbalance vector. From those two unbalance vectors we calculate the correction mass that has to be added and the angle at which this should be added. You can perform as many steps as you wish.



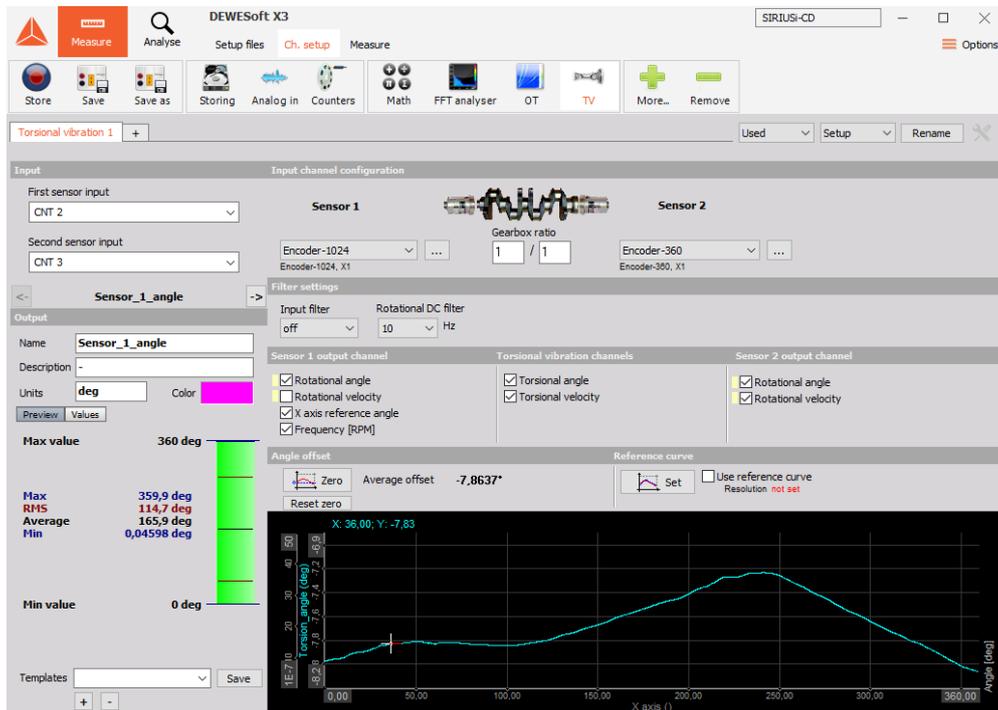
For more detailed explanation of balancing parameters and settings, please visit:  
<https://www.dewesoft.com/pro/course/balancing-44>

## 7. Torsional vibration

**Additional needed equipment:** SIRIUS with 2 CNT modules and accelerometer.

Connect two angle sensors to SIRIUS. Add a torsional vibration module. Select the first (reference) and second angle sensor input and assign sensors to the counter channels.

Select the wanted output channel from the module. Detailed description of the parameters and setting can be found here: <https://www.dewesoft.com/pro/course/rotational-and-torsional-vibration-34>



Enter the measure mode. Plugin creates a new display with 2 XY recorders for displaying the rotational angles and torsional angle against the reference angle sensor.

On the time recorder you can see the behaviour of the rotational angle and observe how the vibrations change with the RPM.

