# V2i

## FROM VIBRATIONS TO IDENTIFICATION

**V2i S.A.**
Avenue du Pré-Aily, 25
Liège Science Park
4031 LIEGE - BELGIUM

T. +32 4 287 10 70
F. +32 4 287 10 71
info@v2i.be
www.v2i.be

# Acquisitor v4.2.3

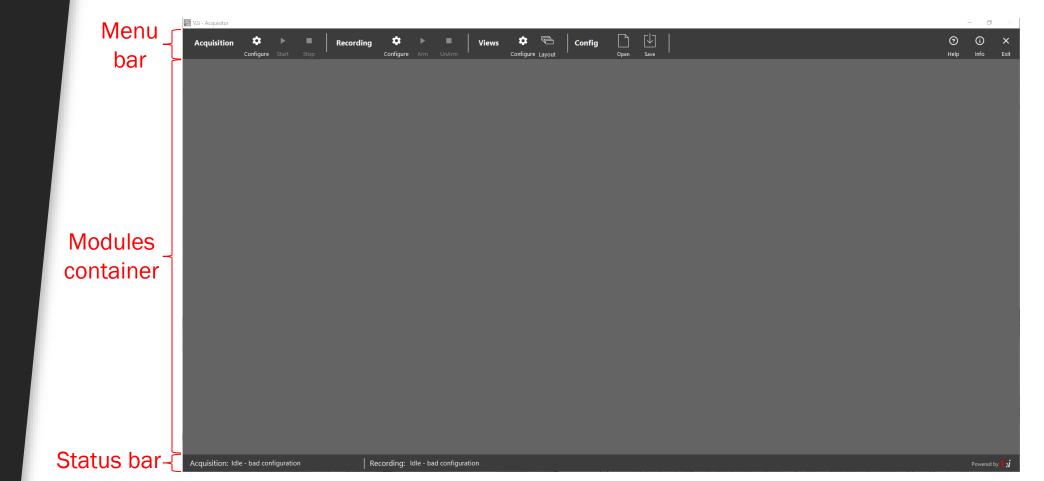# Quick Start Guide

September 1, 2023

# Introduction

- The Acquisitor, developed by V2i, is an integrated software capable of acquiring different hardware (mainly from National Instruments for now), recording the data, showing the data and processing them

- This Quick Start Guide provides the basic information for all the functionalities

- Click on the table of contents to go the desired section

- For more information and for pricing, please send an email to support@v2i.be

# Main UI

- The main UI is split into three horizontal zones
  - **Menu bar:** includes the controls of the acquisition, the recording and the views
  - **Modules container:** container where the modules windows are located
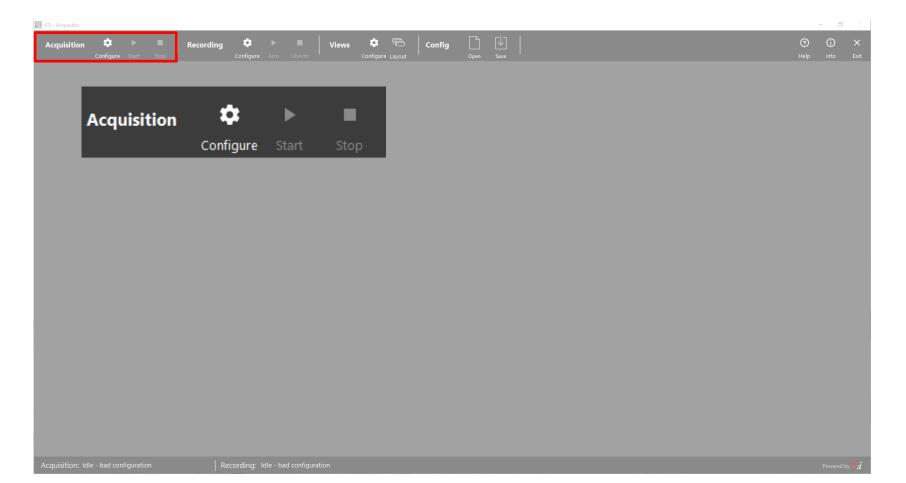  - **Status bar:** includes the status of the acquisition and the recording

# Acquisition – Controls

- The acquisition menu bar includes three controls
  - **Configure:** launches the [acquisition configuration editor](#)
  - **Start:** starts the acquisition; only if the acquisition configuration is valid
  - **Stop:** stops the acquisition; only if the acquisition is running

# Acquisition – Status

- The acquisition status bar contains the status of the acquisition
  - **Idle – bad configuration:** configuration not valid; check the configuration editor
  - **Idle – ready to start:** configuration valid; press start to launch the acquisition
  - **Creating task:** task is being created
  - **Starting task:** task is being started
  - **Acquisition in progress…:** the acquisition is running correctly
  - **Stopping task:** task is being stopped
  - **Clearing task:** task is being cleared
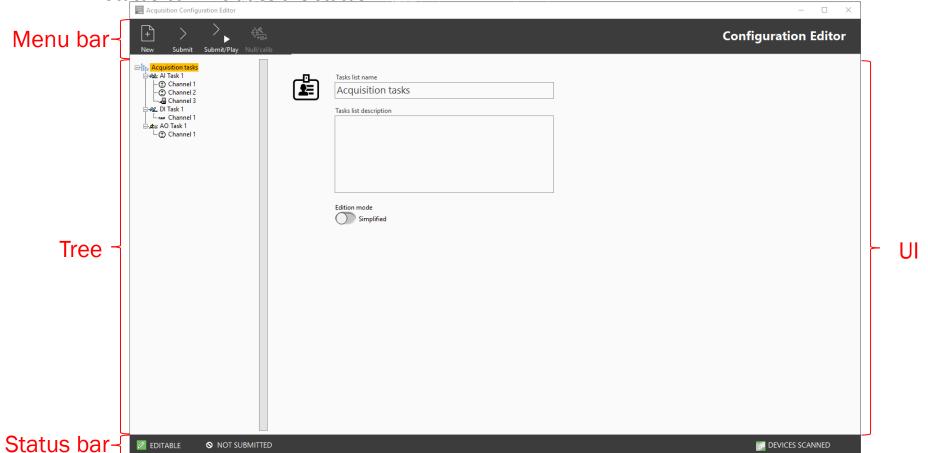
# Acquisition – Configuration editor

- The acquisition configuration editor is split into four zones
  - **Menu bar:** includes the controls
  - **Tree:** visualizes the acquisition structure, consisting of tasks and channels
  - **UI:** user interface of the selected task/channel
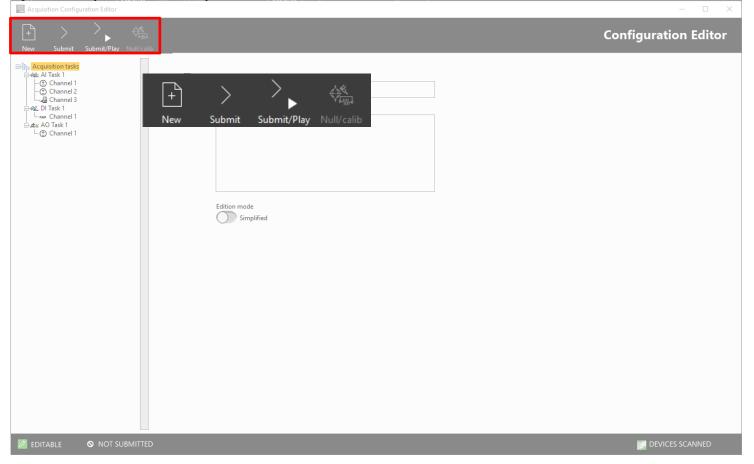  - **Status bar:** includes the status

# Acquisition – Configuration editor

- Menu bar
  - **New:** resets the configuration
  - **Submit:** creates and verifies the tasks
  - **Submit/Play:** creates, verifies and starts the tasks
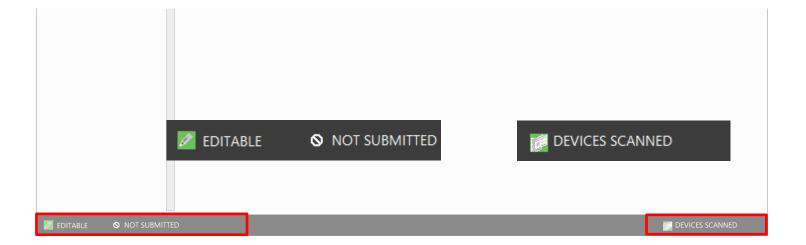  - **Null/calib:** opens the null/calib UI

# Acquisition – Configuration editor
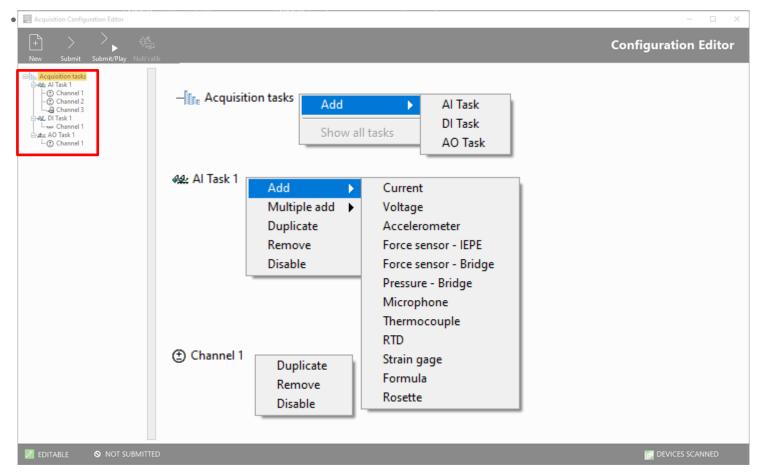
- Status bar
  - **Editable status:**
    - NOT EDITABLE
    - EDITABLE
  - **Submit status:**
    - NOT SUBMITTED
    - SUBMITTING
    - ERROR : an error has occured during submission; check tasks/channels
    - WARNINGS : some warnings have occurred during submission; check tasks/channels
    - VALID CONFIG
  - **Scanning status:**
    - SCANNING DEVICES
    - ERROR WHILE SCANNING: an error has occurred during devices scanning; hover your mouse on status for more information
    - DEVICES SCANNED
  - Click on the scanning status to scan the devices

# Acquisition – Configuration editor

- Tree
  - Right click on tasks list to add a task
  - Right click on a task to add one or multiple channels, to duplicate the task, remove it or disable it
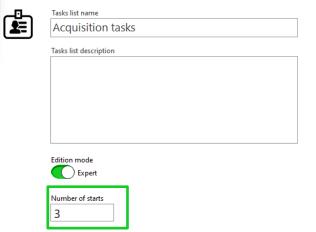  - Right click a channel to duplicate it, remove it or disable it

# Acquisition – Configuration editor – Tasks list

- Tasks list

  - **Tasks list name**
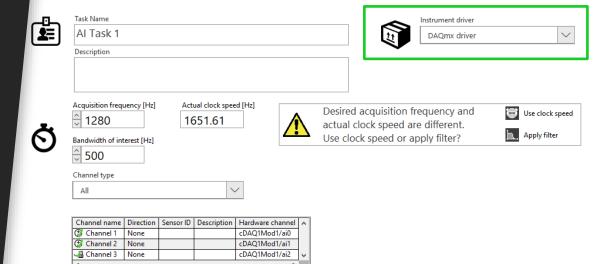  - **Tasks list description**

  – **Edition mode:** choose whether to display all the parameters in the tasks/channels UI (expert mode) or only the essential ones (simplified mode). In the following pages, the parameters not shown in simplified mode are framed in green

  – **Number of starts:** choose the number of time the application starts the acquisition (only for time-limited acquisitions)

- AI Task: analog in task

  – **Task name**

  – **Description**

  – **Instrument driver:** choose which driver to use; DAQmx by default

– **Acquisition frequency [Hz]:** desired acquisition frequency

– **Actual clock speed [Hz]:** after submission, shows the actual clock speed used by the hardware

– **Warning:** in case the desired acquisition frequency and the actual clock speed are different, you can choose to use the clock speed (the acquisition frequency will change to match the clock speed) or to apply a filter to keep the desired acquisition frequency

– **Bandwidth of interest [Hz]:** equals to the acquisition frequency divided by 2.56, maximum frequency shown in spectral and waterfall modules

– **Channels listbox:** displays all the channels of the task. Choose the channel type to show all the parameters of this type. You can directly modify the parameters in this listbox
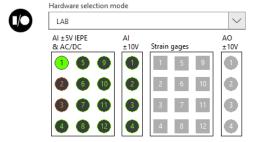
# Acquisition – Configuration editor – AI Task

- Channel – common parameters
  - **Channel Name**
  - **Direction:** None, +X, -X, +Y, -Y, +Z, -Z
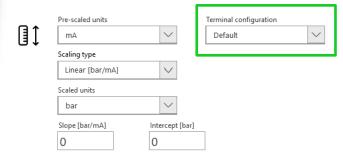  - **Sensor ID**
  - **Description**



  - **Hardware selection mode:** there are three different mode to select the hardware channel:
    - **Chassis/Module/Input:** you can choose separately the chassis, the module and the input
    - **Hardware channel:** you can choose the hardware channel by its LabVIEW channel name
    - **LAB:** if you use the V2i Laboratory Acquisition Box (LAB), you can choose the hardware channel by its position in the LAB front panel.

        - Selected hardware channel
        - Hardware channel already used
        - Selectable hardware channel
        - Incompatible hardware channel

# Acquisition – Configuration editor – AI Task

- ⊕ Current channel
  - **Terminal configuration**
    - **RSE:** Referenced Single-Ended mode
    - **NRSE:** Non-Referenced Single-Ended mode
    - **Differential**
    - **Pseudodifferential**
    - Unavailable modes are surrounded by < >
  - **Pre-scaled units:** choose between mA and A. This unit is used if you choose not to scale and in the scaling data

  - **Scaled units:** you can enter whatever you want

  - **Scaling type**
    - In the following, 'unsc.' corresponds to the pre-scaled unit and 'EU' to the scaled unit
    - **No scaling**
    - **Linear [EU/unsc.]:** enter the slope in [EU/unsc.] and the intercept in [EU]
    - **Linear [unsc./EU] :** enter the slope in [unsc./EU] and the intercept in [unsc.]
    - **Map ranges:** enter the minimum and maximum value in [EU] and the minimum and maximum value in [unsc.]
    - **Polynomial:** enter in an array the terms $a_0, a_1, a_2, ...$ of the polynomial equation $y = a_0 + a_1 x + a_2 x^2 + \cdots$ where $x$ is in [unsc.] and $y$ in [EU]
    - **Table:** enter in two arrays the pre-scaled values and the corresponding scaled values. A linear interpolation is applied to the values inbetween

# Acquisition – Configuration editor – AI Task

- ⊕ Voltage channel
  - **Terminal configuration, scaled units and scaling type:** see description of [current channel](current channel)
  - **Pre-scaled units:** choose between 'mV' and 'V'
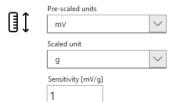
  - **Coupling**
    - **AC:** removes the DC offset from the signal
    - **DC:** measures all of the signal
    - **GND:** removes the signal from the measurement and measures only ground
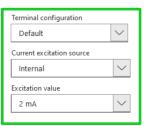    - Unavailable couplings are surrounded by < >

# Acquisition – Configuration editor – AI Task

- Accelerometer channel

  - **Pre-scaled units:** choose between 'mV' and 'V'

  - **Scaled units:** choose between 'g', 'm/s²' and 'in/s²'

  - **Sensitivity:** enter the sensitivity in the selected units

  - **Terminal configuration:** see current channel

  - **Current excitation source:**

    - **External:** use an excitation source other than the built-in excitation source of the device

    - **Internal:** use the built-in excitation source of the device

    - **None:** supply no excitation to the channel

  - **Excitation value:**

    - If 'External' is chosen, enter the value of the excitation

    - If 'Internal' is chosen, choose between the supplied values or 'Default' which will select the maximum value

  - **Make triaxial:** right click on the channel in the tree and click and 'Make triaxial'. The channel will be twice duplicated and the three channels will have '+X', '+Y' and '+Z' direction respectively

# Acquisition – Configuration editor – AI Task
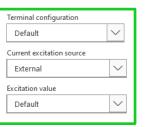
- Force sensor – IEPE
  - **Scaled units:** choose between 'N' and 'lb'
  - **Sensitivity:** enter the sensitivity in the selected units
  - **Coupling:** see [voltage channel](#)
  - **Terminal configuration:** see [current channel](#)
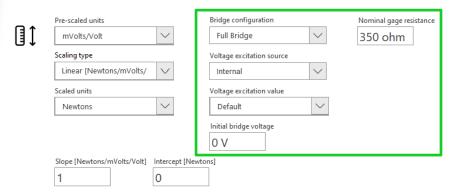  - **Current excitation source, excitation value:** see [accelerometer channel](#)

Scaled unit
N

Sensitivity [mV/N]
1

Coupling
Default

Terminal configuration
Default

Current excitation source
External

Excitation value
Default

# Acquisition – Configuration editor – AI Task

- Force sensor – Bridge channel

  – **Scaling type:** see [current channel](current channel)

  – **Voltage excitation source, voltage excitation value:** see [accelerometer channel](accelerometer channel)

  – **Pre-scaled units:** choose between 'mVolts/Volt' and 'Volts/Volt'

  – **Scaled units:** choose between 'Newton', 'Pounds' and 'kgf'

  – **Bridge configuration:** choose between 'full bridge', 'half bridge' and 'quarter bridge'

  – **Nominal gage resistance:** enter the bridge resistance

  – **Initial bridge voltage:** offset of the bridge voltage to null the bridge. It will be overridden by the null/calib UI

# Acquisition – Configuration editor – AI Task

- 📧 Pressure – Bridge channel
    - **Scaling type:** see [current channel](current channel)
    - **Voltage excitation source, voltage excitation value:** see [accelerometer channel](accelerometer channel)
    - **Pre-scaled units, bridge configuration, initial bridge voltage, nominal gage resistance:** see [force sensor – bridge channel](force sensor – bridge channel)
    - **Scaled units:** choose between 'Pascals', 'psi' and 'bar'

# Acquisition – Configuration editor – AI Task

- Microphone channel
  - **Terminal configuration:** see [current channel](#)
  - **Voltage excitation source, voltage excitation value:** see [accelerometer channel](#)
  - **Sensitivity:** enter sensitivity in [mV/Pa]

# Acquisition – Configuration editor – AI Task
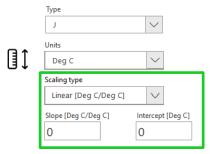
- 🌡 Thermocouple channel
  - **Scaling type:** see current channel
  - **Type:** choose between 'J', 'K', 'N', 'R', 'S', 'T', 'B' and 'E'
  - **Units:** choose between 'Deg C', 'Deg F', 'K'

# Acquisition – Configuration editor – AI Task

- 🌡 RTD channel

  - **Scaling type:** see current channel

  - **Resistance configuration:** choose between '2-Wire', '3-Wire' and '4-Wire'

  - **R0 [Ohm]:** choose between '100' and '1000'

  - **Units:** choose between 'Deg C', 'Deg F', 'K'

Resistance Configuration
4-Wire

R0 [Ohm]
100

Units
Deg C

Scaling type
Linear [Deg C/Deg C]

Slope [Deg C/Deg C]
0

Intercept [Deg C]
0

# Acquisition – Configuration editor – AI Task
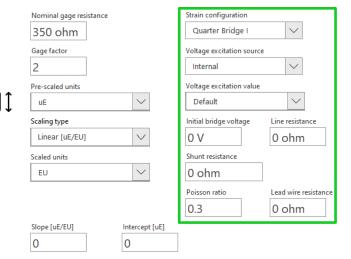
- Strain gage channel

  - **Nominal gage resistance**

  - **Gage factor**

  - **Pre-scaled units:** choose between 'uE' and 'E'

  - **Scaling type, scaled units:** see current channel

  - **Voltage excitation source, voltage excitation value:** see accelerometer channel

- **Strain configuration:** choose between 'Full bridge I', 'Full bridge II', 'Full bridge III', 'Half bridge I', 'Half bridge II', 'Quarter bridge I' and 'Quarter bridge II'

- **Initial bridge voltage:** offset of the bridge voltage to null the bridge. It will be overridden by the null/calib UI

- **Line resistance:** line resistance of the bridge to calibrate it. It will be overridden by the null/calib UI

- **Shunt resistance:** depending of the device used

- **Poisson ratio**

- **Lead wire resistance**

- **Make rosette:** right click on the channel in the tree and click and 'Make rosette'. The channel will be twice duplicated and a rosette channel will be created
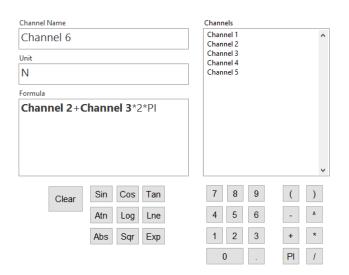
- ✐ Formula channel
  - This channel is a virtual channel computed from other channels. It is not bound to a hardware channel
  - **Channel name**
  - **Unit**
  - **Channels:** list of channels of the current task. Click on one channel to put it in the formula. Only the channels on top of the formula channel can be selected

  - **Formula:** the names of available channels are in bold. You can write the formula or use the buttons hereunder
  - **Clear:** clear the formula

# Acquisition – Configuration editor – AI Task

- Rosette channel
    - This channel is a virtual channel computed from other channels. It is not bound to a hardware channel
    - **E [MPa]:** Young modulus
    - **nu:** Poisson ratio
    - **Unit:**
        - 'uE' or 'E' if strain
        - 'deg' or 'rad' if angle
        - 'MPa' or 'Pa' if stress
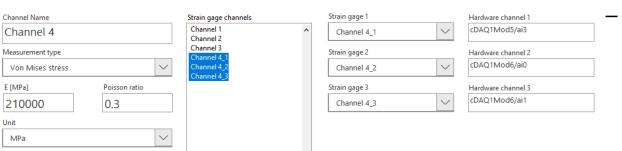
- **Rosette type:**
    - **rectangular (45°)**
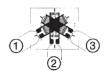


    - **delta (120°)**



- **Strain gage channels:** select using the listbox (multiple select using CTRL + click or SHIFT + click) or using the comboboxes 'Strain gage 1', 'Strain gage 2' and 'Strain gage 3'. Respect the numbering of the schemas hereabove

# Acquisition – Configuration editor – AI Task

- Rosette channel
  - **Measurement type:** for rectangular (45°) rosette
    - **Principal strain 1 $\varepsilon_P$ and Principal strain 2 $\varepsilon_Q$**

$$\varepsilon_{P,Q} = \frac{\varepsilon_1 + \varepsilon_3}{2} \pm \frac{1}{\sqrt{2}}\sqrt{(\varepsilon_1 - \varepsilon_2)^2 + (\varepsilon_2 - \varepsilon_3)^2}$$

    - **Principal stress 1 $\sigma_P$ and Principal stress 2 $\sigma_Q$**

$$\sigma_{P,Q} = \frac{E}{2}\left[\frac{\varepsilon_1 + \varepsilon_3}{1 - \nu} \pm \frac{\sqrt{2}}{1 + \nu}\sqrt{(\varepsilon_1 - \varepsilon_2)^2 + (\varepsilon_2 - \varepsilon_3)^2}\right]$$

- **Von Mises strain**

$$\varepsilon_{VM} = \sqrt{\varepsilon_P^2 + \varepsilon_Q^2 - \varepsilon_P \varepsilon_Q}$$
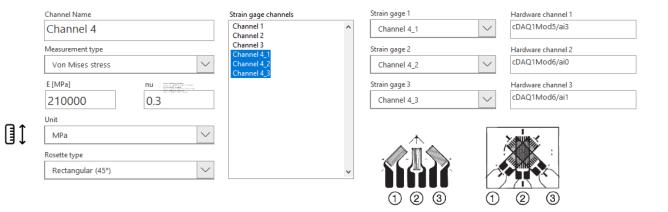
- **Principal angle**

$$\phi_{P,Q} = \frac{1}{2}\tan^{-1}\left(\frac{2\varepsilon_2 - \varepsilon_1 - \varepsilon_3}{\varepsilon_1 - \varepsilon_3}\right)$$

- **Von Mises stress**

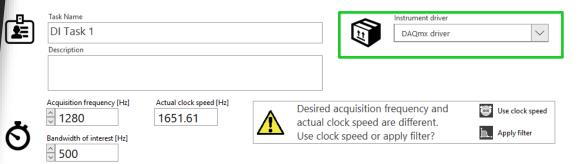$$\sigma_{VM} = \sqrt{\sigma_P^2 + \sigma_Q^2 - \sigma_P \sigma_Q}$$

- Rosette channel

  - **Measurement type:** for delta (120°) rosette

    - **Principal strain 1 $\varepsilon_P$ and Principal strain 2 $\varepsilon_Q$**

$$\varepsilon_{P,Q} = \frac{\varepsilon_1 + \varepsilon_2 + \varepsilon_3}{3} \pm \frac{\sqrt{2}}{3}\sqrt{(\varepsilon_1 - \varepsilon_2)^2 + (\varepsilon_2 - \varepsilon_3)^2 + (\varepsilon_3 - \varepsilon_1)^2}$$

    - **Principal stress 1 $\sigma_P$ and Principal stress 2 $\sigma_Q$**

$$\sigma_{P,Q} = \frac{E}{3}\left[\frac{\varepsilon_1 + \varepsilon_2 + \varepsilon_3}{1 - v} \pm \frac{\sqrt{2}}{1 + v}\sqrt{(\varepsilon_1 - \varepsilon_2)^2 + (\varepsilon_2 - \varepsilon_3)^2 + (\varepsilon_3 - \varepsilon_1)^2}\right]$$

- **Von Mises strain**

$$\varepsilon_{VM} = \sqrt{\varepsilon_P^2 + \varepsilon_Q^2 - \varepsilon_P\varepsilon_Q}$$
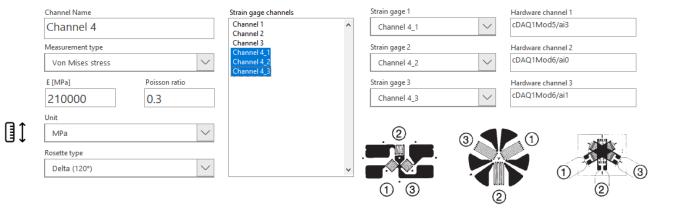
- **Principal angle**

$$\phi_{P,Q} = \frac{1}{2}\tan^{-1}\left(\frac{\sqrt{3}(\varepsilon_2 - \varepsilon_3)}{2\varepsilon_1 - \varepsilon_2 - \varepsilon_3}\right)$$

- **Von Mises stress**

$$\sigma_{VM} = \sqrt{\sigma_P^2 + \sigma_Q^2 - \sigma_P\sigma_Q}$$

# Acquisition – Configuration editor – DI Task

- DI Task: digital in task
    - **Task name**
    - **Description**
    - **Instrument driver:** choose which driver to use; DAQmx by default



- **Acquisition frequency [Hz]:** desired acquisition frequency
- **Actual clock speed [Hz]:** after submission, shows the actual clock speed used by the hardware
- **Warning:** in case the desired acquisition frequency and the actual clock speed are different, you can choose to use the clock speed (the acquisition frequency will change to match the clock speed) or to apply a filter to keep the desired acquisition frequency
- **Bandwidth of interest [Hz]:** equals to the acquisition frequency divided by 2.56, maximum frequency shown in spectral and waterfall modules

# Acquisition – Configuration editor – DI Task

- ⎍ Line Channel
  - See [common parameters](#)

# Acquisition – Configuration editor – AO Task

- AO Task: analog out task
    - **Task name**
    - **Description**
    - **Instrument driver:** choose which driver to use; DAQmx by default
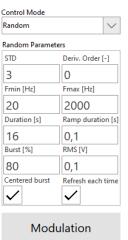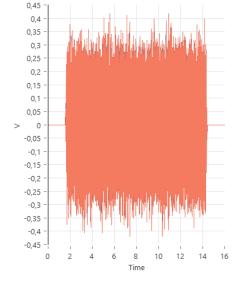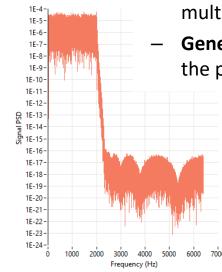
    - **Generation frequency [Hz]:** desired generation frequency.
    - **Control Mode:** choose the type of excitation
        - **Sine Dwell**
        - **Sine Sweep**
        - **Stepped Sine**
        - **Random**
        - **Multisine Random**
        - **From File**
    - **Modulation:** modulates the excitation for multiple excitations points
    - **Generate:** generates the signal according to the parameters and displays it on the graphs

# Acquisition – Configuration editor – AO Task

- AO Task: analog out task
  - **Sine Dwell**
    - **Freq [Hz]:** frequency of the sine tone
    - **Amplitude [V]:** amplitude
    - **Duration [s]:** duration of the excitation
    - **Ramp duration [s]:** duration of the ramp at the start and end of the excitation
    - **Multitones:** launches a popup to create a multitones sine excitation by modifying frequencies, amplitudes and phases
  - **Sine Sweep**
    - **Fstart [Hz]** and **Fend [Hz]:** start and end frequencies of the sweep
    - **Duration [s]**, **Ramp duration [s]** and **Amplitude [V]**: see Sine Dwell
    - **Burst [%]:** percentage of the duration in which the excitation is active; during the rest of the time, the excitation is null
    - **Centered burst:** if marked, the excitation is centered in the duration period; if not, the excitation begins at the start
    - **Speed:** sweep rate in oct/min or Hz/s depending of the mode
    - **Mode:** logarithmic or linear
  - **Stepped Sine**
    - **Fstart [Hz]**, **Fend [Hz]**, **Duration [s]**, **Ramp duration [s]**, **Speed**, **Amplitude [V]** and **Mode**: see Sine Sweep
    - **Number of steps:** number of steps
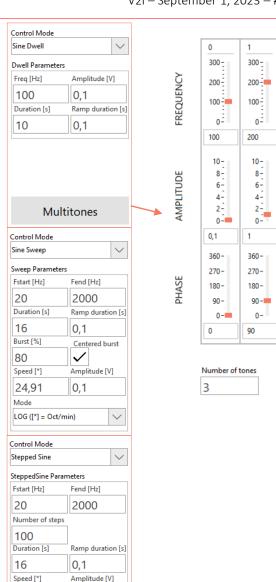
# Acquisition – Configuration editor – AO Task

- AO Task: analog out task
  - **Random**
    - **STD:** Standard deviation of the generated noise
    - **Deriv. Order:** order of the derivation to be applied to the signal; a negative order means an integration
    - **Fmin [Hz]** and **Fmax[Hz]:** cutoff frequencies of the bandpass filter applied to the signal
    - **Duration [s]**, **Ramp duration [s]**, **Burst** [%] and **Centered burst**: see Sine Sweep
    - **RMS [V]:** Root Mean Square of the signal
    - **Refresh each time:** if marked, generates a new signal at each start
  - **Multisine Random**
    - **Fmin [Hz]** and **Fmax[Hz]:** minimum and maximum frequencies of the sine tones
    - **RMS [V]:** Root Mean Square of the signal
    - **Duration [s]:** duration of one block
    - **N time blocks:** number of time blocks used in one acquisition
    - **N to ignore:** number of time blocks to ignore at the beginning of the signal before performing the average
  - **From File**
    - **File Path:** path of the file to read
    - **MasterScaling:** scaling to apply to the signal

- AO Task: analog out task
  - **Modulation**
    - when at least two channels have been added to the AO task, the modulation is activated
    - **Amplitude**: tweaks the amplitudes of the different outputs; a value of one corresponds to the amplitude sets in the control parameters
    - **Phase:** tweaks the phase of the different outputs

- **Calib:** tweaks the amplitude of the different outputs
- **Generate:** generate a wave of the given type at the given order; only the amplitudes and phases are modified, not the calib
- **Order:** order of the signal
- **Type:**
  - **Stationary wave:** a sine wave of the given order is applied to the amplitudes and the phases are at zero
  - **Rotating wave:** the amplitudes are at one and a linear signal of the given order is applied to the phases
- **Save:** saves the pattern in a .xml file
- **Load:** loads the pattern from a .xml file
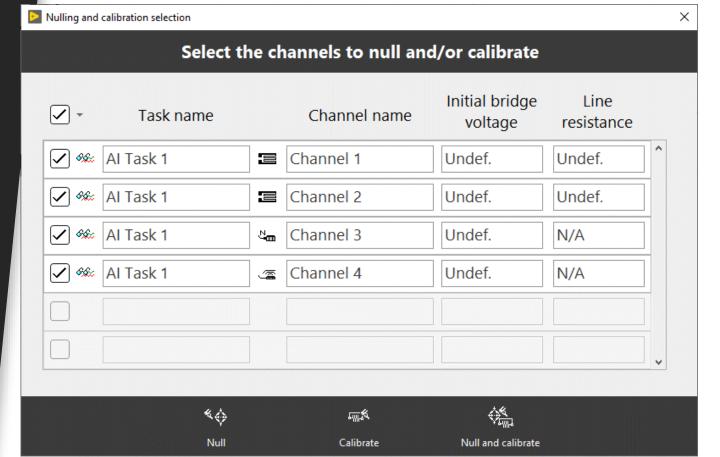
# Acquisition – Configuration editor – AO Task

- ⊕ AO Voltage channel
  - No parameters
- ⊕ AO Current channel
  - No parameters

# Acquisition – Configuration editor

- Null/calib UI
  - After submission of a configuration containing 'Strain gage', 'Force sensor – Bridge' or 'Pressure – Bridge', you can open the Null/calib UI
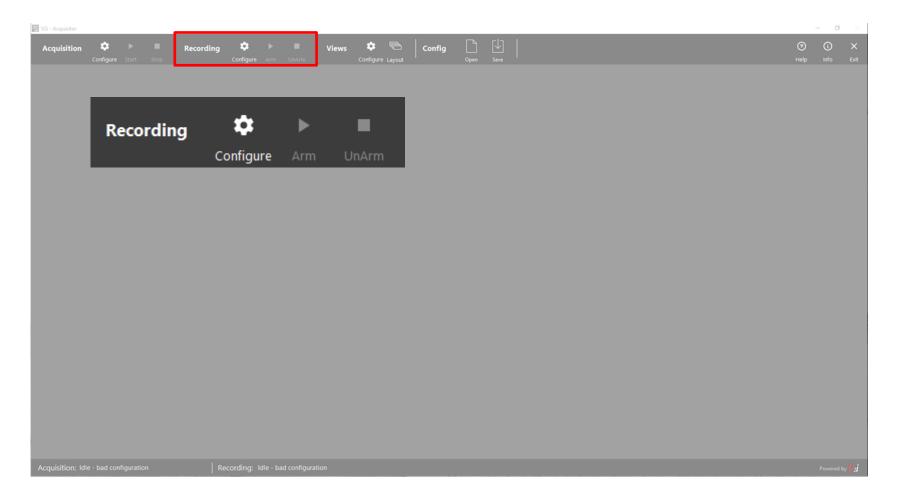


- You can select the channels to null or calibrate either by clicking on the checkboxes on the left or by clicking the arrow on the top left and choosing between 'None', 'All' or all the channels for a given task
- Click then on 'Null', 'Calibrate' or 'Null and calibrate'
- After nulling, the column 'Initial bridge voltage' will be filled
  - Undef.: nulling not already done
  - Error: error during nulling
- After calibrating, the column 'Line resistance' will be filled
  - Undef.: calibration not already done
  - Error: error during calibration
  - N/A: not applicable, when the channel is a 'Force sensor – Bridge' or a 'Pressure – Bridge'

# Recording – Controls

- The acquisition menu bar includes three controls
    - **Configure:** launches the [recording configuration editor](recording configuration editor)
    - **Arm:** starts waiting for a trigger. The data is recorded as soon as the trigger condition is met
    - **UnArm:** stops waiting for a trigger (no recording in progress) or stops the current recording

# Recording – Status

- The recording status bar contains the status of the recorder
  - **Idle – bad configuration:** configuration not valid; check the configuration editor
  - **Idle:** configuration valid; press arm to start waiting for a trigger
  - **Armed waiting for trigger:** the recorder waits for the configured trigger start condition
  - **Recording:** the acquired data is being recorded
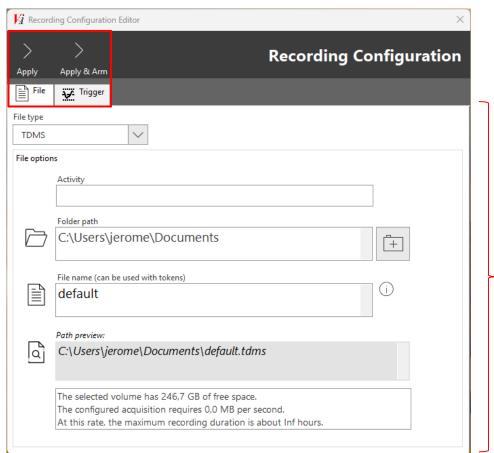
# Recording – Configuration editor

- The recording configurator is made of a menu bar and two tabs
  - **Apply:** submits the recording configuration
  - **Apply & Arm:** submits the recording configuration and arms the system
  - **File:** opens the file configuration tab, which configures **where** the data is saved
  - **Trigger:** opens the trigger configuration, which configures **when** the data is saved
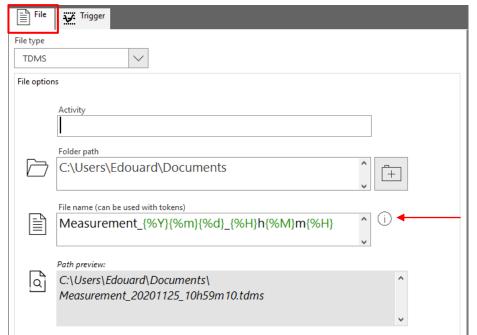


Selected tab

# Recording – Configuration editor – File Configuration

- The **file** tab is used to define **where** the data is saved. The following options are available:
  - **File type:** the output data format. Only TDMS is available so far
  - **Activity:** a general metadata that is written in the TDMS file
  - **Folder path:** the folder where the TDMS file is saved
  - **File name:** the name of the TDMS file. Tokens are available to use dynamic names which are automatically generated. In this example, the year, month, day, and time of the day at which each recording is started is automatically generated. A token helper is available (see next page)
  - **Path preview:** a preview of the complete save path, including the tokens.



token helper
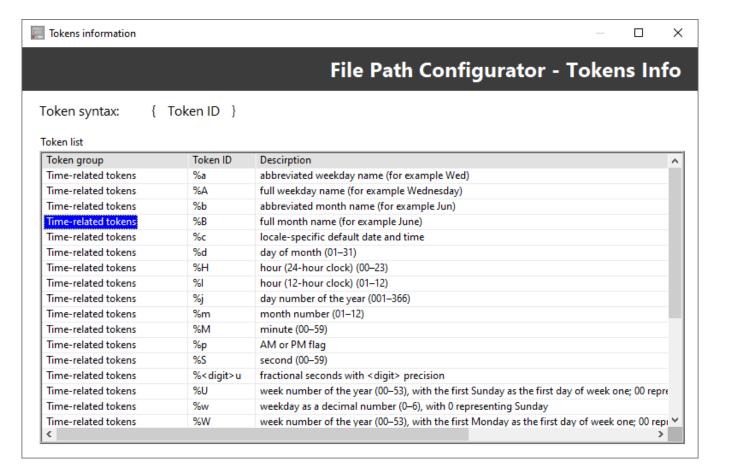
# Recording – Configuration editor – Token helper

The token helper displays all the available tokens.

Double clicking on a token automatically inserts the token in the **File name** field of the file configuration editor, at the location where the cursor was before selecting the token helper.
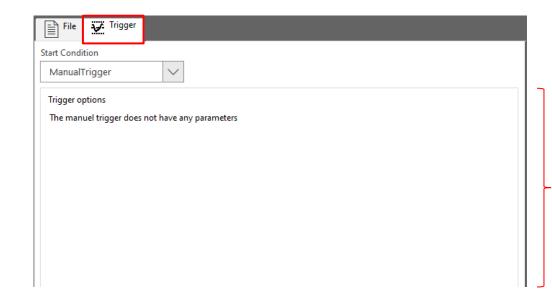
# Recording – Configuration editor – Trigger Configuration

- The **trigger** configuration tab is used to define **when** the data is saved. The trigger type is selected via the **Start Condition** tab. Specific trigger conditions can be configured when applicable via the UI.
  - **Manual trigger** (manual start & stop)
  - **Time trigger** (manual start, stop after a selected duration)
  - **Periodic time trigger** (measures XX seconds each YY seconds)
  - **Gate trigger** (measures while the amplitude is above/below a given level)
  - **Gate and time trigger** (measures for XX seconds once the amplitude reaches a given level)
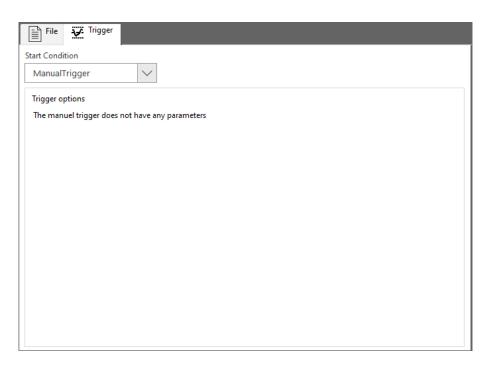


Selected trigger configuration

# Recording – Configuration editor – Trigger Configuration

- Manual trigger: the recording is started and stopped via the **Arm** and **UnArm** buttons.
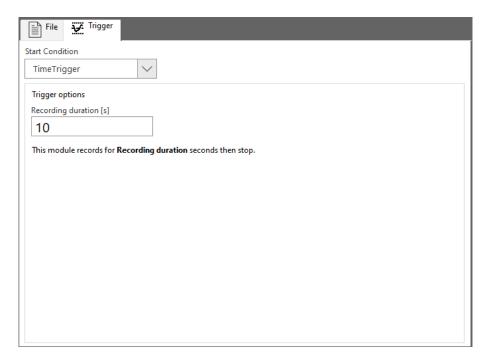
# Recording – Configuration editor – Trigger Configuration

- Time trigger: the recording is stated via the **Arm** button and stops after the user defined duration or via the **UnArm** button.
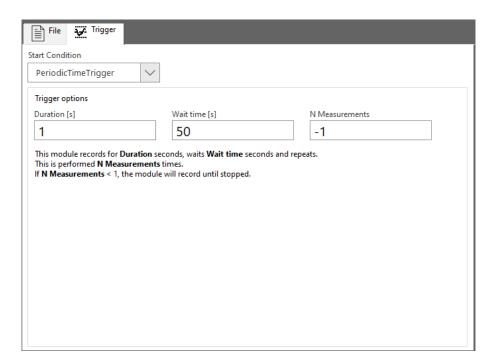
# Recording – Configuration editor – Trigger Configuration

- Periodic Time trigger: measurements are performed periodically. The following options are available:
  - **Duration**: specifies the duration of each recording, in seconds
  - **Wait time**: specifies the amount of time to wait between two successive recordings, in seconds
  - **N Measurements**: specifies the amount of recordings to perform. If a negative value is used, the system won't stop until it is manually unarmed.

# Recording – Configuration editor – Trigger Configuration

- Gate trigger: the system starts recording once the trigger condition is met and records as long as the amplitude is above or below a threshold. The following options are available:
  - **Trigger channel**: the acquisition channel user to start/stop recording
  - **Auto Re-arm**: the recorder starts looking for a new trigger once a stop trigger has been found
  - **Absolute value Trigger**: the absolute value of the channel is compared with the trigger level
  - **Trigger level**: the level which the trigger channel must reach to start recording
  - **Pre-Trigger**: the duration of the pre-trigger (measurements occurring before the trigger occurs)
  - **Starting Edge**: specifies if the system looks for a value above or below the trigger level
  - **Stop level**: the level which the trigger channel must reach to stop recording
  - **Post-Trigger**: the duration during which the trigger channel must remain below/above the stop level to stop the recording
  - **Stopping Edge**: specifies if the system looks for a value above or below the stop trigger level

# Recording – Configuration editor – Trigger Configuration

- Gate and time trigger: the system starts recording for a given duration once the amplitude reaches a treshold
  - **Trigger channel**: the acquisition channel user to start recording
  - **Auto Re-arm**: the recorder starts looking for a new trigger once a measurement is finished
  - **Absolute value Trigger**: the absolute value of the channel is compared with the trigger level
  - **Trigger level**: the level which the trigger channel must reach to start recording
  - **Pre-Trigger**: the duration of the pre-trigger (measurements occurring before the trigger occurs)
  - **Starting Edge**: specifies if the system looks for a value above or below the trigger level
  - **Duration**: the duration of each measurement, including the pre-trigger.

# Views – Controls
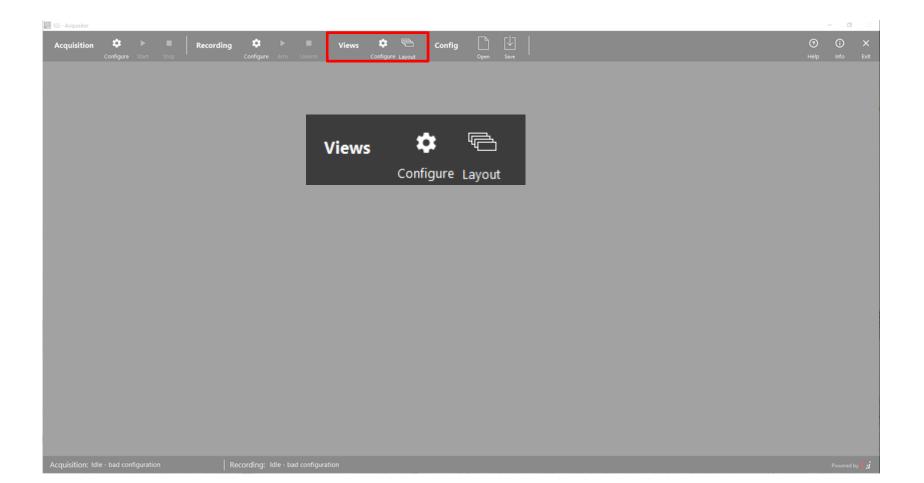
- The views menu bar includes two controls
  - **Configure:** launches the views manager
  - **Layout:** changes the layout of the windows
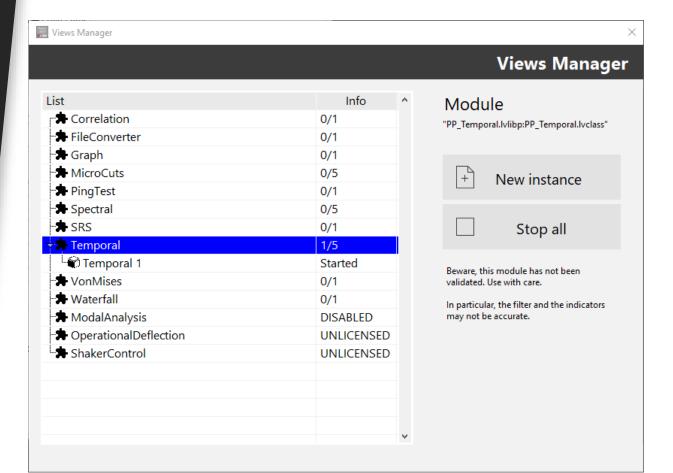
# Views – Views manager

- The Views manager allows to start and stop instances of modules
  - The list on the left indicates the available modules and the number of instances started



- Click on a module and 'New instance' to start an instance of the module
- Click on an instance and 'Stop' or on a module and 'Stop all' to stop the instances of the module
- If the module is disabled, make sure that the corresponding library is in the '%localappdata%\V2iAcquisitor\PPL\Plugin' folder
- If the module is unlicensed and you want to activate it, send an email to acquisitor@v2i.be and specify your license parameters and the modules you want to activate
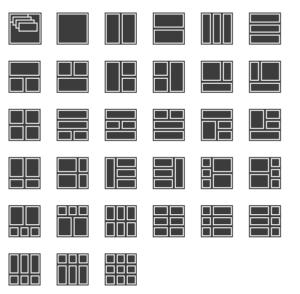
# Views — Layout

- The Layout button allows you to change the windows layout
  - You can choose between 33 different layout
  - If there are more windows than on the layout, the remaining windows will be put in cascade mode
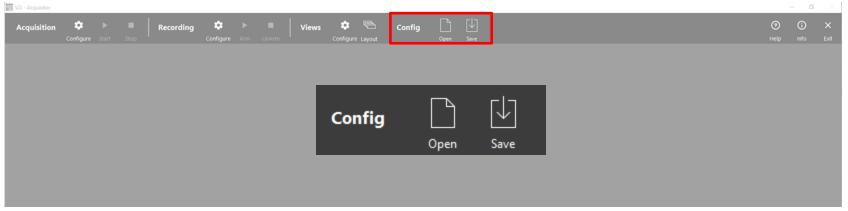
# Config

- The config menu bar includes two controls
  - **Open:** opens a file dialog to select a xml file containing the configuration to load. The acquisition and recording configurations are then loaded in the software, the corresponding editors are opened and the configurations submitted.
  - **Save:** opens a file dialog to select a xml file in which to save the configuration



- Each time the acquisition or recording configuration is submitted, a temporary file is created in the folder %temp%\acquisitor
- When the software is launched, you can click on "Load the last config used" to load the last temporary config file saved

# Temporal – Processing configuration
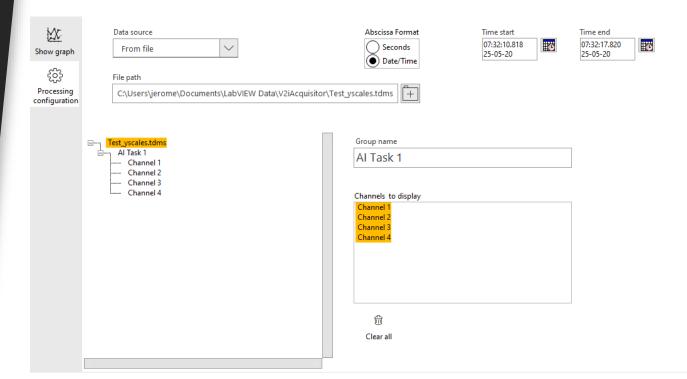
- Configure the acquired channels ('From acquisition') or recorded channels ('From file')
  - To choose the channels to display, select their names (or the task name) on the tree and drag and drop it in the 'Channels to display' list
  - To delete channels, select them on the 'Channels to display' list, right click and select 'Delete'
  - You can also delete all channels by clicking on 'Clear all'
  - The maximum number of channels is eight
  - You can change the period between the data updating by choosing the 'refresh period'
  - Two abscissa format options are available
    - Seconds : relative time, with 0 corresponding to when you selected the channels or when the acquisition was started, whichever is the more recent
    - Date/Time : absolute time
  - In 'From file' mode, you can also select the file path and the time start and time end
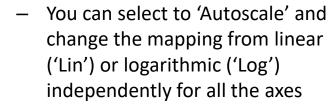
# Temporal – Show graph

- Displays the data
  – There are four Y scales available. If there are multiple units, the software will choose automatically the Y scales. If you want to change, click on the legend curve and select the Y scale
  – In 'From acquisition' mode, you can click on ⏸ to pause the data refreshing
  – The abscissa format defined in the processing configuration tab can be changed  ('X scale')
  – You can select to 'Autoscale' and change the mapping from linear ('Lin') or logarithmic ('Log') independently for all the axes
  – You can display a cursor ('Cursor') and attach it to a curve ('Curve selection')
  – You can export data in multiple formats

Right click menu

# Temporal – Indicators computation

- The indicators are computed in 'From file' mode when the data are displayed and in 'From acquisition' mode when in pause. To select the indicators,

  | Indicators ▶ | ✓ Mean |
  | --- | --- |
  | | ✓ RMS |
  | | ✓ Peak |
  | | Crest factor |
  | | Standard deviation |
  | | Skewness |
  | | Kurtosis |

  - The indicators are computed in one-pass parallel computation
  - For each $x$ in the data,

$$\delta = x - M_1$$

$$M_1 = M_1 + \frac{\delta}{n}$$

$$M_4 = M_4 + \delta^4 \frac{(n-1)(n^2 - 3n + 3)}{n^3} + 6 \frac{\delta^2}{n^2} M_2 - 4 \frac{\delta}{n} M_3$$

$$M_3 = M_3 + \delta^3 \frac{(n-1)(n-2)}{n^2} - \frac{3\delta M_2}{n}$$

$$M_2 = M_2 + \delta^2 \frac{n-1}{n}$$

  - And

$$Mean = M_1$$

$$Standard\ deviation = \sqrt{\frac{M_2}{n-1}}$$

$$Skewness = \sqrt{n} \frac{M_3}{M_2^{1.5}}$$
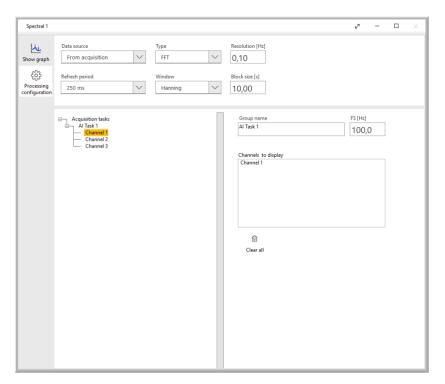
$$Kurtosis = n \frac{M_4}{M_2^2}$$

# Spectral – Channel Configuration

- Configure the acquired channels ('From acquisition') or recorded channels ('From file')
  - To choose the channels to display, select their names (or the task name) on the tree and drag and drop it in the 'Channels to display' list
  - To delete channels, select them on the 'Channels to display' list, right click and select 'Delete'
  - You can also delete all channels by clicking on 'Clear all'
  - The maximum number of channels is eight
  - You can change the period between the data updating by choosing the 'refresh period'
  - In 'From file' mode, you can also select the file path and the time start and time end
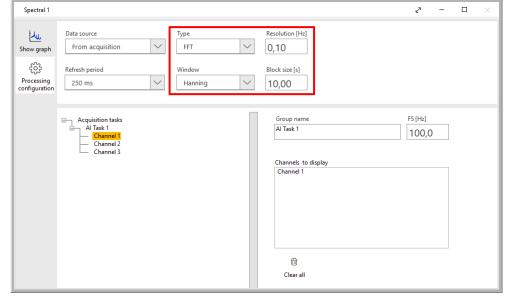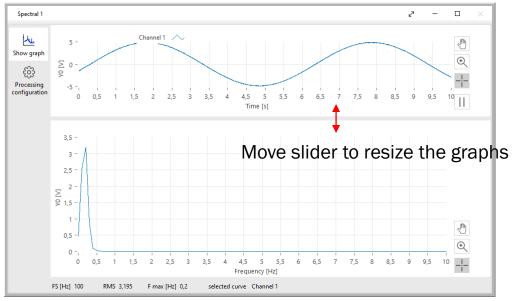
# Spectral – From Acquisition

- The following parameters are available in 'From Acquisition' mode:
  - **Type**: Selects the spectral analysis to perform (**FFT** (Fourier Transform), **PSD** (Power Spectral Density))
  - **Window**: Selects the window to apply to each block
  - **Resolution**: The frequency resolution of the spectrum
  - **Block size**: The buffer size used to compute the FFT
- The Graph window displays:
  - The signal currently in the buffer (top)
  - The spectrum of the signal (bottom)

  The graphs options are mostly identical to those of the temporal module



Move slider to resize the graphs

# Spectral – From File

- The following parameters are available in 'From File' mode:
  - The **Time start/end** and **abscissa format** are identical to those of the temporal module
  - **Type**: Selects the type of spectral analysis to perform (FFT or PSD)
  - **Window**: Selects the window to apply to each block

The spectrum is computed as follows:

> **N Avg** spectra are computed from blocks of duration **Block Size**, which can be **overlapping** or not. The spectra are averaged using the **Avg. Mode** method. The total duration of the signal used to compute the spectra is given in **Duration**. The frequency resolution of the resulting spectrum is given by **Resolution**.
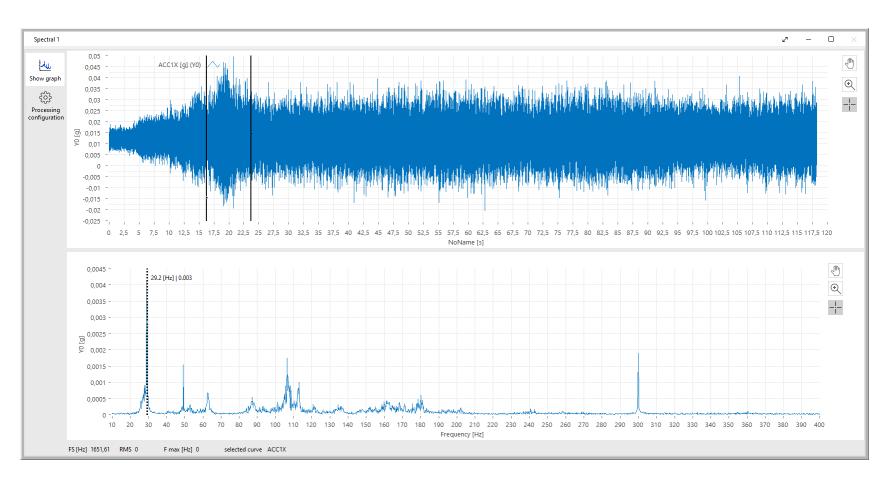
# Spectral – From File

- The graph window of the "From file" mode is similar to that of the "From acquisition" mode
  - In this case, the whole imported signal is displayed in the top figure
  - The spectrum is computed on the signal between the cursors, which can be moved
  - Most of the plot options are identical to those of the Temporal Post-Processing
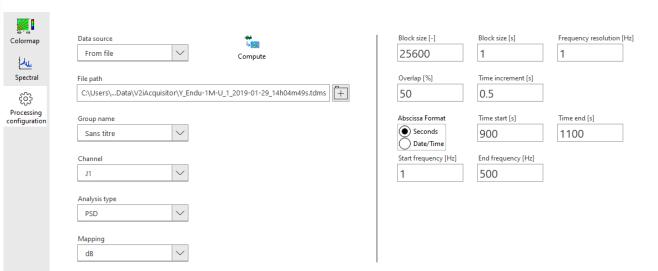
# Waterfall – Processing configuration
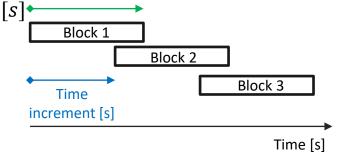
- Configure the acquired channels ('From acquisition') or recorded channels ('From file')

  - Analysis type: 'PSD' (*Power Spectral Density*), 'Power Spectrum' or 'FFT' (*Fast Fourier Transform*)

  - Mapping: 'Linear', 'Logarithmic' or 'dB' – decides which mapping to use for the Z-scale (the color)

  - 'Block size [-]' (number of points), 'Block size [s]' and 'Frequency resolution [Hz]' are correlated; they represent the size of the temporal block used for the computation

  - 'Overlap [%]' and 'Time increment [s]' are correlated; they represent the duration between each block start time

$$overlap\ [\%] = 100\left(1 - \frac{Time\ increment}{Block\ size}\right)$$

$$Frequency\ resolution\ [Hz] = \frac{1}{Block\ size\ [s]}$$
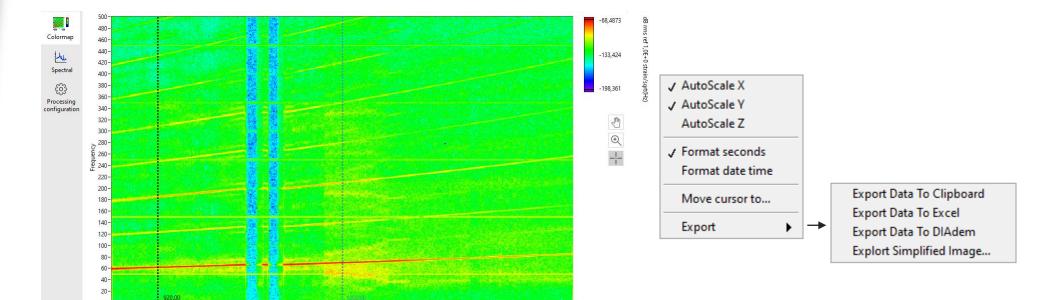


- You can select the start and end frequency of the spectra to be computed

- In 'From file' mode, you can choose the time history portion to analyze by selecting the time start and the time end

# Waterfall – Colormap

- Displays the colormap
  - You can move the cursor either by drag&drop or by right-click -> 'Move cursor to…'; this cursor marks the start position of the block used to compute the spectrum visible in the 'Spectral' tab
  - As in the Temporal module, you can choose to autoscale, you can select 'seconds' or 'date time' as abscissa format and you can export the data

  - If you double-click on the top (or bottom) tick of the color scale, you can customize the maximum (or minimum) value of the scale; all the values over the maximum will be red and all the values under the minimum will be purple
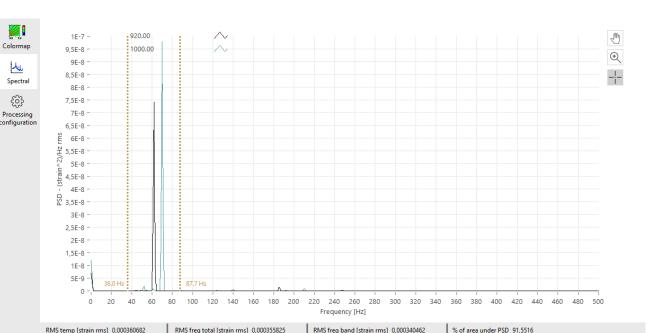
# Waterfall – Spectral

- Displays the selected spectrum
  - The two spectra are computed from the temporal block starting at the positions marked by the cursors in the colormap tab and indicated on the legend
  - You can select to autoscale and the mapping ('Lin' or 'Log') in the right-click menu

- The 'RMS temp' is the Root Mean Square computed on the temporal block
- The 'RMS freq total', only available on a PSD, is the square root of the area under the PSD and should be equivalent to 'RMS temp'
- The 'RMS freq band', only available on a PSD, is the square root of the area under the PSD delimited by the two cursors
- The '% of area under PSD', only available on a PSD, is the ratio, in %, of the area delimited by the two cursors and the total area

# Use case "Data acquisition"

This example provides a step-by-step procedure for the acquisition configuration from a triaxial accelerometer and a strain gage (with a simulated or a real chassis)

- With NI MAX (or use a real NI-chassis):
    - Creation of a simulated data acquisition device
- With V2i's Acquisitor:
    - Channels (sensors) configuration
    - Recording configuration
    - Live-time temporal view of acquired signals

The final configuration is saved in a .XML configuration file, provided in the tutorial files

# Use case "Data acquisition" – Simulated devices and signals
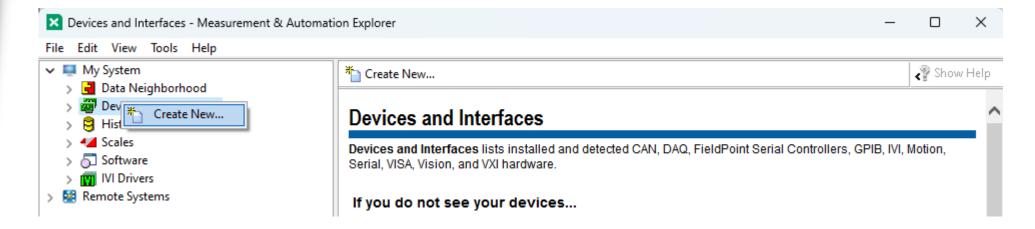
1) Open NI MAX and *Create New* in *Devices and Interfaces*
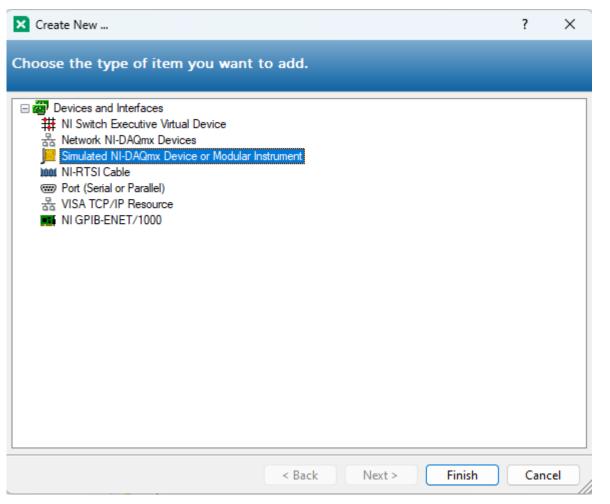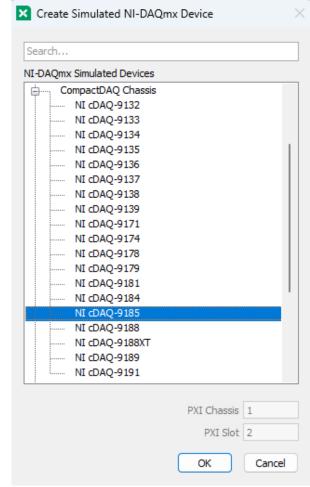
2) Click on *Simulated NI-DAQmx Device* and choose a type of chassis, NI cDAQ-9185 for example
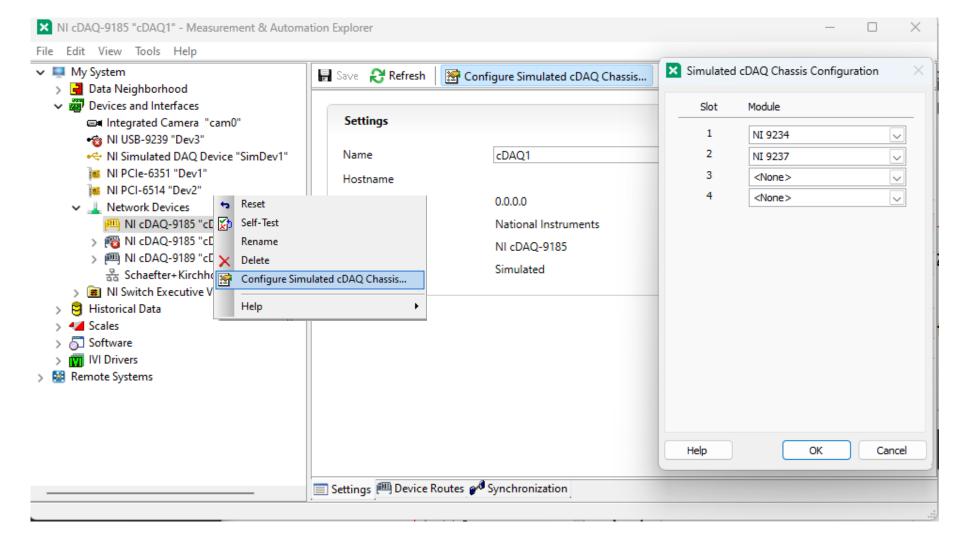
3) Click on *Configure Simulated cDAQ Chassis* and choose a type of module, for example a NI 9234 for the triaxial accelerometer and a NI 9237 for the strain gauge, they will appear similarly to real NI DAQ under *Network Devices*
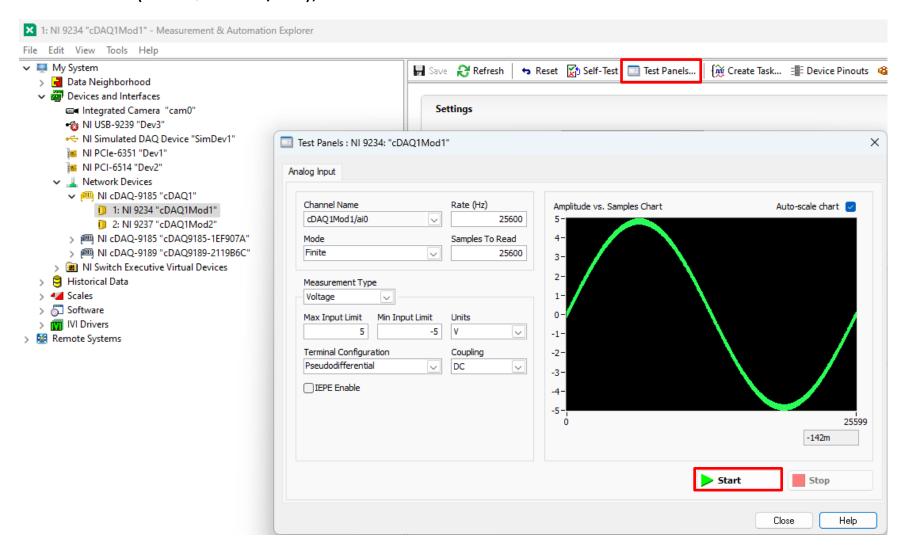
# Use case "Data acquisition" – Simulated devices and signals

3) By selecting a NI module, you can check on *Test Panels* the generated signal. For example, on the NI 9234 (cDAQ1Mod1/ai0), a sinusoid between –5 et +5 V with 3% noise.
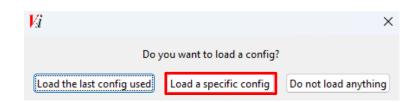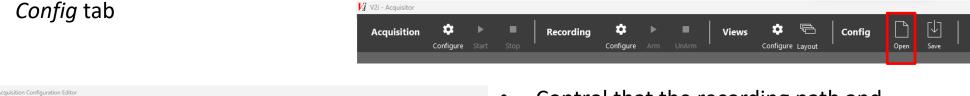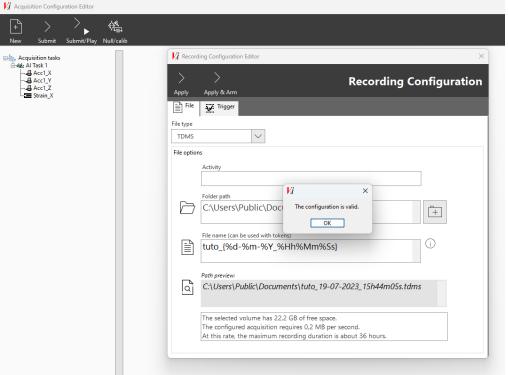
# Use case "Data acquisition" – File loading

4*) Open V2i's Acquisitor, <u>if you have a previous .XML configuration file</u> (available in tutorial files in the subfolder "data" of the installation folder) you can load the Acquisition and Recording configuration from the popup windows (*Load a specific config*) or *Open* on the *Config* tab

- Control that the recording path and parameters are correctly set
- Control that the configuration is valid (in green) and *Submit* and *Apply* any change in the configuration)

- Go to step 9 to show real-time temporal signals
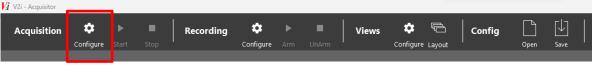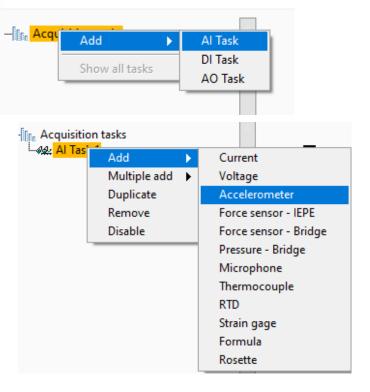
# Use case "Data acquisition" – Acquisition

4) For a manual configuration (with configuration file creation), click on *Configure* under *Acquisition*
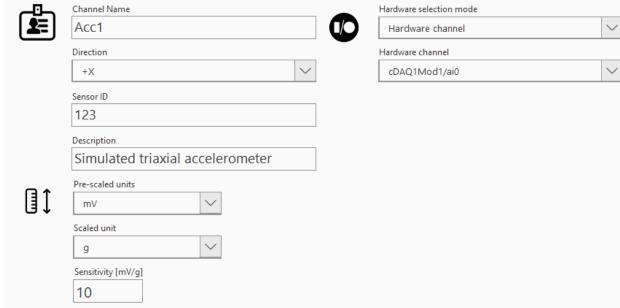


First, *Add > AI Task*, then *Add > Accelerometer.*



Fill the accelerometer parameters:

*Direction = +X, Sensor ID = 123, Description, Sensitivity = 10 mV/g* and *Hardware channel = cDAQ1Mod1/ai0* (first channel in first module of the simulated DAQ)
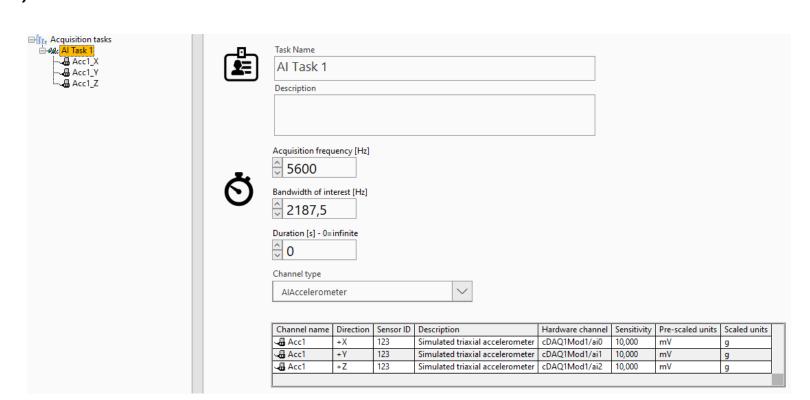
# Use case "Data acquisition" – Acquisition

5) *Make triaxial* the accelerometer *Acc1_X* to create *Acc1_Y* and *Acc1_Z* with updated parameters. Control that the directions and channels are well updated for them :

- *Direction +Y* and *Hardware channel = cDAQ1Mod1/ai1*

- *Direction +Z* and *Hardware channel = cDAQ1Mod1/ai2*

On *AI Task 1*, all channels are summarized with hardware, direction, units. Choose *Acquisition frequency = 5600 Hz.*





| Channel name | Direction | Sensor ID | Description | Hardware channel | Sensitivity | Pre-scaled units | Scaled units |
|---|---|---|---|---|---|---|---|
| Acc1 | +X | 123 | Simulated triaxial accelerometer | cDAQ1Mod1/ai0 | 10,000 | mV | g |
| Acc1 | +Y | 123 | Simulated triaxial accelerometer | cDAQ1Mod1/ai1 | 10,000 | mV | g |
| Acc1 | +Z | 123 | Simulated triaxial accelerometer | cDAQ1Mod1/ai2 | 10,000 | mV | g |

# Use case "Data acquisition" – Acquisition

6) *Add* a *Strain gage* on the *AI Task* and select the following parameters (same as simulated signal in NI MAX):

- *Gage resistance = 350 ohm* and *Gage factor = 2*

- *Hardware channel = cDAQ1Mod2/ai0* (first channel of second module of the simulated DAQ)

# Use case "Data acquisition" – Acquisition

7) The configuration is complete. Control you have those final parameters and *Submit*.

A popup window for valid configuration should appear and the bottom tabs going green.
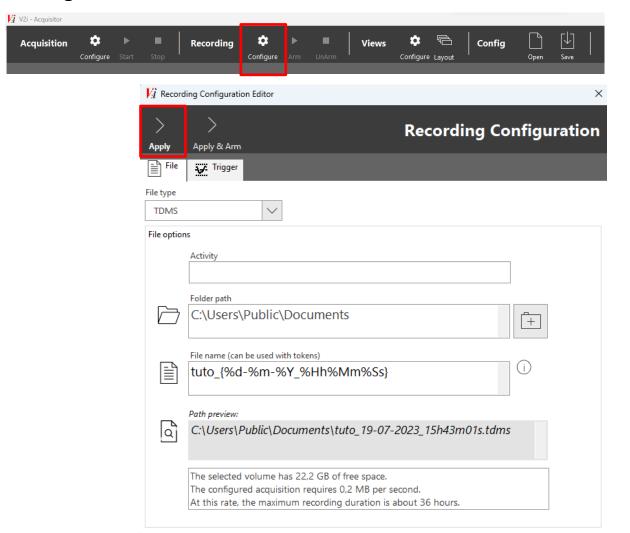
# Use case "Data acquisition" – Recording

8) Now, *Configure* under *Recording*, and choose the folder path and file name for TDMS data (using date time automatic format), then *Apply* and a popup window will apply the configuration.

# Use case "Data acquisition" – Temporal view

9) To show the acquired data in a live temporal view, *Configure* under *View* and *New instance* of *Temporal*. To quit a selected window, select *Module > Stop* and *Stop all* to quit all windows.

# Use case "Data acquisition" – Temporal view
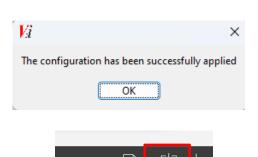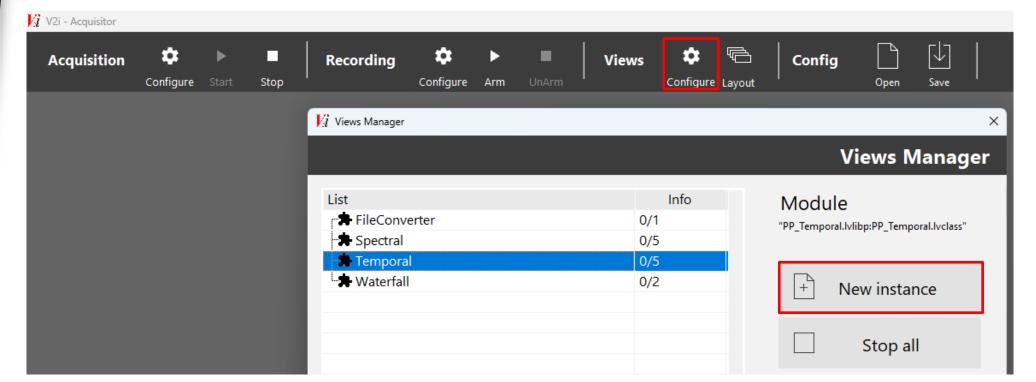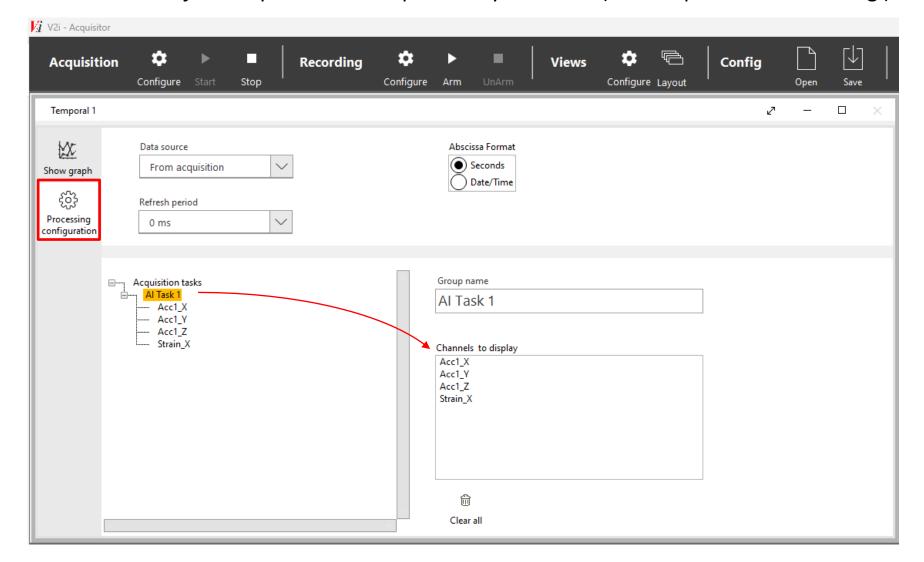
10) In *Processing configuration* of *Temporal*, choose *Data source = From acquisition* to show data in live or *From file* to open TDMS file previously recorded (see Chap 3. Post-Processing ).

# Use case "Data acquisition" – Temporal view
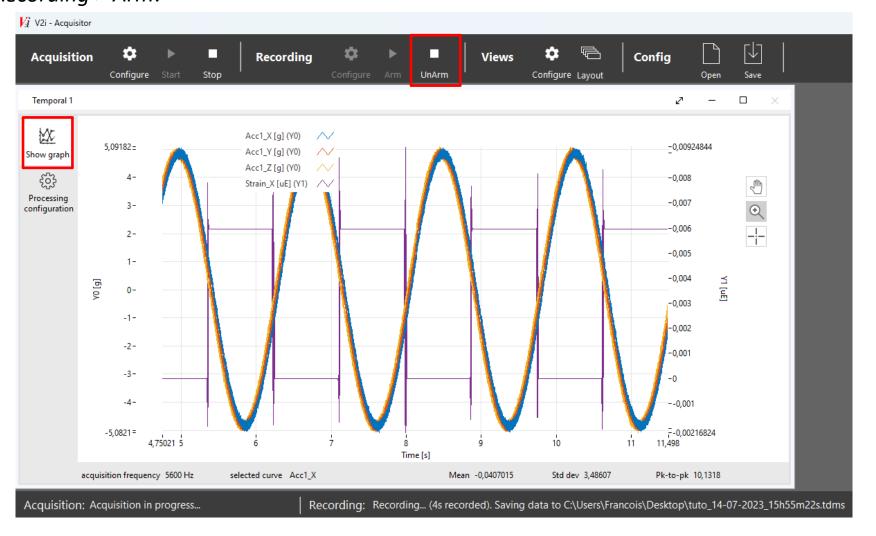
11) In *Show graph* of *Temporal*, temporal graphs are shown in live if *Data source = From acquisition*. To start saving measured data with previously selected settings (step 12), select *Recording > Arm*.

# Use case "Processing"
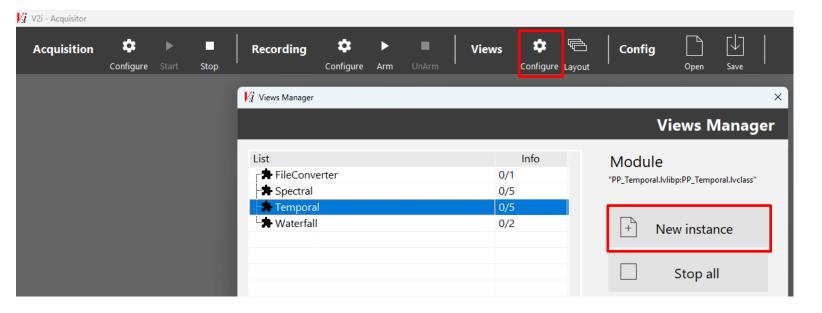
This chapter presents an example of post-processing procedure of previously measured data in .TDMS format. The four modules presented here can be accessed using the "View" window
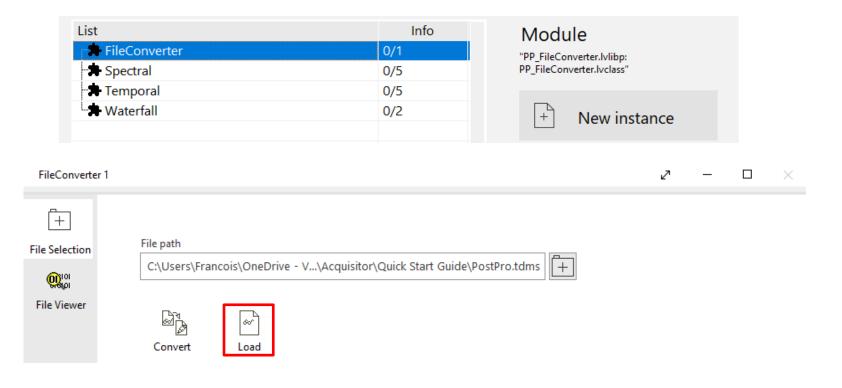


The file "PostPro.tdms" located in the subfolder "data" of the installation folder is used for this example. It contains measurements of a tri-axis accelerometer performed on a rotating machine at 3300 RPM (orbital welding).

# Use case "Processing" – File Converter
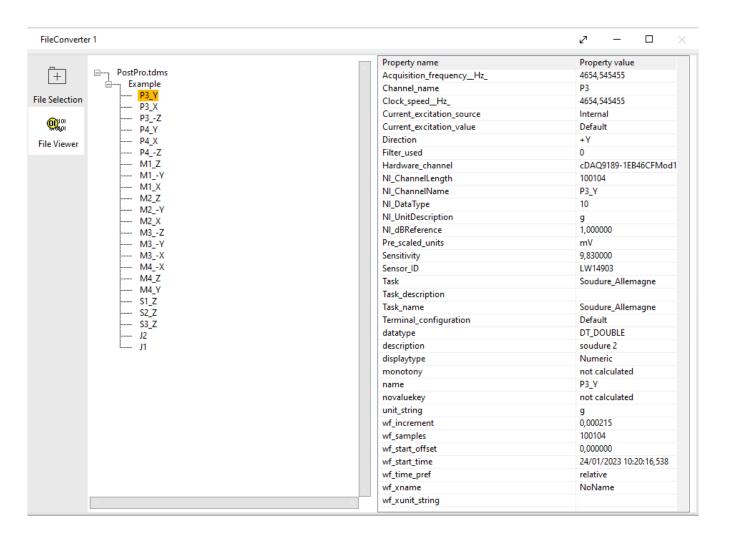
1) To explore file metadata (acquisition frequency, sensors description, sensitivity etc), open a *FileConverter* window in *Views > Configure*. Select the .TDMS file in *File Selection* and *Load* it. For this tutorial, open PostPro.tdms

# Use case "Processing" – File Converter
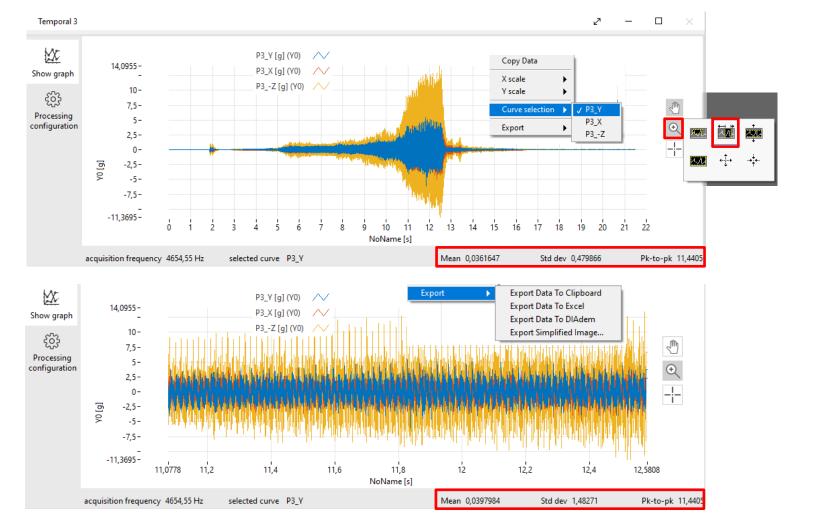
2) All metadata for each sensors are then available in the *File Viewer*, under the task *Example*.

# Use case "Processing" – Temporal
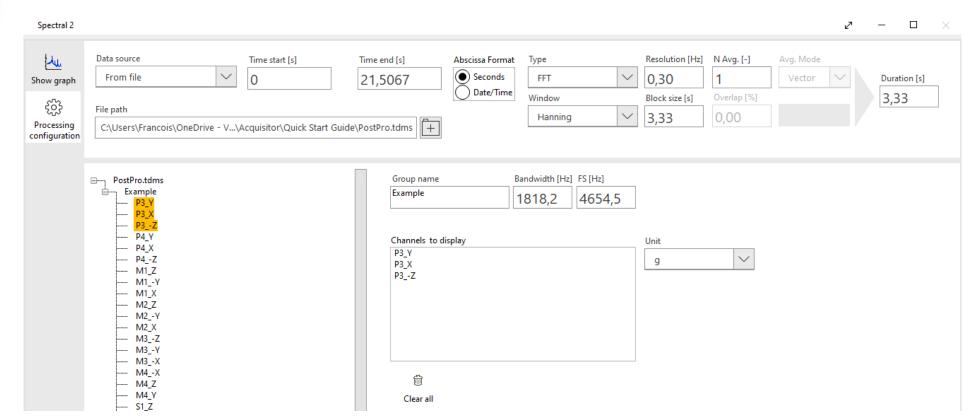
3) To show temporal graphs, apply the procedure of steps 13 to 15 of Chapter 2. Information and statistics are given in the bottom tab (mean, standard deviation etc) and a window of interest can be selected with zoom tool. Statistics will update for the selected window, and selected curve (right click on the graph). Data can also be saved in several format using *Export*.

# Use case "Processing" – Spectral

4) For frequency analysis, create a *Spectral* window in *Views*.

- In *Processing configuration* select the *Channels to display*.

- Choose spectral settings (time start-end, type of frequency representation, windowing, resolution, averaging)

- Resolution and block size automatically adapt when modifying each other and, with N averaging, give automatically the duration (in [s]) for which the spectrum is computed.
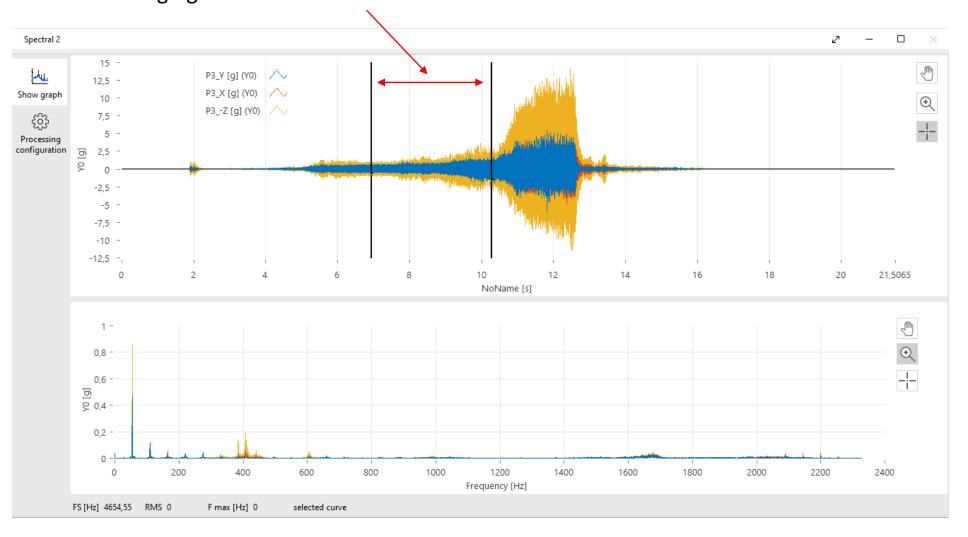
# Use case "Processing" – Spectral
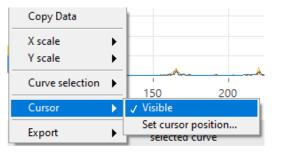
5) In *Show graph*, both temporal and spectral graphs are shown, with the spectrum updating when changing the window interval.
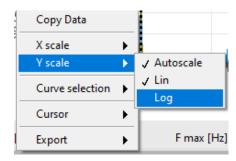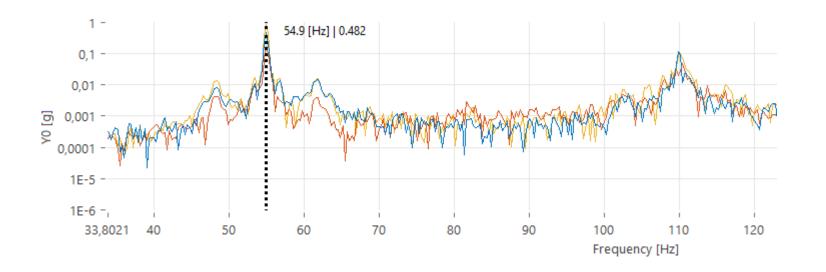
# Use case "Processing" – Spectral

6) To quickly dentify the first natural frequency, right click on the spectral graph and make a *Cursor > Visible* and show *Y scale* in *Log* scale.
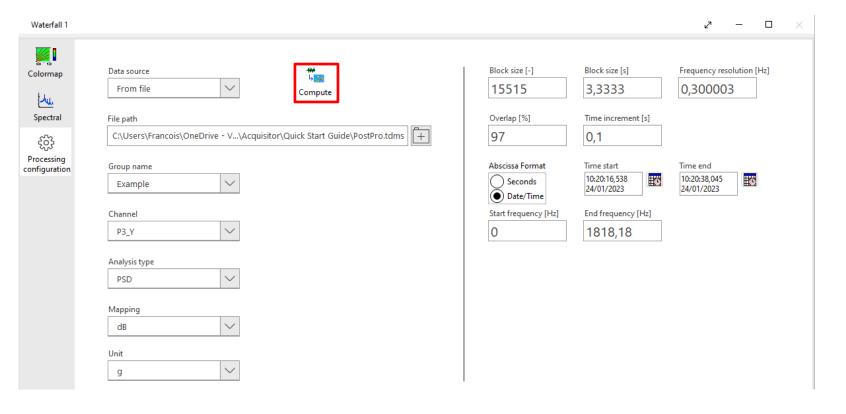
# Use case "Processing" – Waterfall

7) To show the instantaneous frequency content, choose a *Waterfall Window*. It is useful to study the temporal variation of the spectrum and identify intervals of different frequency behavior.

Choose Waterfall settings : analysis type, frequency resolution (or block size), time increment (instantaneous) and select *Compute.*
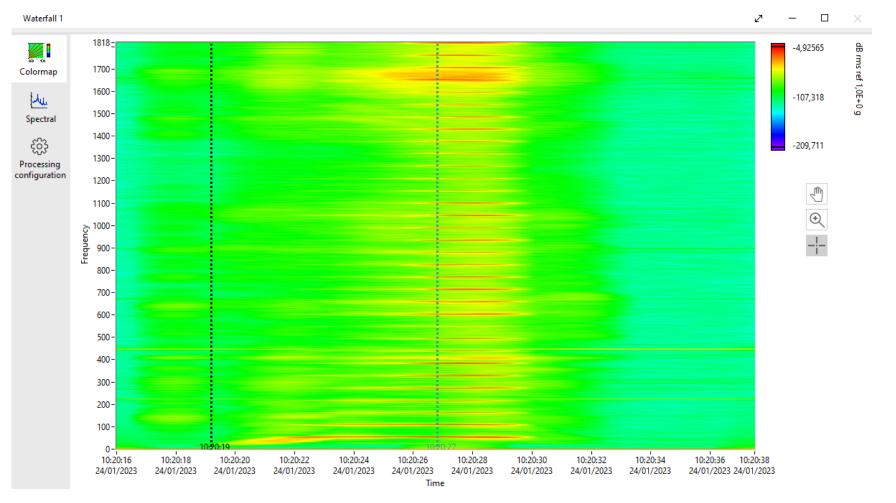
# Use case "Processing" – Waterfall

8) The obtained figure is shown in *Colormap*, as a time-frequency 2D color graph. In this case, horizontal lines in red are present at harmonics of 55 Hz (turning machine data) when vibrations are high (see the graph at step 3). Two cursors can be moved to show spectra at these time stamps (cuts in the Waterfall diagram) in *Spectral* tab.

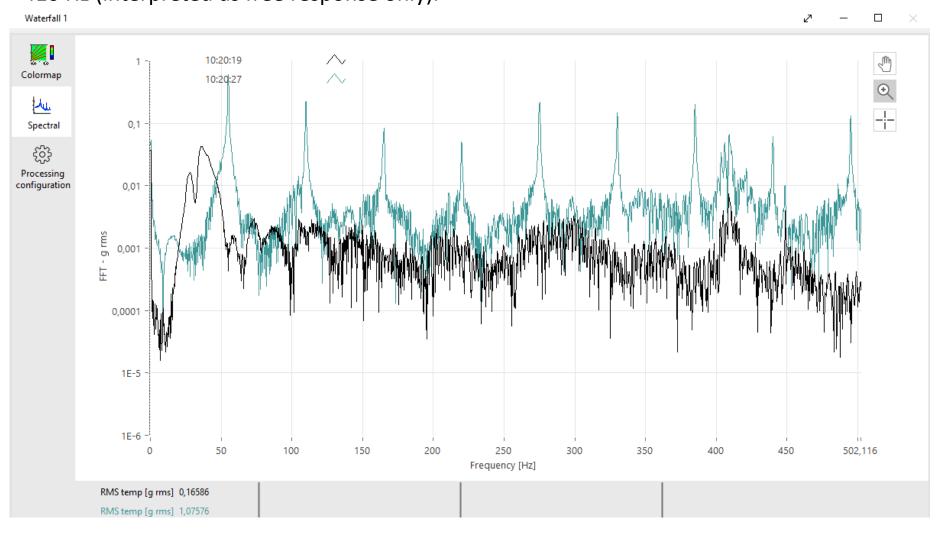# Use case "Processing" – Waterfall

9) The spectra corresponding to the selected time stamps are shown below. The blue line showing harmonics at 55 Hz (rotation phase) and the black line presenting a mode around 410 Hz (interpreted as free response only).

# Thank you!

Tel: +32 4 287 10 70

Website: www.v2i.be
Email : support@v2i.be