DYNAMate – User Manual

Specifications

Operation Limits

Parameter	Value	Units
Maximum Voltage		
Trigger	5000	Volts
Sensor Input	150	
DC Input	36	
USB	10	
Temperature Range	-10 to +70	°C

Power Requirements

Parameter	Value	Units
DC Input Voltage	9-36	Volts
Current Consumption	450	mA

Data Acquisition

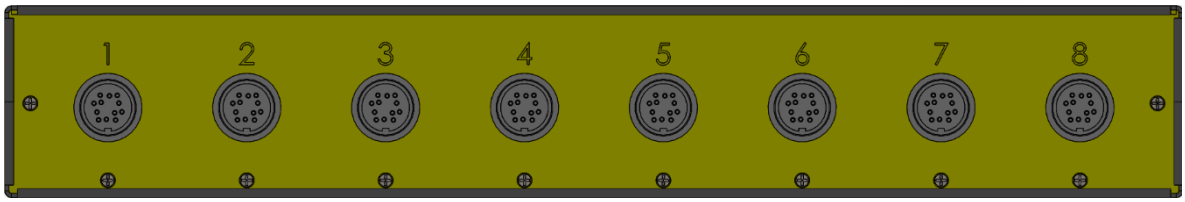
Parameter	Value	Units
Resolution	16	bit
Sample Rate	4000 downsampled to 1000	Hz
Conversion Time	4	µs
Analog Bandwidth	250	Hz
CMRR, DC to 60 Hz	100	dB
Gain Error	115	ppm
SNR	75	dB
Crosstalk	-65	dB

Filters and Amplification

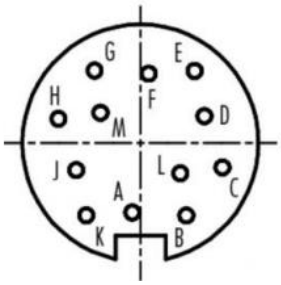
Parameter	Value	Units
Filter Bank – low-pass	32, 64, 128	Hz
Roll-off	80	dB/dec
High-pass	0.01	Hz
Roll-off	40	dB/dec
Input Amplifier		
Gain	x5, x50	
Output Amplifier		
Gain	x1, x10, x100, x1000	
Calibrated Sensitivity Scales	100, 10, 1, 0.1, 0.01	mm/s

Inputs and Operation

Back Panel

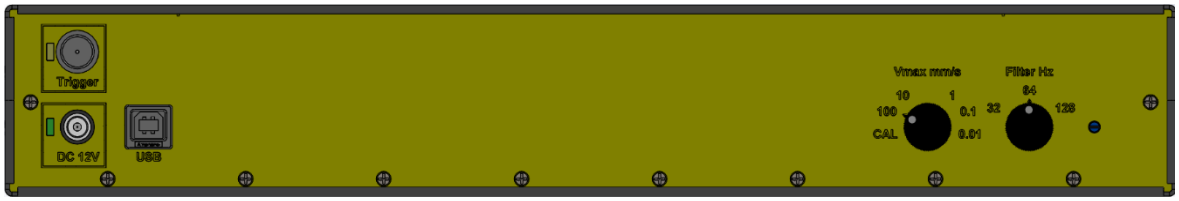


The back panel contains the input ports for attaching the provided sensors. The ports are numbered form 1-8 and correspond to the panels in the data logging software. All sensor ports, sensors and corresponding cables use polarized connectors to ensure proper mating. Every port has 20kOhm input resistance and has the following pinout:



Pin	Signal
A	Z-
B	X+
C	X-
D	Y+
E	Y-
F	N\C
G	CAL+
H	Cal-
J	N\C
K	Z+
L	N\C
M	N\C

Front Panel



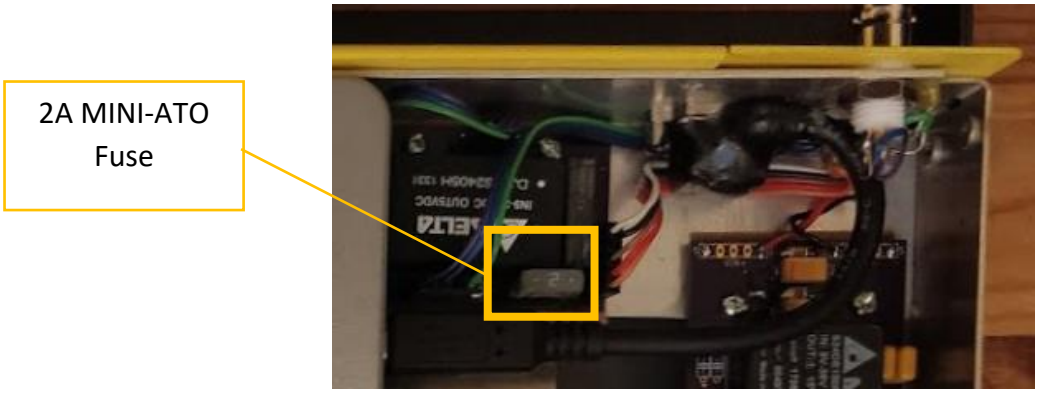
The front panel contains the data, power supply and control interfaces of the data acquisition unit. The two knobs on the right side of the panel control the currently selected amplification and filter cutoff. The amplification controls the maximum recordable velocity before clipping occurs, and it supports 100, 10, 1, 0.1 and 0.01 mm/s with the provided sensors. The CAL setting of the amplification knob enables the internal calibration pulse generator which is used to verify sensor function. Calibration constants will vary if sensors different from the provided are used.

On the left side of the panel are the data and power interface ports. Computer connection is achieved using the USB 2.0 port, which also powers the internal ADC. Amplifiers and filters are powered by the DC 12V plug (5.5mm/2.55mm barrel connector). The nominal power supply voltage is 12V, however the system can support a supply voltage between 9 and 36V. A red/green LED is provided beside the power supply port that monitors the polarity of the provided power supply, it will illuminate green when the power supply meets requirements, and red otherwise.

The trigger input is a 75ohm coaxial BNC connector, and should be used with matching coaxial cable. It is internally isolated from the rest of the circuitry for up to 5kV. While external power is connected to the unit, and the trigger input is not connected to an external trigger, the center pin of the coax is kept at 5V DC through an internal pull up resistor, while the bayonet is at 0V. Triggering condition occurs when the two pins are shorted and 0V appears on the center pin of the connector (with respect to the connector sleeve).

Fuse Location

In case of a short or overcurrent through the power supply unit, the internal protective fuse will blow to preserve the electronics. The fuse is MINI-ATO 2A rated auto fuse and is located behind the power supply port. To replace the fuse the top lid should be removed by removing the 8 screws (4 on each side of the lid) and the fuse replaced. The following picture shows the location of the fuse:

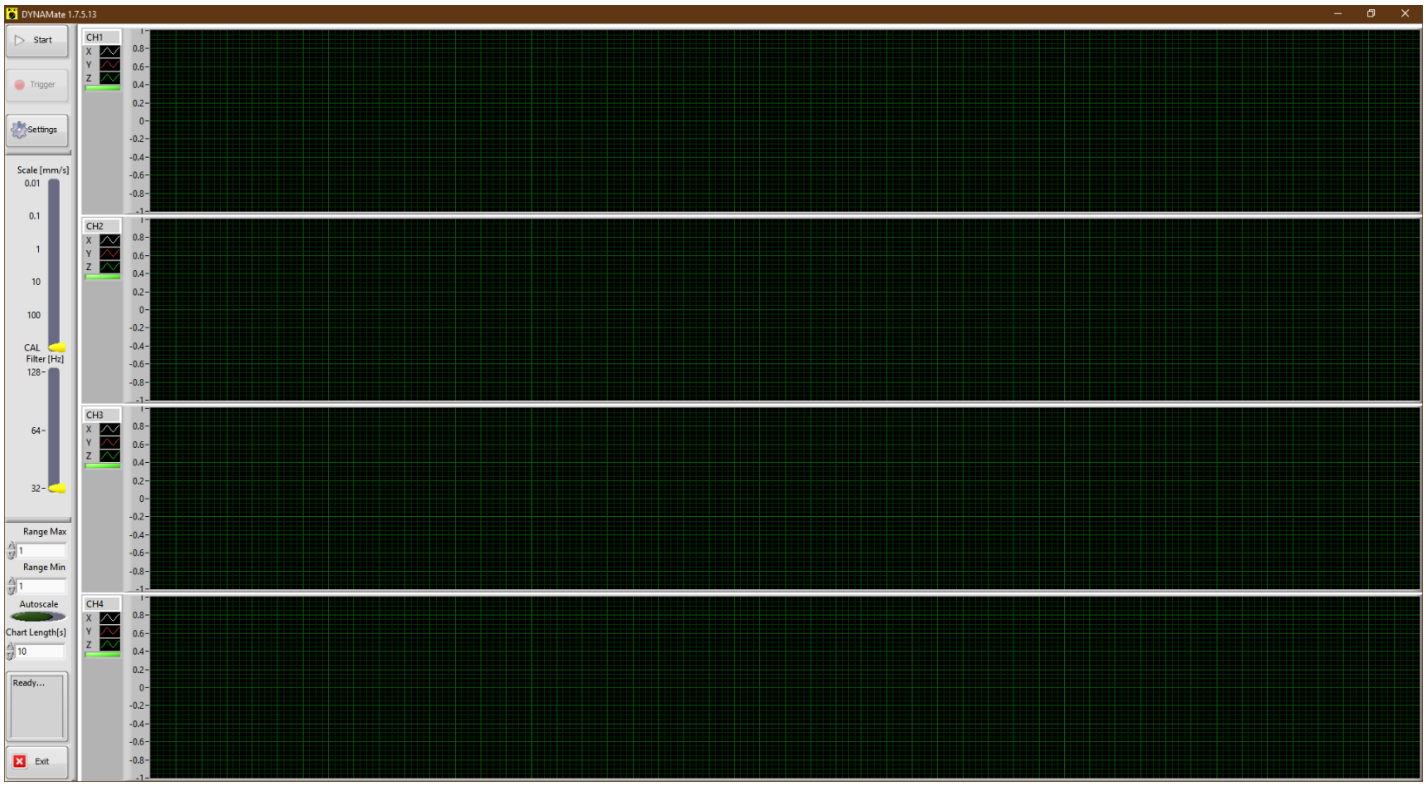


Sensor installation

The kit contains two types of sensor platforms. A short option that fits between the legs of the sensor, and a long option that is larger than the footprint of the sensor. Selection of which platform is be used is depended on the intended application, and available mounting surface. To properly install the sensor unit, the mounting surface (concrete, metal or wood) should be cleaned of all debris and grease. Using the provided leveling gauge, the platform should then be placed on the surface, and using shims it must be leveled. Using fast setting epoxy (or other suitable adhesive) the platform and shims should then be secured in place, by thoroughly covering the bottom of the platform with adhesive and then proper time should be given for the adhesive to set. Once the platform is secured the sensor is mounted on top using the provided brackets, screws and foam insulators.

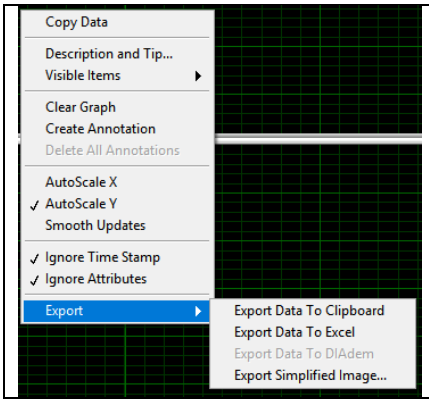
User Interface

Main UI Window

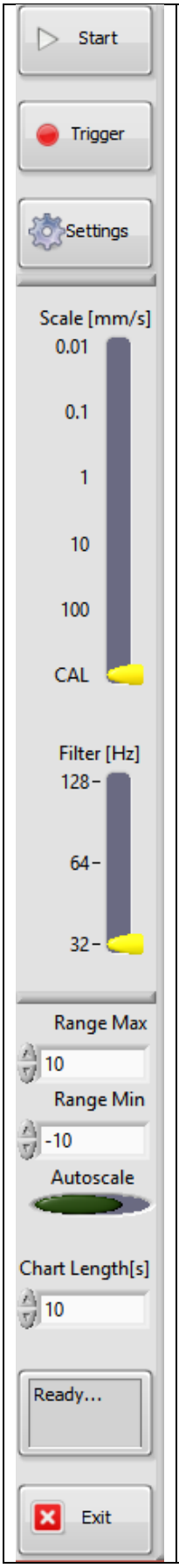


The user interface consists of a control panel situated on the left-hand side of the screen and signal monitoring panels for active channels in the middle of the screen.

The Channel legend present for each active channel displays: configured Channel Name(top), Component legend(middle) and clipping indicator(bottom). Active channels are configured using the setting menu. The clipping indicator will turn red for signal sections that exceed the selected amplification scale.

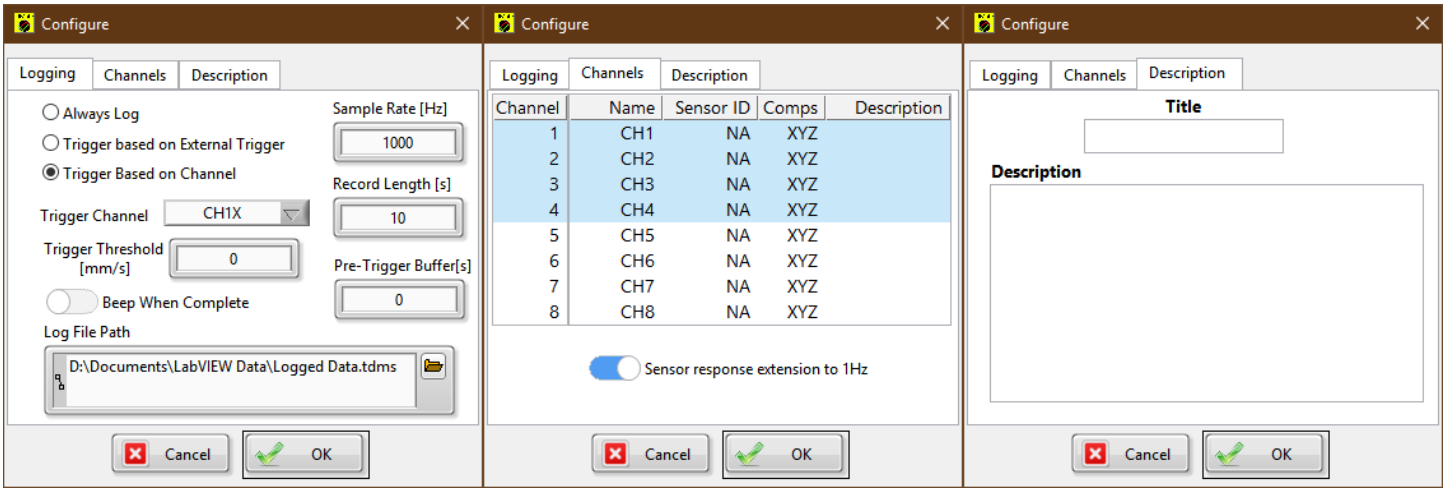


By default, the chart displays will fill out right to left with new samples entering from the right. Under the right click context menu, auto scales can be toggled individually for each channel, and for either axis: amplitude or time. The charts can be cleared and annotated using the context menu as well. It also allows the data of that specific chart to be copied to the clipboard in ascii format.



Start/Stop button	All controls are disabled until the Start button is pressed. Pressing the button will begin data collection and visualization but will not start logging until a trigger condition is met. Once the system is running the Start button will toggle to the Stop button, which terminates the current acquisition task and disables other controls.
Force Trigger	The trigger button forces a trigger condition regardless of the current trigger mode. Pressing the button will begin data logging based on the last setting configured in the settings menu.
Settings button	Logging configuration can be modified through the Settings window (see next Section)
Currently selected amplification scale in mm/s	The current hardware setup is displayed in the two bar controls, which are read-only, as those settings can only be changed using the knobs provided on the DAQ unit.
	The displayed chart amplitude will scale according to the currently selected amplification, and it will always be displayed in mm/s.
Currently selected filter	Any change to the max/min amplitude controls will affect all chart displays at the same time and disable autoscaling for all charts. If it is required, scales can be set individually for each chart by clicking the number displayed on the corresponding axis and entering the required values. Autoscaling can be either set individually for each chart by right clicking the chart or the amplitude scale, and then selecting the auto scale option, or at the same time for all charts by clicking the autoscale control.
	The length of data displayed at a time can be adjusted for all charts at the same time by using the chart Length control.
Max amplitude	The status display will show the current state of the unit, as well as potential error messages relevant to the operation of the unit.
Min amplitude	The application can be closed by clicking the exit button, which will be terminating the current acquisition session, and close any open logging files.
Toggle Auto scale For all charts	
Chart duration	
Status Display	
Close the application	

Configuration Window



Logging Configuration

This page allows the configuration of acquisition, triggering and logging parameters.

Configurable parameters are: Sample Rate (max 1000 Hz), Record length, Pre-trigger buffer size. The pre-trigger buffer will store up to the specified number of seconds of data and store it in the output file at offset time stamp, i.e. for a 10sec record with 2s pre-trigger the final file will begin at time -2s and be 12s long (end at 10s).

The pane also allows the user to set logging parameters data logging path and file name, triggering condition. All logged data is saved in TDMS format. It can be opened in Microsoft Excel, using the provided plugin or post-processed using DynaMateProcess.

Four different triggering options are supported:

1. Always Log – As soon as the start button is pressed all data will be recorded to the specified file
2. External Trigger – Logging will start based on the external trigger
3. Based on channel - By specifying a channel number and a threshold, logging will begin as soon as the given channel crosses the specified threshold. Channels available for triggering must be selected as active channels in the Channels pane
4. Forced Trigger – When in either External Trigger or Channel trigger, pressing the Trigger button on the Main UI will start the logging process, bypassing any trigger requirements.

Each time a trigger condition occurs, a new filename is created using the provided filename, by concatenating the filename with the timestamp of file creation. Each file will contain a maximum number of samples determined by the specified Record length. If the Beep when complete switch is set, then at the end of each record DynaMate will play the system notification sound to alert the operator to the end of recording event.

Channel Configuration

The channel configuration pane allows the user to select which channels are considered active. This is done by selecting multiple lines in the provided table, by either holding Shift or Ctrl while clicking on the lines. To edit channel description, name, etc. use double click in the appropriate cell. Sensor IDs(number displayed on the actual sensor) should be specified correctly for response expansion to work accurately.

If the sensor response extension is enabled, then DynaMate will visualize and log data that has undergone digital response expansion to 1Hz, if it is not enabled the sensor response starts from 4.5Hz.

DYNAMate Process v1.91

User Manual

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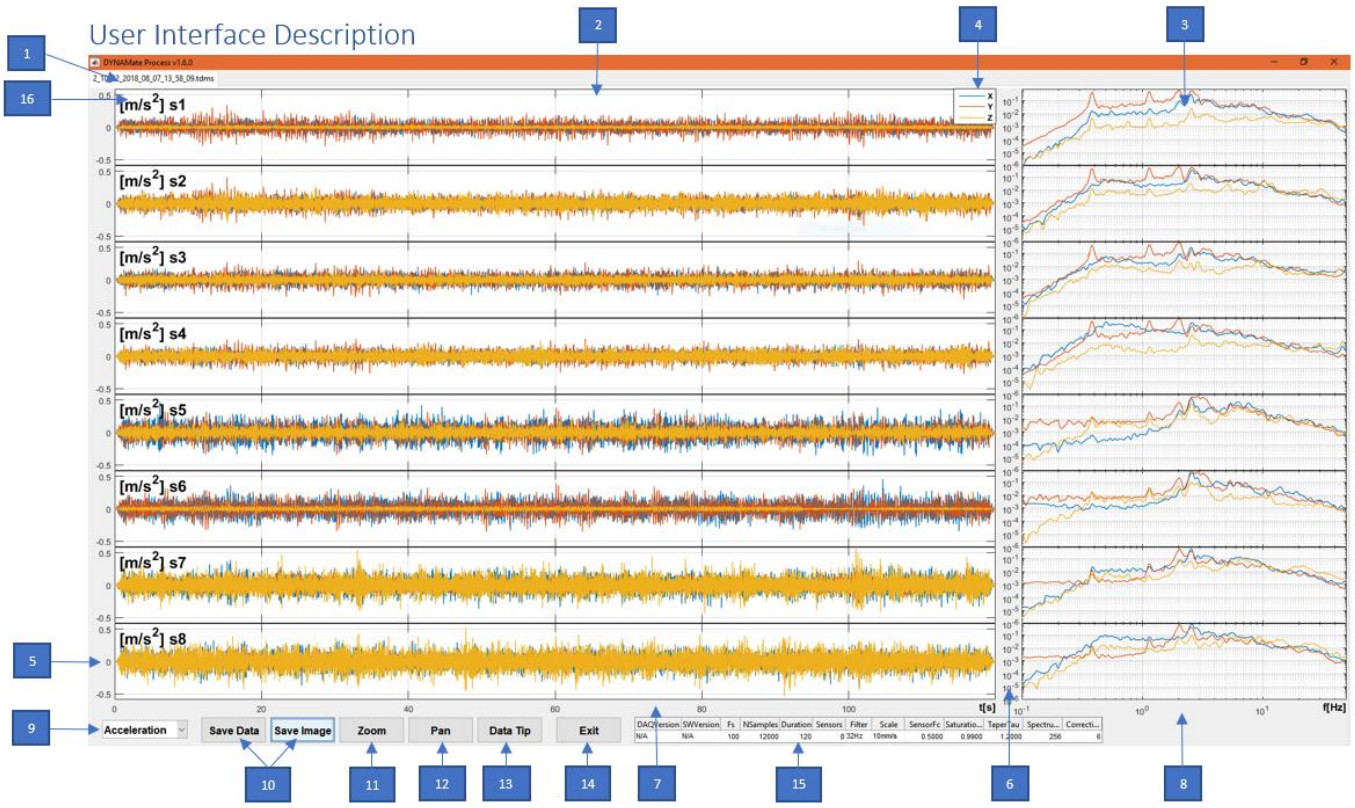
Contents

Description

DYNAMate Process is a helper Graphical User Interface used to process the data outputted from the DYNAMate DAQ System. It allows the user to process and investigate TDMS files and includes the following features:

- Visualize the recorded data
- Extend the sensors' frequency range down to 0.5Hz
- Produce a smoothed amplitude spectrum
- Interactively investigate events in the data using the Zoom and Pan tools provided
- Annotate the data and its spectrum using the Data Tips tool
- Generate Displacement and Acceleration waveforms from the recorded Velocity data
- Produce PNG images of the data including all annotations
- Save All generated waveforms and spectra as an Excel xlsx file



1	Tab control with open files	9	Acceleration/Velocity/Displacement selector
2	Time waveform graphs, one channel per row	10	Save Buttons
3	Frequency graphs, one channel per row	11	Zoom button (hold SHIFT to zoom out)
4	Legend	12	Pan button
5	First channel's amplitude scale	13	Data tip button (hold SHIFT to add more than one annotation)
6	First channels frequency amplitude scale	14	Exit button
7	Time axis for all channels' waveforms	15	Configuration Table (DAQ and Processing parameters) Read Only
8	Frequency scale for all channels' spectra	16	Channel Name and Units ([mm/s], [m/s^2] or [mm])

Startup and Operation

Upon Startup the software will display a splash screen while loading the MATLAB Runtime in the background. This Runtime is used to facilitate program operation. Once the runtime loads the user will be present with an Open File Dialog. In this dialog, the user can select one or multiple TDMS files for processing. Each file will be processed in turn and will generate one tab in the tabular environment of the GUI. Before data loading begins the program will look for the file "sensor_configuration.txt" in the folder that contains the selected data files. This file describes which channels are in use and what sensors (SensorID, or serial number) are connected to each channel. This allows the software to trim the input data to only the used section of channels and determine sensor parameters that are needed during the response extension processing step. If this file cannot be found or there is an error made in its composition the dialog in Figure 1 will appear. At this point the operator can either exit to fix the sensor_configuration file or accept default settings (All 8 channels active, all sensor elements have the same characteristics, i.e. 4.5Hz corner frequency) and continue with processing.

During loading the user will be asked if sensor frequency response extension is required using the dialog shown in Figure 2. If the user answers “Yes” or “Yes to All”, sensor response correction will be applied to the current file, and in the case of “Yes to All”, to all subsequent files. The opposite holds for selecting “No” and “No to All”. If the correction is requested, then a check for saturation on each channel is performed, as the correction procedure does not function correctly under saturation conditions. If saturation is detected, then a warning dialog will be presented (Figure 3). The warning dialog cannot be closed until loading is complete and shows to the operator the channels (in the format “name_component”) that are suspected of saturation, and to which file those channels belong. Correction will still be performed on the rest of the channels that satisfy saturation criteria.

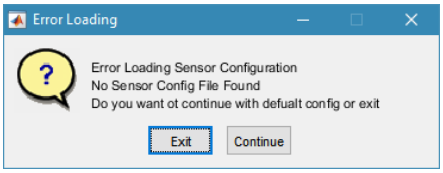


Figure 1

Figure 2

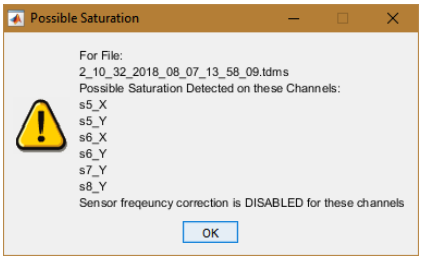


Figure 3

Once all the processing is complete, indicated by the loading bar present on screen during loading, the UI is generated and presented on the screen. At this point all processing is complete and data analysis can begin. The displayed graphs can be changed between acceleration, velocity and displacement using the provided drop-down menu.

To zoom on a section of the waveform or spectrum, select the zoom tool and drag a box around the section in interest. All graphs will follow the selection and adjust accordingly. It is possible to select horizontal or vertical zoom only by using the context(right-click) menu as seen in Figure 4. To zoom out, hold the SHIFT key and click on the center of the required zoom out operation. Double-clicking will revert the graph to its original display size, which is the view defined at program Startup. Pressing the Zoom button again will disable the tool.

To pan/move the waveform or spectrum, select the pan tool and drag the waveform or spectra. All graphs will follow the new view and adjust accordingly. It is possible to select horizontal or vertical pan only by using the context(right-click) menu as seen in Figure 5. Double-clicking will revert the graph to its original display state. Pressing the Pan button again will disable the tool.

To annotate the graphs, either time waveforms and spectra (as in Figure 6), select the Data Tip tool. Clicking on any chart line will generate an information box containing amplitude and time/frequency data for the selected point. Successive clicks or dragging of the selected point will move the selection along the originally selected line. To generate more than one Data Tip, hold the SHIFT key. Annotation will be removed when switching between Acceleration/Velocity/Displacement views.

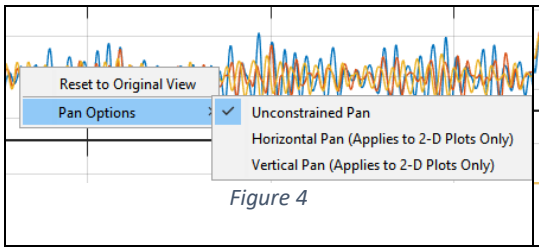


Figure 4

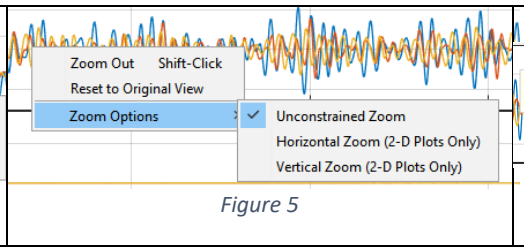


Figure 5

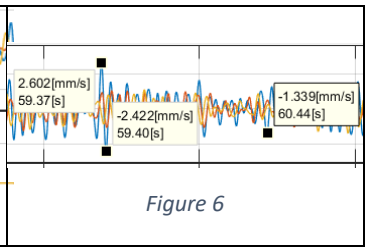


Figure 6

Configuring sensor information

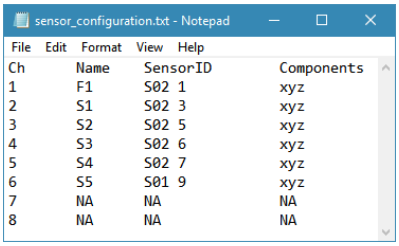


Figure 7

Sensor configuration can be specified by placing a file named sensor_configuration.txt in the same folder as the data files that are to be loaded. DYNAMate process assumes that all files in that directory share the same sensor configuration, i.e. they are consecutive recording for the same test conditions. The format of this file can be seen in Figure 7. The first column specifies the Channel number, the second column gives that channel a name (best chosen based on sensor location during the test), the third column gives the sensor serial number as written on the sensor, and the last column specifies the order of components for that sensor (leave as is). Data is delimited using Tab, with consecutive Tabs treated as one.
Only channels whose name is not "NA" (Not Available) will be used by the software and are used to signify unused DAQ channels. This also permits, for example, to have sensors attached in Ch 2 and 3, and then 6 and 7, with the software treating them as 4 consecutive channels.
If using DynaMate 1.75 or higher there is no need for the sensor_configuration.txt file.

Saving Data

Saving data with DYNAMate Process requires the operator to press the Save Data button and select an output filename. To do this, when the save button is pressed a File Save Dialog will appear, which will default to the same directory from which the files are selected, and a filename that matches the filename used to load the data. The extension will be changed from TDMS to XLSX. Pressing the save button for a given tab will save all data (Acceleration Velocity and Displacement) related to the currently displayed tab. Saving will produce "Filename.XLSX" containing 7 sheets: 'Configuration' (Configuration Information), 3 sheets for the Acceleration, Velocity and Displacement time waveforms and 3 sheets for the spectra of Acceleration, Velocity and Displacement (with a prefix 'FFT_'). The configuration sheet contains sensor and processing information as well as some signal statistics (see Figure 8 for details). The data sheets display appropriate sensor names, components and units.

Pressing the Save Image button will produce a Save File Dialog, similar to the Save Data Button, however the filename will be suffixed by the currently displayed data type (Acceleration, Velocity or Displacement). The result is, example FileName_Velocity.PNG, that contains an image of the current working environment, including Data Tips.

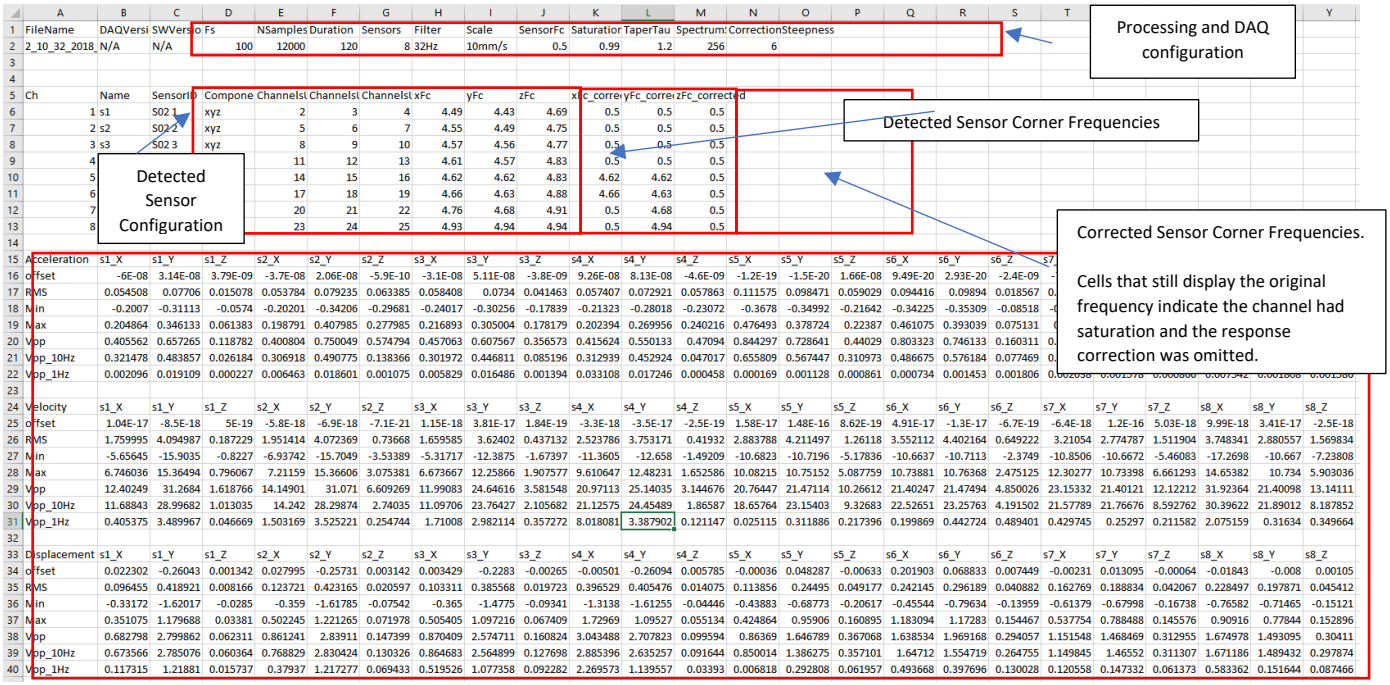


Figure 8

Configuring processing parameters

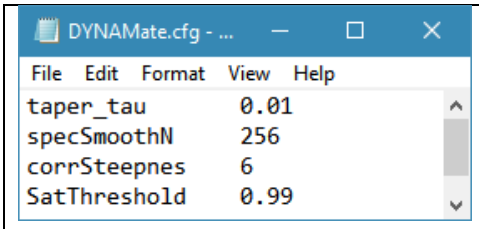


Figure 9

To configure the processing parameters, edit the DYNAMate.cfg file (Figure 9), located in the Startup directory of the software. The accessible parameters are:

- **taper_tau** – duration as a fraction (0-1) of the total signal length of the taper applied at the beginning and end of the signal. Specify 0 to disable.
- **specSmoothN** – sharpness of the window used to smooth the spectrum graphs. Specify 0 to disable.
- **corrSteepnes** – drop off rate for the corrected response, equal to (value-2)*5 dB/dec
- **SatThreshold** – Saturation detection threshold as a fraction of the scale used to record the data, i.e. at threshold 0.99, and scale selected of 10mm/s any signal with values greater than 9.9mm/s will be considered possibly saturated