

AnyWave

Contents

What is AnyWave?	3
AnyWave home directories	3
Opening a file in AnyWave	4
Quick re-open a recent file	4
Viewing the content of a file	5
Choose what you want to view and how	5
Change the signals gains or amplitude scales	7
Changing the time scale	7
Adding/Removing signal views	7
Synchronizing/Desynchronizing views	8
Browsing through the file	8
Filtering data	9
Turn filters on/off	9
Selecting channels	9
The Selection Key	9
Applying options to a selection	10
Mapping of activities	10
Mapping mode	10
Select channels using the mapping user interface	11
Ending mapping mode	11
Montages	12
Using the Montage UI	13
Editing the current Montage	13
Modifying references	14
Dealing with SEEG electrodes	14
Bad channels	14
Virtual channels	15
Filtering and colors	15
Viewing a channel with different perspectives	15

Managing custom montage files	17
Quick montages.....	17
How custom montage files are applied.....	17
Markers	18
Adding markers	18
Basic marking.....	19
Advanced marking.....	19
Ending marking mode.....	19
Managing the markers	20
Editing markers.....	21
Selecting markers	21
Special actions on markers.....	21
Display Rules.....	22
Navigation and statistics	23
Export Wizard	24
Processing data	25
Checking for process input	26
Checking for channels as input.....	26
Checking for time selections as input.....	26
Launch a process	27
MATLAB plug-ins	27
MATLAB Compiled plug-ins	28
ICA	28
Reviewing the components.....	29
Removing/adding components	31
Application preferences	32
General	32
MATLAB	33
Screen Calibration	33

What is AnyWave?

AnyWave is a free, multi-platform software that can be used to visualize electrophysiological data, as well as being used as a development framework in order to build custom plug-ins.

AnyWave uses plug-ins to load or write files formats. A set of reader and writer plug-ins is bundled with AnyWave and brings the possibility to read several EEG or MEG manufacturers' formats. The plug-ins are also used to add entirely new signal processing, data analysis and visualization capabilities to AnyWave.

AnyWave opens and displays the contents of EEG or MEG files. Acquired signals are then displayed by AnyWave as well as markers that might be stored in the file.

Markers can be read from a file, added by the user or even by a signal processing plug-in. Markers can be saved to or loaded from a specific AnyWave format.

AnyWave home directories

AnyWave creates directories inside the user's home directory.

Using the Unix file system notation, the directories created are:

/home/user/AnyWave/Montages

/home/user/AnyWave/Markers

/home/user/AnyWave/Setups

/home/user/AnyWave/Plugins

/home/user/AnyWave/Plugins/MATLAB (put here MATLAB plugins)

/home/user/AnyWave/Plugins/Python (put here Python plugins)

/home/user/AnyWave/Work

On Windows, replace home/user by "My Documents"; on Mac OS X, it will be in the /Users/user.

Montages:

AnyWave allows the user to save and load custom montages, and the default location for these files is the Montages folder. All Montages saved in this directory will be easily accessible within AnyWave. Note that Montages files located in the current open data file's folder; will become accessible as well.

Markers:

This is the place where AnyWave will save files related to marker's management. For example, rules created by the user to filter markers.

Setups:

AnyWave also allows users to save custom display setups, and these files, by default, will be saved and loaded from the Setups folder.

Plugins:

Users may provide their own plug-ins, and AnyWave will look in this folder when it starts. This directory can be empty. It's up to the user to place some custom plug-ins for AnyWave here. This is a convenient way to set user specific plug-ins that will only be available to the user and not for all people that may use the computer.

Work:

This is the place where custom signal processing plug-ins may save temporary files. When AnyWave launches a signal processing plug-in, a sub-directory with the name of the plug-in is created in order for the plug-in to use it as a temporary directory.

Opening a file in AnyWave

This is the first action you will do after launching AnyWave: select the *File* menu and then choose *Open*. You can also click on the small button in the toolbar, which is a shortcut for opening a file:

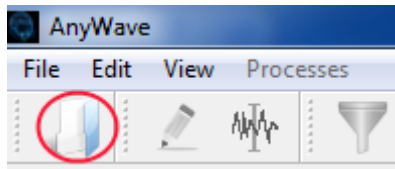


Figure 1

Quick re-open a recent file

AnyWave also keeps tracks of the ten most recently opened files and offers a shortcut to re-open one of those previous files easily by clicking the *File* menu and then clicking *Recent files*.

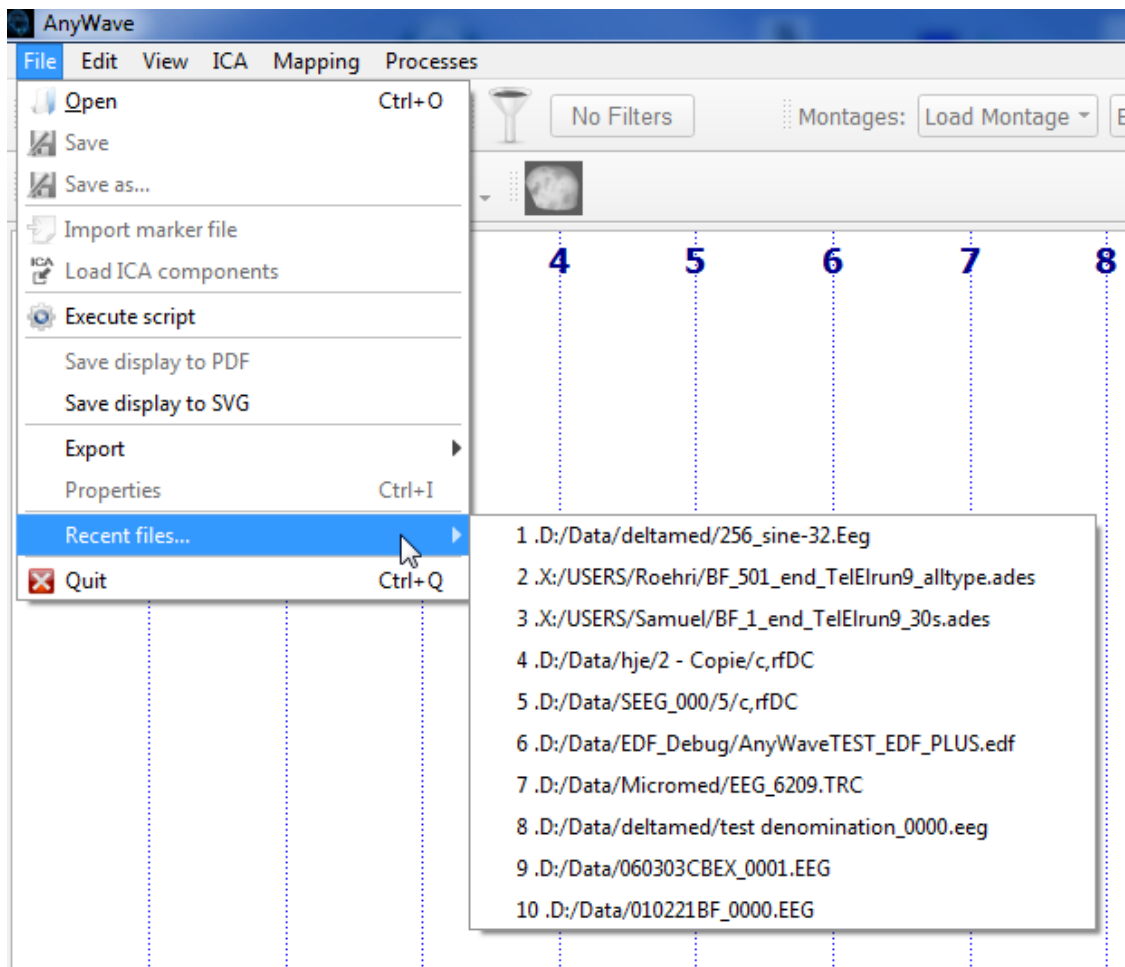


Figure 2

Viewing the content of a file

If a file was successfully open, then you should see its content. By default, is the file is open for the first time, with the default montage, then AnyWave will show MEG;EEG;SEEG channels found in the data file.

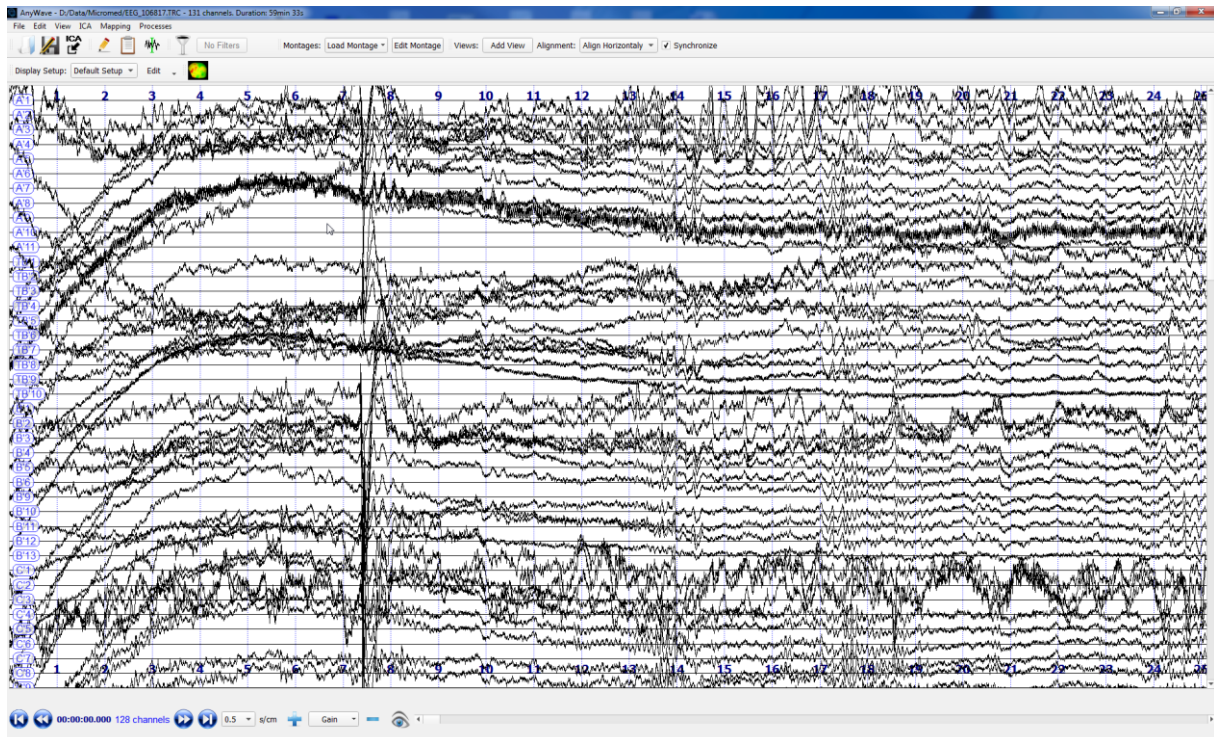


Figure 3

The figure 3 shows the content of a Micromed .trc file containing EEG traces.

Choose what you want to view and how

Just below the traces, you can see some widgets which allow choosing some display options for the traces:

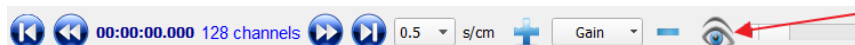


Figure 4

Let's focus on the right part of this button bar, and particularly on the eye button. One click on this button will open a graphics interface allowing choosing how we want to see the traces displayed in the view but also what kind of traces we want to see.

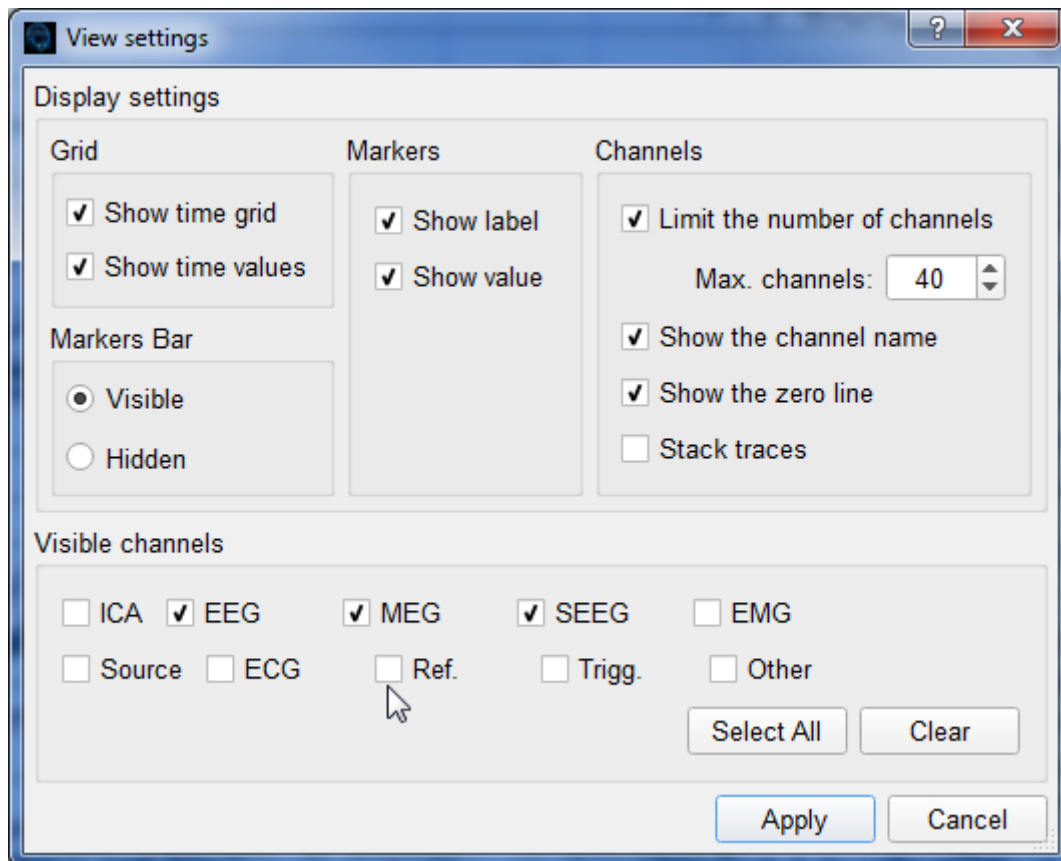


Figure 5

The figure 5 shows the default options set by AnyWave for a signal view.

- On the top left part, we are able to change the time grid settings (hide it or not, display seconds number or not).

- On the top center part, we can set the way markers are displayed over the traces (Show their label or not, show the associated value or not).

We will see what markers are and how to handle them later in the documentation.

- On the top right part, we can set how we want to view the traces:

It is possible to limit the maximum number of channels to be displayed within the current view. By default, AnyWave will limit this number to 40.

It is possible to hide the channels labels. By default the channel label or electrode name is shown.

It is possible to stack traces of the same type. By default, this option is disabled.

On the left middle part, it is possible to choose if we want to see the marker bar below the traces or not. The marker bar is a quick reminder displaying small markers representation UNDER the traces to not confuse too much the view.

On the bottom part of this windows, we can choose what kind of channels or traces we want to see in the current view:

- By default, as already explained, EEG, MEG and SEEG channels are shown.

Change the signals gains or amplitude scales

Let's focus on the toolbar above the view:



Figure 6

AnyWave can handle several kinds of channels or traces that may be stored in the data file. To quickly rise or low the amplitudes scales for all types of channels, press the + or – buttons located around the Gain button.

However, when dealing with several views displaying several types of data (for example if the view is displaying EEG signals and MEG signals), this action will rise or low the amplitudes of ALL the signals (EEG and MEG). In this case, it is suggested to use the Gain button to manually specify the amplitude scale for a particular channel type.

Note: It is not advised to display EEG and MEG channels within the same view. It is better use several views.

Changing the time scale

AnyWave uses a time scale expressed in seconds by centimeters. This is a legacy of the old EEG paper recording machines. This allows clinicians to properly see the signals even when resizing the views.

Let's look again to the toolbar located above the signals:



Figure 7

The default setting is 0.5s by centimeter but the user can change that value to zoom in or out (in time) the signals.

Note that when the time scale is very low, AnyWave will displays a time grid with vertical lines marking every 100ms.

Adding/Removing signal views

When dealing with several type of channels in a data file, it is more suitable to use a specify signal view for each type of channels.

AnyWave only shows one signal view by default when opening a file for the first time, but it is easy to add a new view.

Let's focus on the toolbar located above the menu bar:



Figure 8

Clicking on the Add View button will allow the user to add a new signal view and to select which type of channels he wants to view in it. When dealing with several views, it is also possible to choose how to align them.

Note that each view may have different settings, time scales and amplitude scales.

To remove a view, click on the view using the right mouse button and choose:

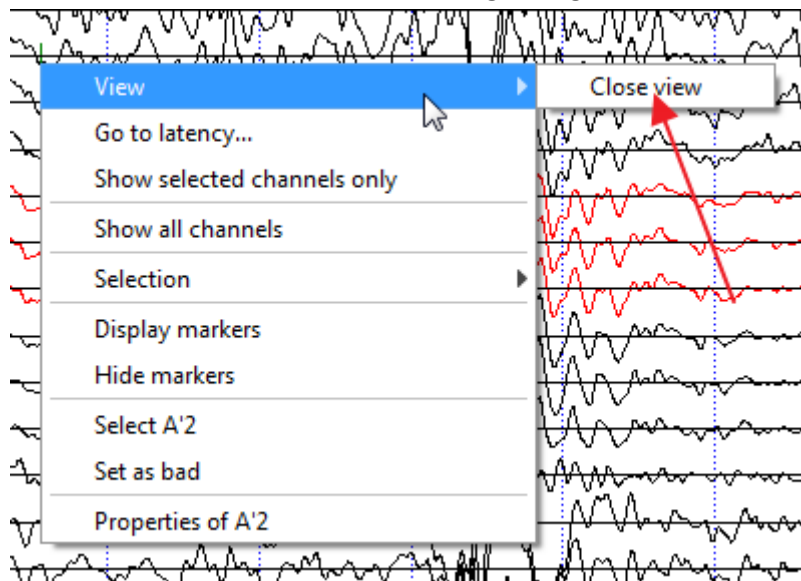


Figure 9

Note: If there is only one view left, you won't be able to close it.

Synchronizing/Desynchronizing views

By default, when adding a new view, AnyWave will consider it to be synchronized with the other views: when the user changes the viewing position in a view, all the other views will be set to the same position in the file.

It is possible to turn off the synchronization by clicking on the top toolbar:

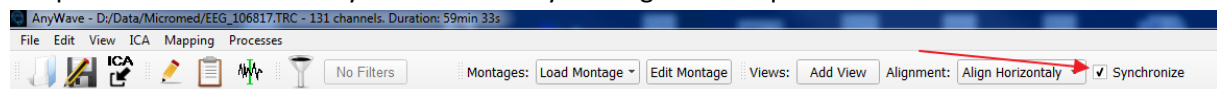


Figure 10

Browsing through the file

Navigating through the file is quite easy. Again, use the bottom toolbar to quickly go to one position in the file:

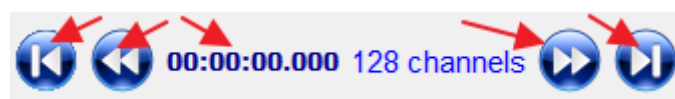


Figure 11

Use the big blue buttons to go forward or backward or straight to the end or to the beginning of file.

The current position of the view is displayed in HMS.MS format (Hour Minutes Seconds Milliseconds).

Filtering data

AnyWave can apply a low and/or high pass filter to the whole data. The filtering options can be set depending on the channel type. To open the filtering user interface use the filtering button in the top toolbar:

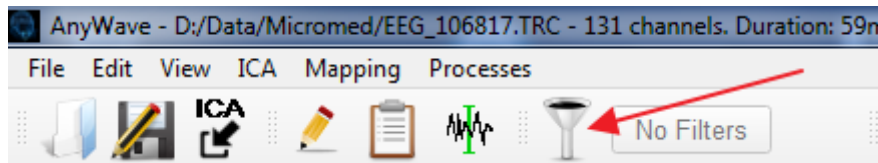


Figure 12

Note: when using the filtering user interface, the filters will be changed for all the channels. It is possible to manually set filters that would be applied to a set of channels. This is described later in the documentation.

Turn filters on/off

When filters are set, the top toolbar will allow to switch them on or off easily:

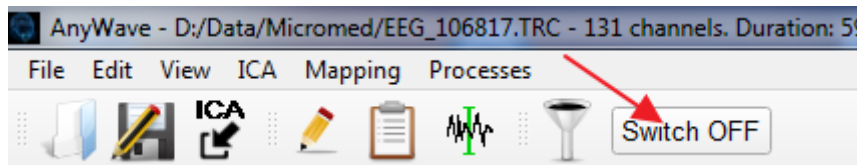


Figure 13

Selecting channels

It is possible to select channels in the views using the selection key. Depending on the operating system, this key may be different. On Windows and Linux the selection key is the **CTRL key**. On Mac OS X this is the **Apple key**.

Note: Click in a view before trying to select some channels to be sure that the view got the input focus.

It is also possible to select a group of channels by holding the selection key and dragging over the channels a selection rectangle.

Another way to select a channel is by using the right mouse button on its label and choosing the proper selection option in the context menu that just appeared.

The menu allows also selecting a group of channels, to clean the current selection or to revert it.

Selected channels are displayed in RED

The Selection Key

In order to select channels using the mouse, the Selection Key must be pressed and hold during the operation. On Windows and Linux systems the key is the **Control key (Ctrl)**. On Mac Systems it is the **Command key**.

There are several ways to select channels:

- To select one channel without using the Selection Key, right click on it with the mouse. In the context menu that appears, choose *Select 'channel'*. If you repeat the operation on a selected

channel, you will get the option to unselect the channel.

- To select several channels that are not laid out side by side, use the Selection Key (see The Selection Key) and click on the channels you want to select.

- To quickly select several channels, use the Selection Key (see The Selection Key), press and hold the left mouse button. A selection rectangle will appear, allowing you to select the channels under it.

After releasing the mouse button, the channels will become selected.

Applying options to a selection

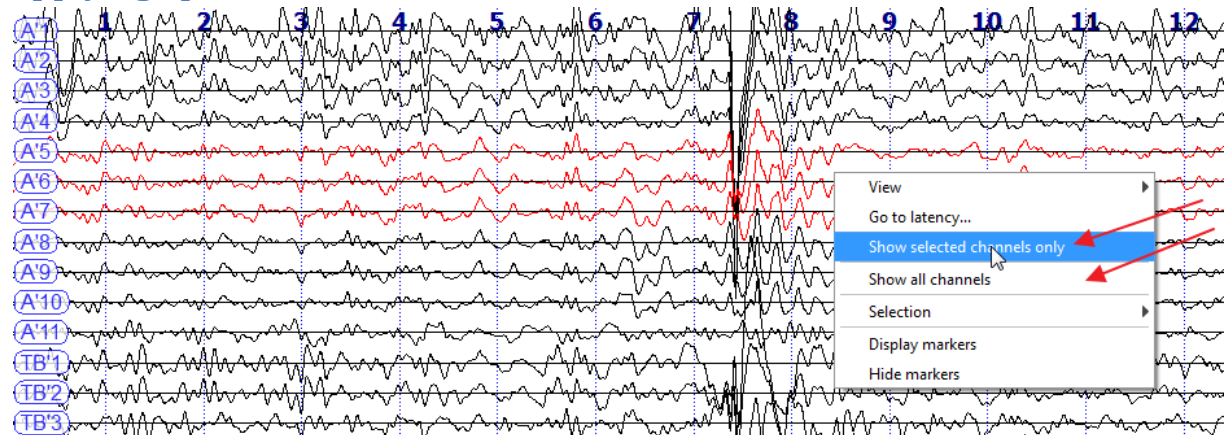


Figure 14

The image above shows three selected channels (A'4, A'5, A'6). The context menu allows seeing only those three channels in the view. The 'Show all channels' options of the menu will revert back the normal display for the view (all channels).

Mapping of activities

Depending on the data file and the reader plug-in which can read it, AnyWave can use 2D or 3D layouts of electrodes to represent a mapping of activities. If the data file does not provide a layout, AnyWave will then try to guess the closest matching layout in its own database that suits the electrodes labels found in the file.

Mapping mode

When requesting the mapping of activities, AnyWave will switch in Mapping Mode:

A cursor will appear following the mouse in the view, and when the user clicks at a position in the view, the mapping at that latency is computed and the maps are updated.

There are two ways to switch to Mapping Mode:

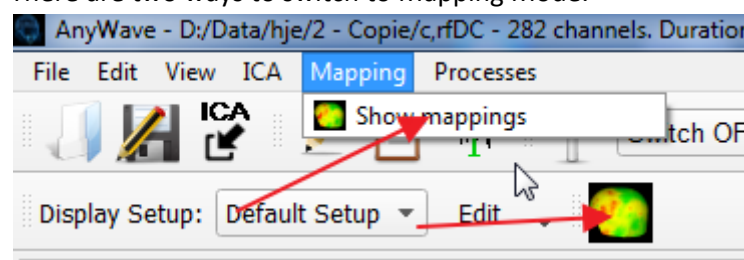


Figure 15

An example of mapping mode activated on MEG data:

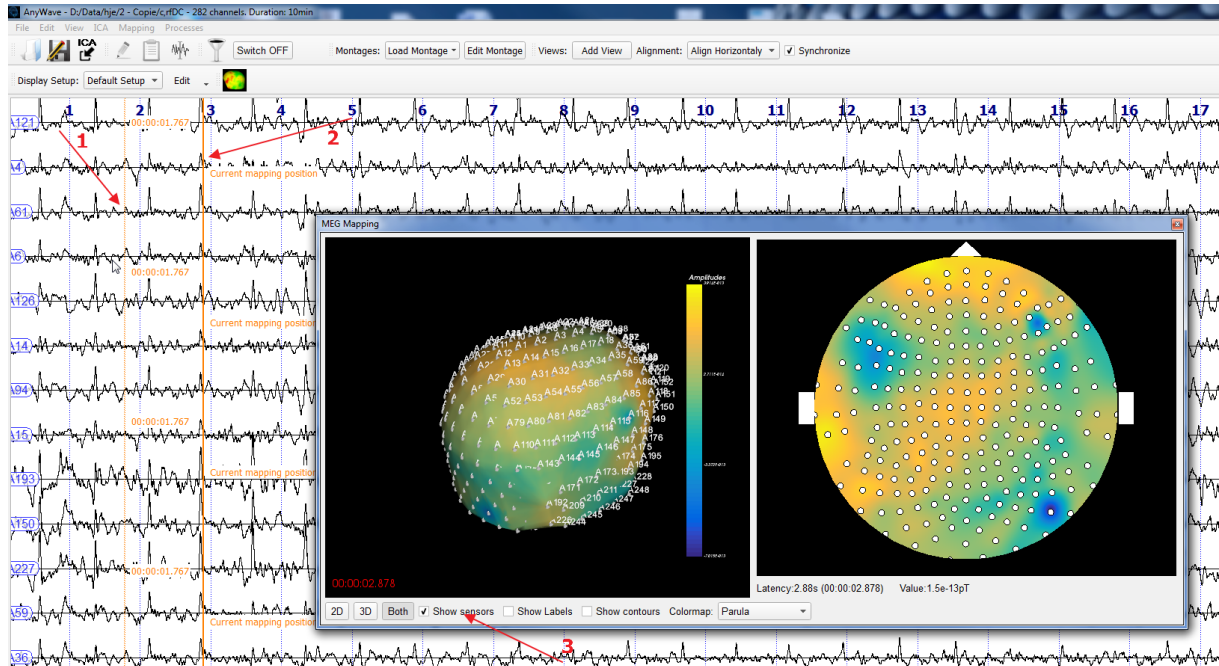


Figure 16

Figure 16 is showing several items that require detailed description:

- 1: This orange cursor shows the current mouse position in the data (in H:M:S).
- 2: This bold orange cursor is showing the current mapping position.
- 3: Within the mapping user interface, the “*Show sensors*” option is enabled, so the user can see the small white dots representing the electrodes.

The mapping user interface allows modifying many options from the color maps used to the 3D and or 2D representations.

Select channels using the mapping user interface

If the “*Show sensors*” option is enabled, then the user can select channels in the different views, by selecting the corresponding sensors.

In the 3D view, press and hold the Selection key and click over the small disks representing the sensors.

In the 2D view, just click over a white dot representing a sensor.

Note: when clicking again over a sensor, the sensor switches to not selected as well as the corresponding channel(s) in the different views.

Ending mapping mode

To quit mapping mode, click to close the mapping user interface window.

Montages

The previous sections explained how to view signals, filter data, and select channels.

But, before the channels are viewable, there is a major component, called the Montage manager, which handles how the data present in the file will be represented as channels in AnyWave.

As described previously, by default, when a sensor is found in the file, AnyWave make it a channel and send it to the active signal views: this is the default Montage.

However, for some specific data type, like SEEG electrodes for example, the data are mostly viewed as bipolar reference. So a bipolar Montage must be applied to the data found in the file before the views can show them, as channels.

AnyWave proposes a user interface to handle, save and load montages and apply them to the current data found in the file.

To open the Montage interface use the following shortcuts:

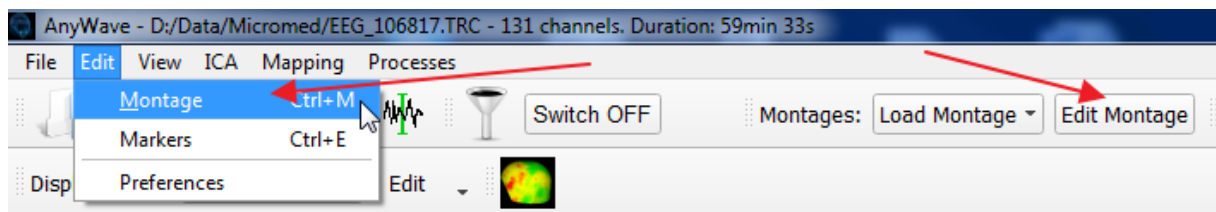


Figure 17

Using the Montage UI

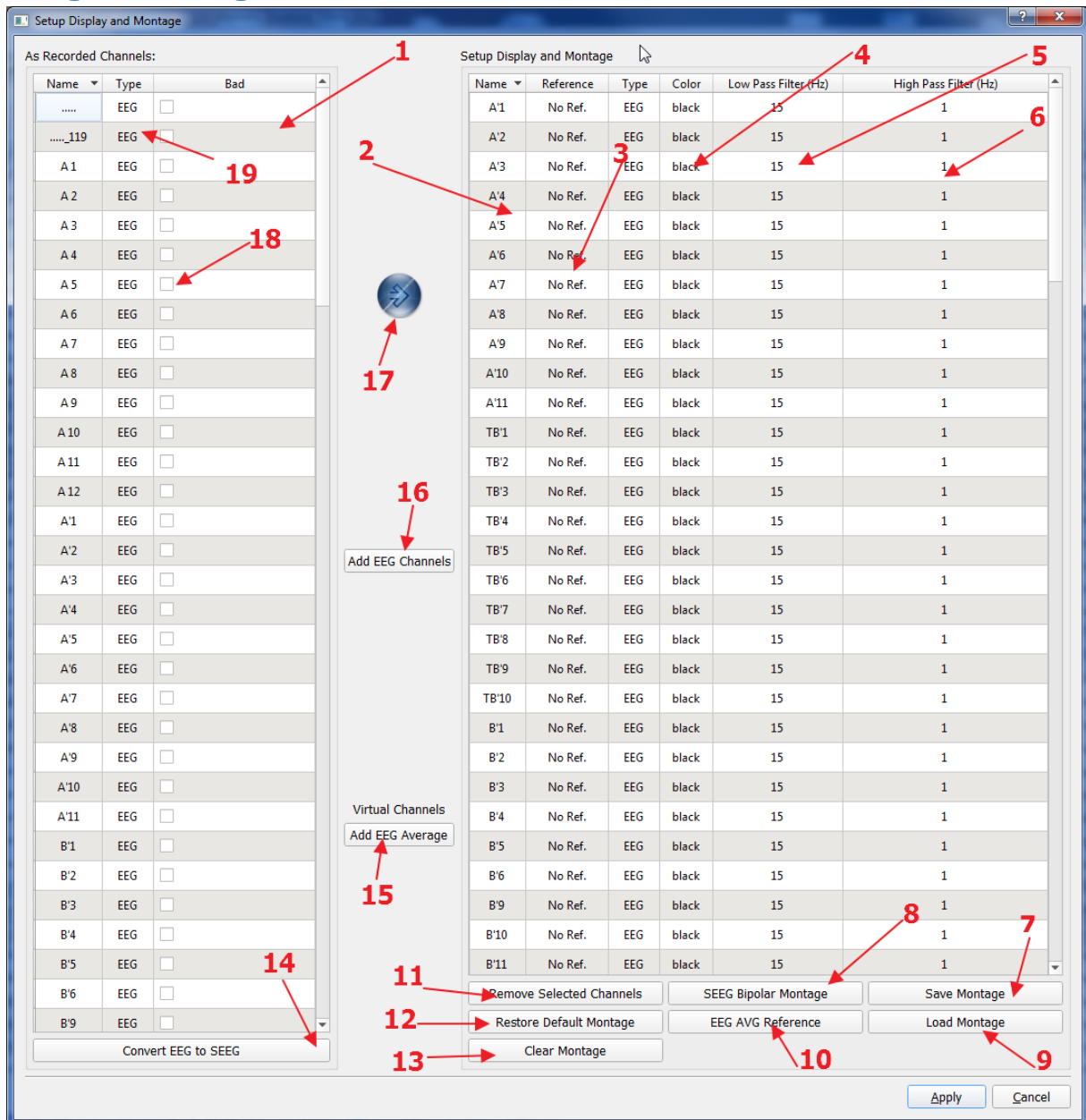


Figure 18

Editing the current Montage

Figure 18 shows two main lists (1, 2):

The first list to the left shows all the sensors found in the data file. They are called As Recorded channels.

The list to the right shows the channels in the current Montage.

This list is the list of viewable channels. When clicking the Apply button, the channels will be sent to the different views for display.

It is possible, so to modify the list on the right:

- Removing channels can be done by selecting the channels and then press the Remove Selected Channels button (11).
- Adding channels can be done by dragging channels from the left list and dropping them in the right

list, or by selecting channels in the left list and by clicking on the add channel button (17).

- Click on (13) to clear the current Montage.
- Click on (12) to restore the default Montage for the current data file.

Note: A channel in the left list can be added SEVERAL times to the right list.

Modifying references

EEG or SEEG channels may be shown as bipolar referenced. To change the reference for a channel in the current Montage, click on the reference tab in the list (3) and a popup window will allow the user to select an electrode as reference for the channel.

Note: For SEEG channel, click on (8) to automatically build a bipolar montage based on the number of the pad for the electrodes. This will only work if SEEG channels are present in the left list.

The Montage user interface allows building custom montages and changing display options for channels. Filtering parameters can also be modified.

Dealing with SEEG electrodes

Most of the EEG recording systems can be also used to record activities coming from SEEG electrodes BUT those channels are recorded as EEG in the data file.

Therefore, when the user opens the file in AnyWave for the first time, all the channels will be set as EEG, not SEEG.

It is possible to change the type of “As Recorded” channels, located in the left list. Right click on the Type tab in the list (19) and change the type for a particular channel or for a selection of channels.

Note: If you are sure that all EEG channels are in fact SEEG channels, then you can use the button Convert EEG to SEEG (14).

Once the channels are set to be SEEG, you can build a bipolar SEEG montage quite easily with button (8).

Bad channels

Bad channels are channels with no data or wrong data. Typically, they are noisy channels or channels with a lot of artifacts or even empty channels.

Some channels can be marked as bad in the data file (by the acquisition system), but it is up to the user to set them manually when needed.

To mark channels as bad, simply enable the Bad flag in the montage user interface (18).

You can also mark channels as bad when reviewing them: if you see a channel or a group of channels that seems bad in a view, select them and then use the right mouse button to choose the options to mark them bad.

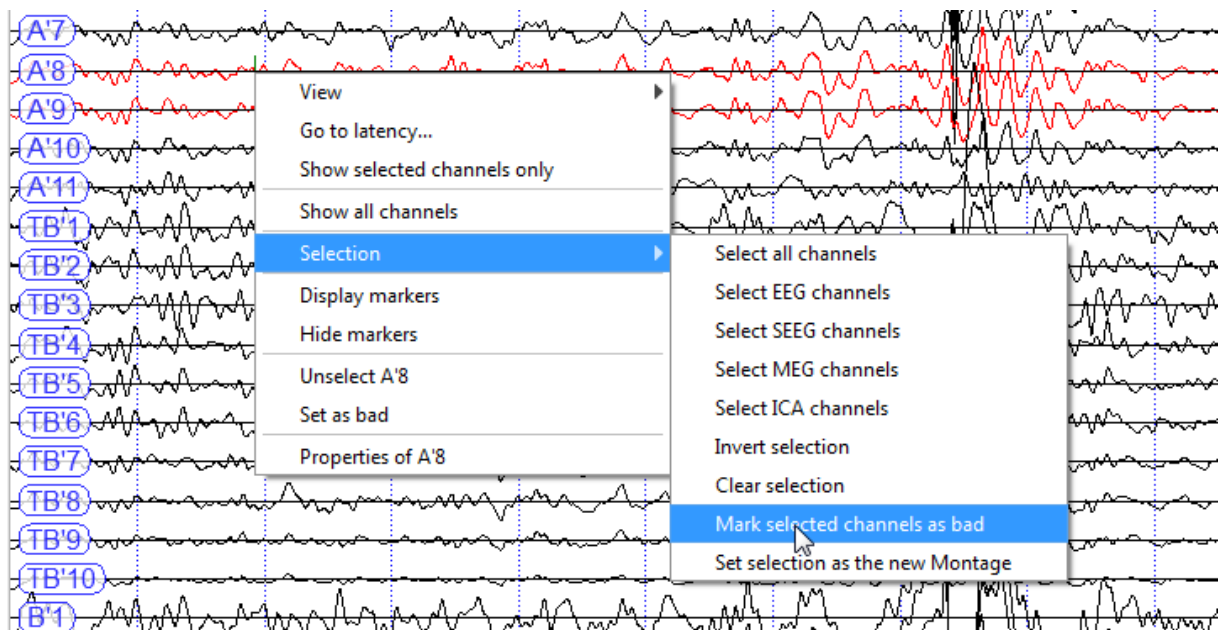


Figure 19 – Two channels (A'8, A'9) will be marked as bad

When channels are marked as bad, they are removed from the montage and cannot be added after that, until they are set to “good” again.

Marking channels as bad will force an update of the current mapping if there is one running and will update the current Montage.

Virtual channels

AnyWave handles virtual channels that could be added to the montage. Virtual channels are channels that do not exist in the data file. AnyWave only handles average channels but other virtual channels can be added to AnyWave by signal processing plug-ins.

Average channels, are channels which data is the average of all the other channels data of the same type.

In a data file which contains EEG signals, then AnyWave will allow to add a virtual average channel for EEG.

Possible average channels are visible in the user interface, in the middle part. One button is added to allow the user to add the average channel of its choice to the current Montage.

Note: Virtual channels can be added to the Montage or used as reference for bipolar montages.

Filtering and colors

Even if it is not directly related to the Montage, the Montage user interface allows the user to change the filters settings and the color for channels before they are sent to the views.

This can be done by editing the corresponding columns in the right list.

Viewing a channel with different perspectives

As we can add the same channels from the file to the montage several times, we can compare a particular channel display, using different filtering options and or colors.

To do so, we will modify the current montage as follow:

As Recorded Channels:

Name	Type	Bad
.....	EEG	<input type="checkbox"/>
....._119	EEG	<input type="checkbox"/>
A 1	EEG	<input type="checkbox"/>
A 2	EEG	<input type="checkbox"/>

Setup Display and Montage

Name	Reference	Type	Color	Low Pass Filter (Hz)	High Pass Filter (Hz)
A 3	No Ref.	EEG	black	15	1
A 3	No Ref.	EEG	black	15	1
A 3	No Ref.	EEG	black	15	1

We added A 3 three times in the current montage. The filtering options are low pass 15Hz, high pass 1Hz for all three channels.

Now we will edit the filtering settings for two of the three channels to get this:

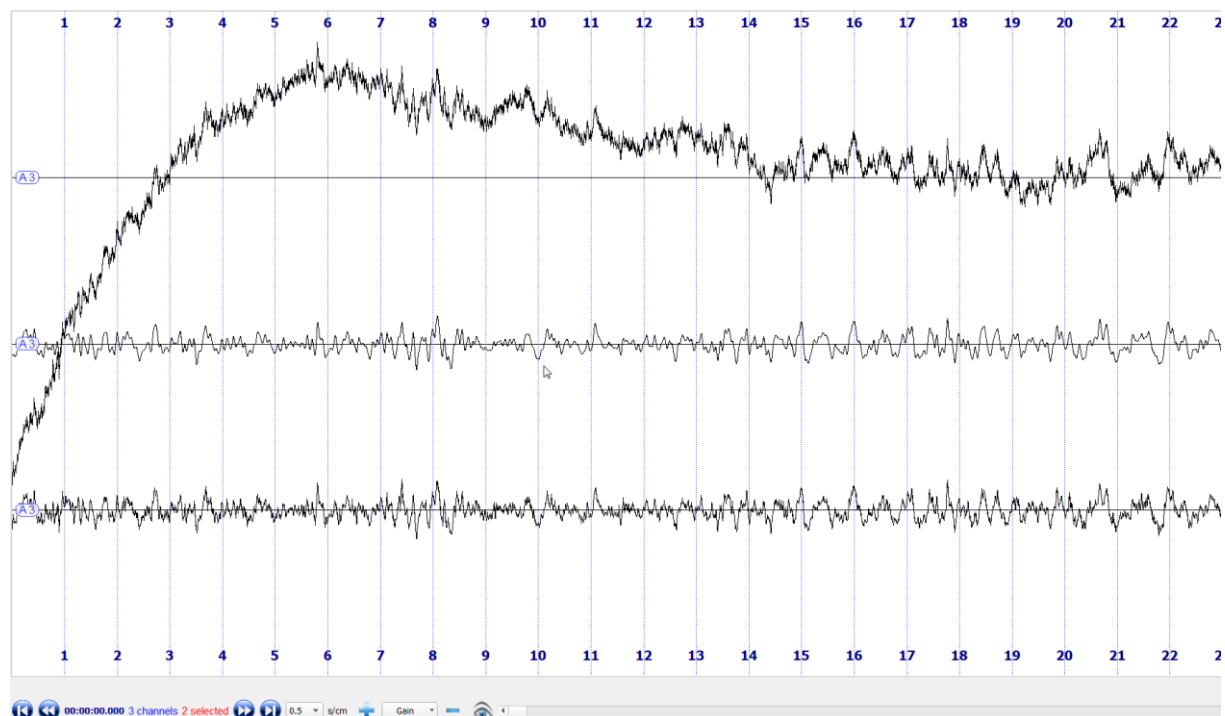
As Recorded Channels:

Name	Type	Bad
.....	EEG	<input type="checkbox"/>
....._119	EEG	<input type="checkbox"/>
A 1	EEG	<input type="checkbox"/>
A 2	EEG	<input type="checkbox"/>

Setup Display and Montage

Name	Reference	Type	Color	Low Pass Filter (Hz)	High Pass Filter (Hz)
A 3	No Ref.	EEG	black	Not set	Not set
A 3	No Ref.	EEG	black	15	1
A 3	No Ref.	EEG	black	45	1

The first A 3 channel has no filters set, so we will see the raw signal. The two others channels have different filter set. Now, by clicking on the Apply button, the current Montage will be applied and sent to the views.



A3 channel viewed using different filters.

NOTE: if the user changes the filtering options using the Filtering User Interface, the filtering options for all channels will be changed too. So you will see three identical channels in the view.

Managing custom montage files

Once the user has created a montage, it can be saved explicitly. The Save Montage button will permit the user to choose a place where to save the montage, for further use.

Montages are saved in an AnyWave format (.mtg), and by default, AnyWave will suggest saving the montage in the user's AnyWave montage directory ("User home directory/AnyWave/Montages"). As long as the montages are saved in this directory, they are available as "quick montages" (see below). That will be also applied to montages saved in the same directory where the data file resides.

Quick montages

Quick montages are available through a dropdown list that is present in the main application toolbar and also in the Montage User Interface. The dropdown list provides an easy way to select a previous saved montage and applies it immediately.

How custom montage files are applied

When loading a montage file either by using the quick montages or by manually importing a montage file, AnyWave will first clear the current montage and then check that channel names match. If some channels in the montage do not match, they are ignored and won't be put in the current Montage. Only channels present in the montage file will be set in the current montage as long as their names match the channels located in the data file.

Note: If the names of the channels in the montage file being loaded do not match those of the data file, then the montage will be empty.

Markers

A marker can be just a position in time or a time selection of the data.

A marker can also target one or more channels.

Markers can also be extracted from the data file, if the reader plug-in is able to do so.

Markers have several attributes:

- A label or name.
- A position in time, from the beginning of the data.
- Time duration, if they marked a selection.
- A numeric value.
- Can target one or several channels.

Adding markers

Click on the small pencil to set AnyWave in adding markers mode.



Switching to adding marker mode will make a tool window appear (Figure 20) and a cursor will appear in the views, following the mouse.

The list of markers will also be shown as a docked window to the left of the views.

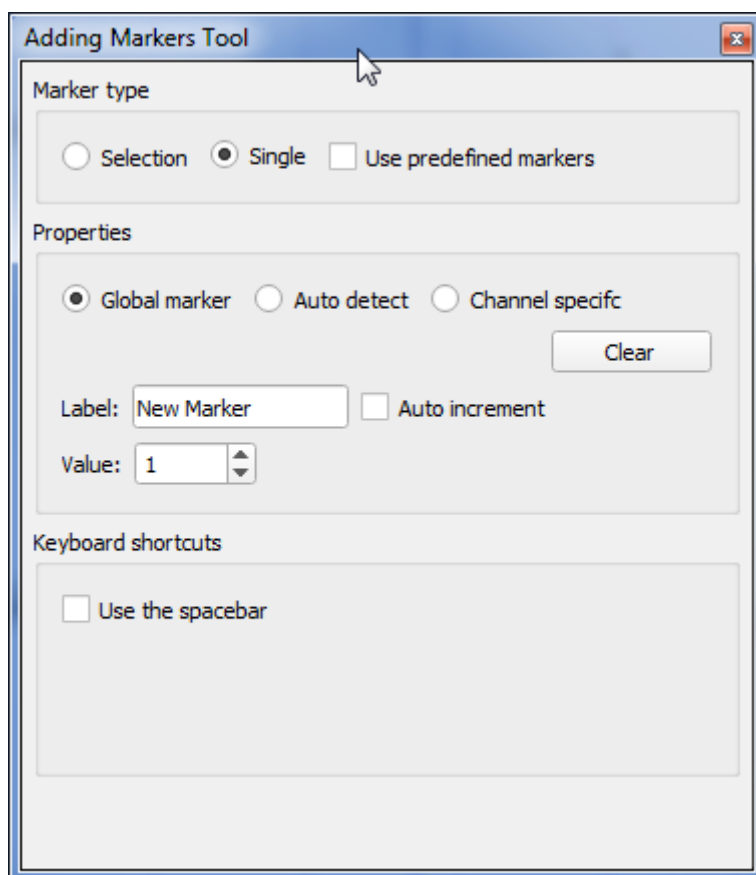


Figure 20

Basic marking

To add an instant marker or event, select the marker type as *Single* (the default).

Edit the label to set the name you want for the marker, let the settings to Global marker.

Move the mouse to the position you want to mark and click once with the left mouse button. The marker is added.

To mark a selection in time, click to change the marker type (see Figure 20) to *Selection*.

Move the mouse to the starting position and click once with the left mouse button. The selection begins, move the mouse to the end of the selection and click again.

Advanced marking

In some cases, you may want to mark a lot of events, of different types. It is not very convenient to click in the tool window to change the marking settings for each marker we want to add.

That is where the Predefined list could help (See Figure 20).

When enabling the *use predefined list* option, we can define markers, with different names and/or values.

Using predefined list is easy, just mark an event by clicking the mouse left button at the corresponding time position or time selection, a menu will appear letting the user choose the predefined marker to be added.

In other cases, the user may want to mark events related to channels. To do so, change the option in the tool window (Figure 20) to Auto detect or Channel specific.

When Auto detect is enabled, just click over a channel to add a marker which will target that channel.

When clicking on Channel Specific, you will be able to manually choose the channels to target from a list.

Ending marking mode

Close the add marker tool window (Figure 20).

Managing the markers

Markers

Label	Value	Pos. (HMS)	Duration (s)	Targets
TB 14/45 choc ...	No value	00:01:03.000	No duration	Global marker
TB 14/13 choc ...	No value	00:02:21.000	No duration	Global marker
TB 12/13 choc ...	No value	00:03:17.000	No duration	Global marker
TB 10/11 choc ...	No value	00:03:45.000	No duration	Global marker
TB 10/11 train 1...	No value	00:06:02.000	No duration	Global marker
TB 8/9 choc 4mA	No value	00:07:25.000	No duration	Global marker
TB 8/9 train 1mA	No value	00:08:07.000	No duration	Global marker
TB 6/7 choc 4mA	No value	00:09:51.000	No duration	Global marker
TB 6/7 train 1mA	No value	00:10:31.000	No duration	Global marker
TB 4/5 choc 3mA	No value	00:12:05.000	No duration	Global marker
tb 2/3 choc 3mA	No value	00:15:08.000	No duration	Global marker
TB 2/3 train 1mA	No value	00:16:04.000	No duration	Global marker
A' 1/2 choc 3mA	No value	00:26:44.000	No duration	Global marker
A' 1/2 train 1mA	No value	00:27:37.000	No duration	Global marker
Crise n°2	No value	00:28:03.000	No duration	Global marker
respire fort	No value	00:28:22.000	No duration	Global marker
regard inquiet	No value	00:28:24.000	No duration	Global marker
A 2/3 choc 3mA	No value	00:33:47.000	No duration	Global marker
A 2/3 train 1mA	No value	00:36:59.000	No duration	Global marker

Display rules

Use rule: No rule
Edit Rules

Quick navigation

Number of markers: 19 marker(s)

By name: TB 14/45 choc 3mA 1 marker(s) Center On

By value: -1 19 marker(s) Prev. Next

Export Wizard Clear Trigger Channel Load Markers Save Markers

Figure 21 - The Markers UI

The markers user interface displays the complete list of all markers associated with the open data file. Markers of type *Single* have their label displayed in red as markers of type *Selection* have their label displayed in purple.

Note: the color used to display markers in AnyWave can be modified in the Preferences. (Click Edit on Menu and choose Preferences)

Note: The window can be docked to the left or to the right of the signal views.

Editing markers

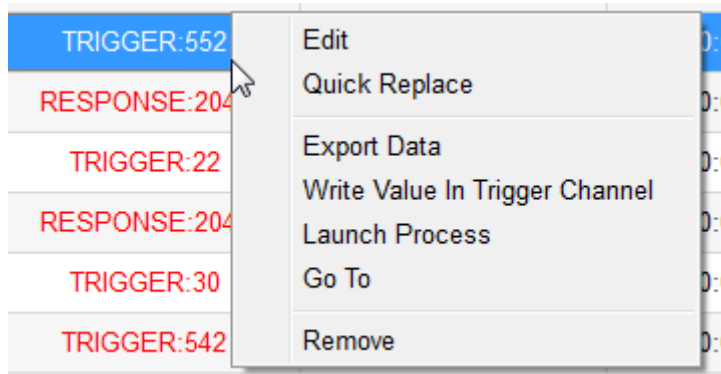
To modify marker's properties, click with the right mouse button on the property to edit and choose *Edit*.

Selecting markers

To select markers, click on a row in the list. The row becomes marked as selected. To select several markers, press and hold the Selection Key and click on chosen rows.

Special actions on markers

When using the right mouse button to display the contextual menu, you will notice other possible actions that may be applied to a marker or a selection of markers.



Edit

Choose Edit to modify the value or name of the marker's attribute.

Quick Replace

This is useful to quickly replace labels or values of markers. Suppose you have several markers named "**condition 1**" and you want to rename them as "**condition 3**". Use the Quick Replace action on a marker named "**condition 1**", choose *Replace label* and type "**condition 3**". The values of many markers can be changed in a similar fashion.

Export Data

This action, used on markers of type Selection, allows exporting the selected data to a file. You cannot use this option on markers of type Single as they do not mark a segment of data.

Write Value To Trigger Channel

Some data file formats use special channels to store events. Those channels are generally called Trigger or Response channels. They store zero values except when an event occurs during the acquisition. A value is associated to an event and stored in the channel.

AnyWave is able to extract these values from those channels when opening the file. The user can do so afterward using the *Processes* Menu and by selection *Trigger Parser*.

AnyWave converts numerical values stored in those technical channels into markers.

It is also possible to do the inverse: newly added markers can be saved to the special channels in the data file, as numerical values.

Select the markers you can to write as values in the technical channels, and choose Write Value In Trigger Channel.

Note: If the reader plug-in that handle the file does not support the feature (because it is not possible in that particular file format), nothing will happen.

Launch Process

Some signal processing plug-ins can handle markers as input or can process a selected part of data. Using that option, allows directly launching a signal processing plug-in on marked data. If no compatible plug-ins are available, nothing will happen.

Go To

Click on that option to center the views on the corresponding position of the marker. You may also double click on a marker in the list to achieve the same goal.

Remove

This option will remove the selected markers from the list. A confirmation is required.

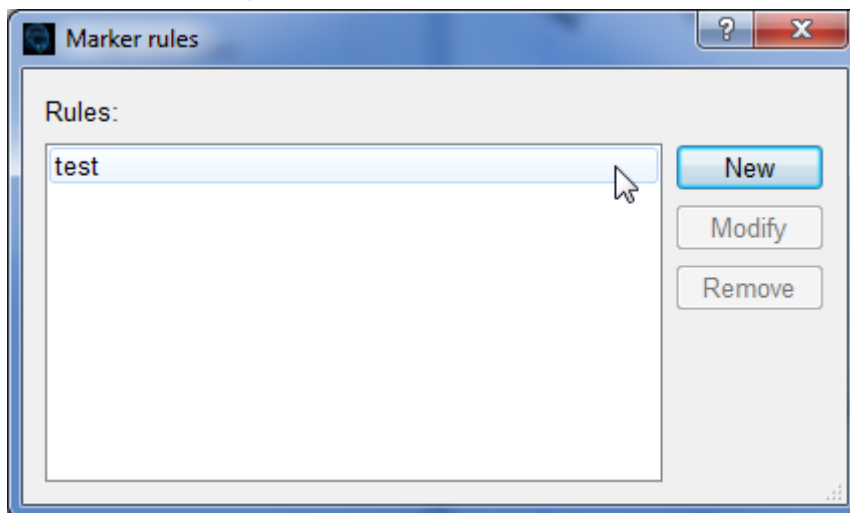
Display Rules

The markers user interface allows the user to create filters that determine the set of markers displayed by AnyWave. In the case of data file which contains a lot of markers, it can be useful to only display markers of interest.

The default display rule is set to *No Rules*, which means that AnyWave won't filter any markers.

To set a specific rule, click on the dropdown list located beside *Display Rules* to choose a previously defined rule. The rule is applied immediately and markers are displayed accordingly.

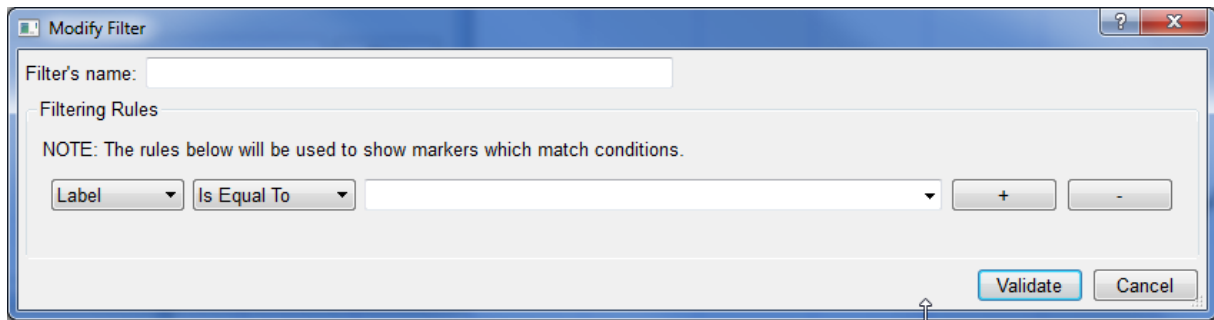
To define a new rule, click on the *Edit Rules* button.



Press New to create a new rule, Modify to modify an existing rule or Remove to delete a rule.

Creating a new rule

Click on the **New** button to create a filtering rule.



First, be sure to provide a name for the rule. The name will be used to create a file in AnyWave user's home directory, so keep in mind that some characters are not suitable for a file name. Avoid spaces and invalid characters like **!&|V~**.

Once a name has been set, the user must define at least one condition.

Conditions are based on the **Label**, the **Value** or the **Duration** of a marker. Click on the dropdown list to choose the purpose of the condition then click on the second dropdown list to define the condition type and finally, choose the matching for the condition to be true.

Example:

Suppose we have a data file containing a lot of markers. Some markers are named '**Condition 1**' and some are named '**Condition 2**'. Condition 1 markers define the position of a particular stimuli displayed during acquisition and Condition 2 markers define another one.

Let's set the filter's name as **show_only_condition1** and the condition to be applied on *Label* with the condition test as *Is Equal To*. On the third dropdown list, we are going to pick Condition 1 as the label's name.

We are done. Clicking on Validate will add the rule and apply it. This rule will tell AnyWave to only display markers named Condition 1.

Note: it is possible to add more conditions to make more complex rules. To do so, click on the + button at the end of the first condition to add another one.

Navigation and statistics

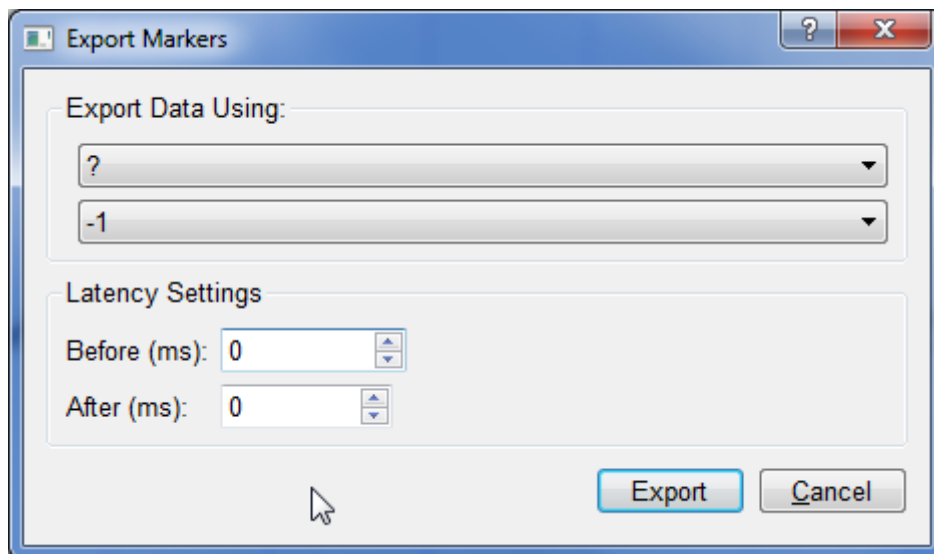
The last part of the user interface briefly summarizes the set of markers.

The total number of markers is displayed in blue color. Above that information, there is the number of markers with a particular label. That can be change to see how many markers have a particular value.

When selecting a label or a value, it is then possible to navigate through those markers. If there is more than one marker, *Prev.* and *Next* buttons will appear allowing to center AnyWave's views on the next or previous marker of that kind. If there is only one marker corresponding to the label or value, then only a *Center On* button will appear.

Export Wizard

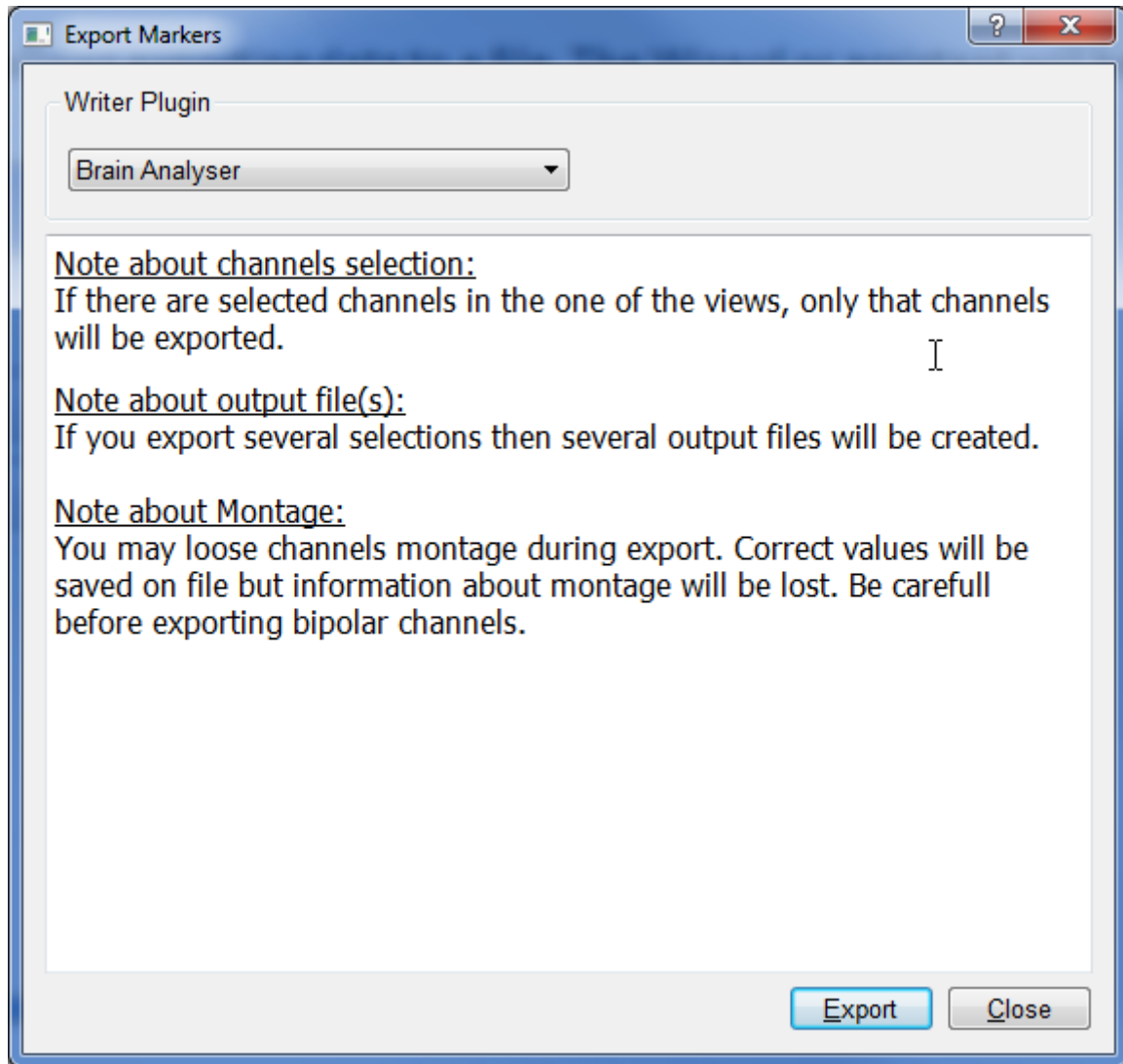
We saw above, that it was possible to export data marked by *Selection* markers. The *Export Wizard* feature will bring an assistant that will help the user to also extract data corresponding to *Single* markers.



The user must choose between label and value to determine markers. In other words, he must choose between exporting data corresponding to a particular label and a particular value.

The latency settings allow transforming a Single marker into a Selection marker by adding time before or after its position. AnyWave will be then able to export the corresponding data segment.

When ready to export, click the Export button to choose the output file format.



Depending on writer plug-ins available to AnyWave, the user can choose the file format to export into.

Other details are explained in the user interface.

Processing data

It is possible to apply some signal processing on the open data file, depending on what Processing plug-ins are loaded by AnyWave during launch.

The default AnyWave installation, will add some plug-ins, like the ICA extraction, Time/Frequency using wavelets, or the H2 correlation plug-in.

By default, the processing plug-in are available under the Process Menu in the main menu bar, but some plug-in may be accessible using other menu. For example, the ICA extraction module is available under the ICA menu.

Checking for process input

Some processing could only be applied on a subset of channels, or on time selections, or event on specific channels types. That's why the user should prepare the input for the processing before launching the processing.

For example, to see the Time/Frequency representation of a signal, the signal must be selected before launching the process.

Note: The Time/Frequency module can handle several signals at the same time.

Checking for channels as input

Some process plug-ins required that some channels must be selected as input before the processing can be applied. That is the case of the Time/Frequency plug-in and the H2 plug-in.

The Time/Frequency module requires that at least one channel is selected, and the processing will compute the corresponding time/frequency representation.

The H2 plug-in requires that at least TWO channels are selected, as the process consists to compute the correlation values between pairs of channels.

Checking for time selections as input

Some process plug-ins required to work on time selections.

Thus, some markers marking time selection must exist before launching this kind of process.

To launch a process while specifying one or more time selections, use the Markers User Interface (See Figure 21), like as follow:

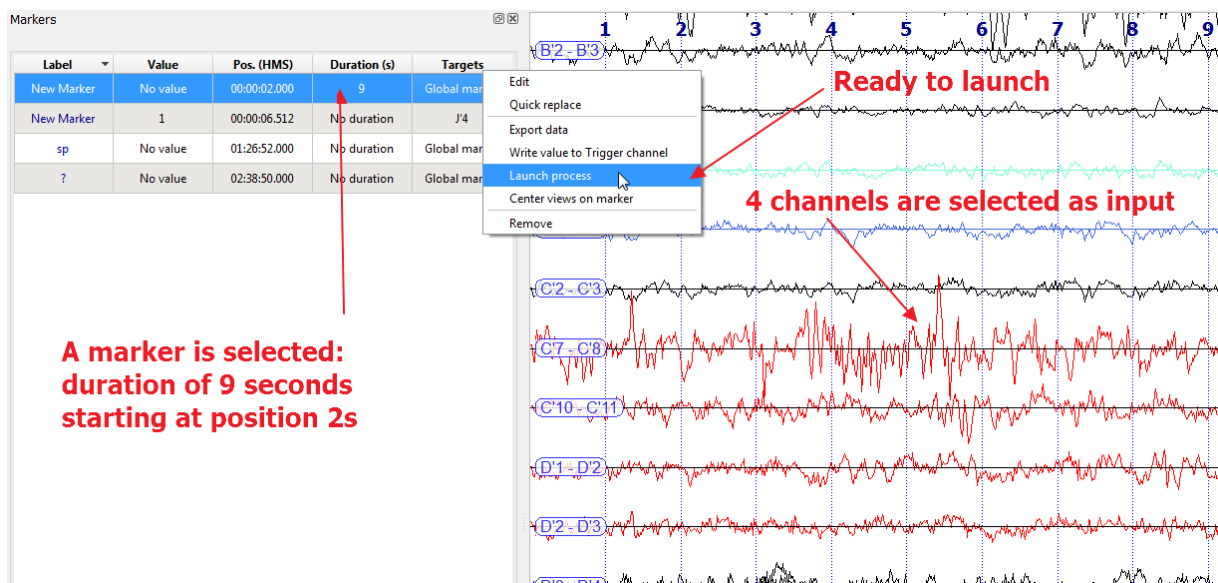


Figure 22 – How to launch a process specifying time selection and channels as input.

After selecting the channels in the view, select the time selection in the Markers UI, and click with the right mouse button to use the Launch process option.

All the process plug-ins which require time selections as input will be available candidates, so the user must then select the process plug-in he wants to use. With the default AnyWave installation, the only plug-in that requires time selections as input is the H2 plug-in.

Launch a process

After using the process menu or the Markers UI to launch a process on data, this UI will appear, docked to the left part of the application:

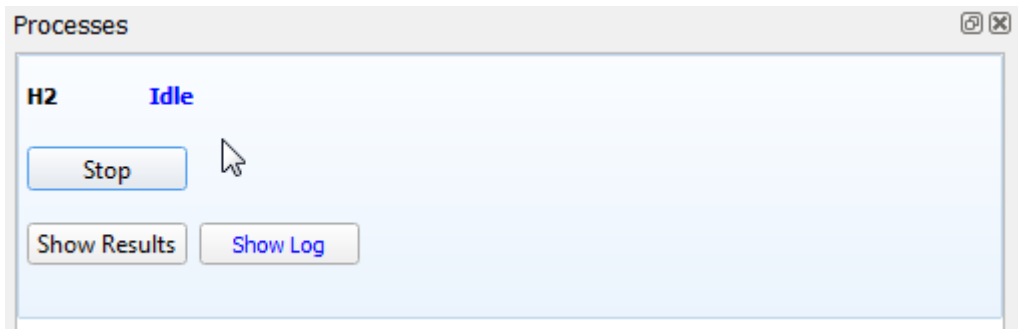


Figure 23 – Processes

The figure above, shows the status of the H2 process. The status is set to Idle, because the process plug-in has finished computing the values but is waiting for the user to review the results.

Note that most of the process plug-ins won't go to the Idle state. Normally, when a process has finished it goes to the finished status.

If the status is set to Running, then the process is currently running, doing calculations. Pressing the Stop button may cancel the current computation and set the process to the aborted or finished status.

The Show Results button will only appear if the process is set to Idle and has some results to show to the user.

The Show Log button will blink in blue, informing that some informations are available in the log.

MATLAB plug-ins

AnyWave is able to launch processing plug-in either written in MATLAB M language or compiled by the MATLAB Compiler as standalone executables.

See the section about home directories on page 3.

The place to put the MATLAB plug-ins is the /home/user/AnyWave/Plugins/MATLAB directory.

A MATLAB plug-in is also a directory containing the plug-in script or executable and a file informing AnyWave about what the plug-in does.

After a MATLAB plug-in is copied within this directory, launch AnyWave and the check if the plug-in is available.

MATLAB Compiled plug-ins

A MATLAB plug-in which are compiled as a standalone executable, requires the MATLAB Runtime to be installed on the system.

This runtime is freely available from Mathworks website

(<http://fr.mathworks.com/products/compiler/mcr/>) and must match the version of MATLAB used to compile the plug-in. For now, all MATLAB plug-ins available for AnyWave are using the MATLAB R2015a runtime.

Install the runtime, and then launch AnyWave.

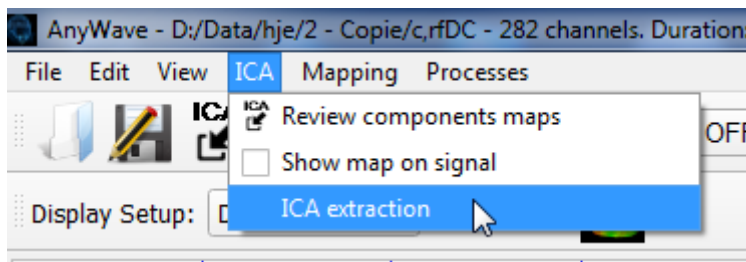
Note: on Mac OS X or Linux systems, the full path to the installed MATLAB runtime must be specified in the AnyWave preferences (Open the Preferences and go to the MATLAB tab).

ICA

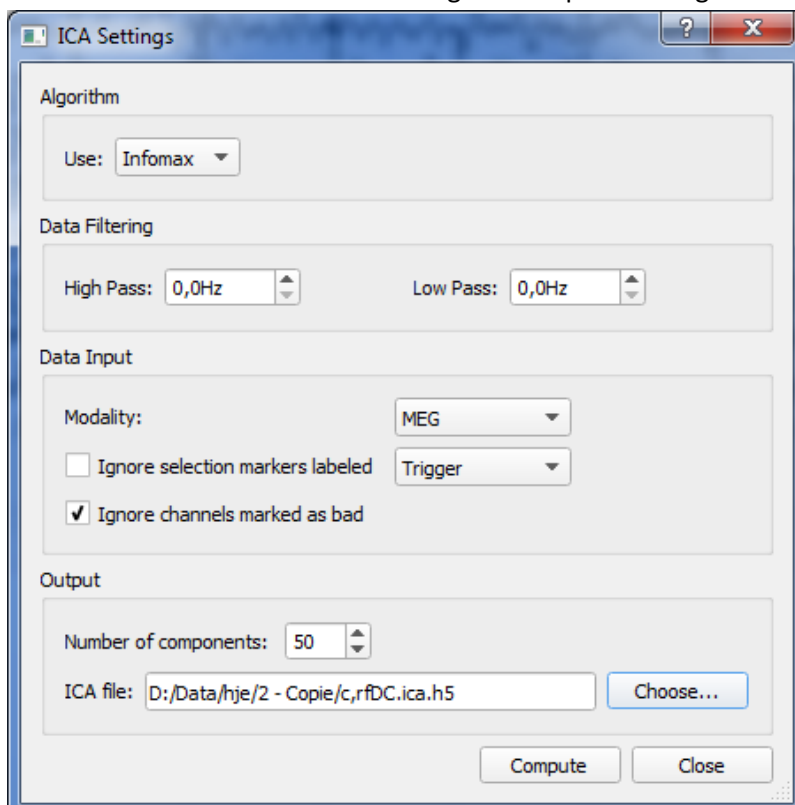
The AnyWave installation package includes the ICA process plug-in which proposes two algorithms (Infomax and Fast ICA).

ICA components extraction will only be applied on EEG or MEG channels, for now.

The ICA process is available under the ICA menu:



The ICA user interface allows selecting the compute settings:



The default selected algorithm is Infomax, filtering can also be applied to data BEFORE the computation, the user can select the channels modality (EEG or MEG is both channel types are present), channels marked as bad will be ignored.

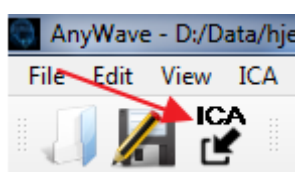
The number of independent components is fixed at 50 but the user can set it manually.

The output of the computation will be a file, in HDF5 format, containing the mixing matrix, the un-mixing matrix, and the labels of the channels.

Note: if a low pass filter is set, the data will be decimated by a factor depending on the chosen frequency. This will speed up the process.

Reviewing the components

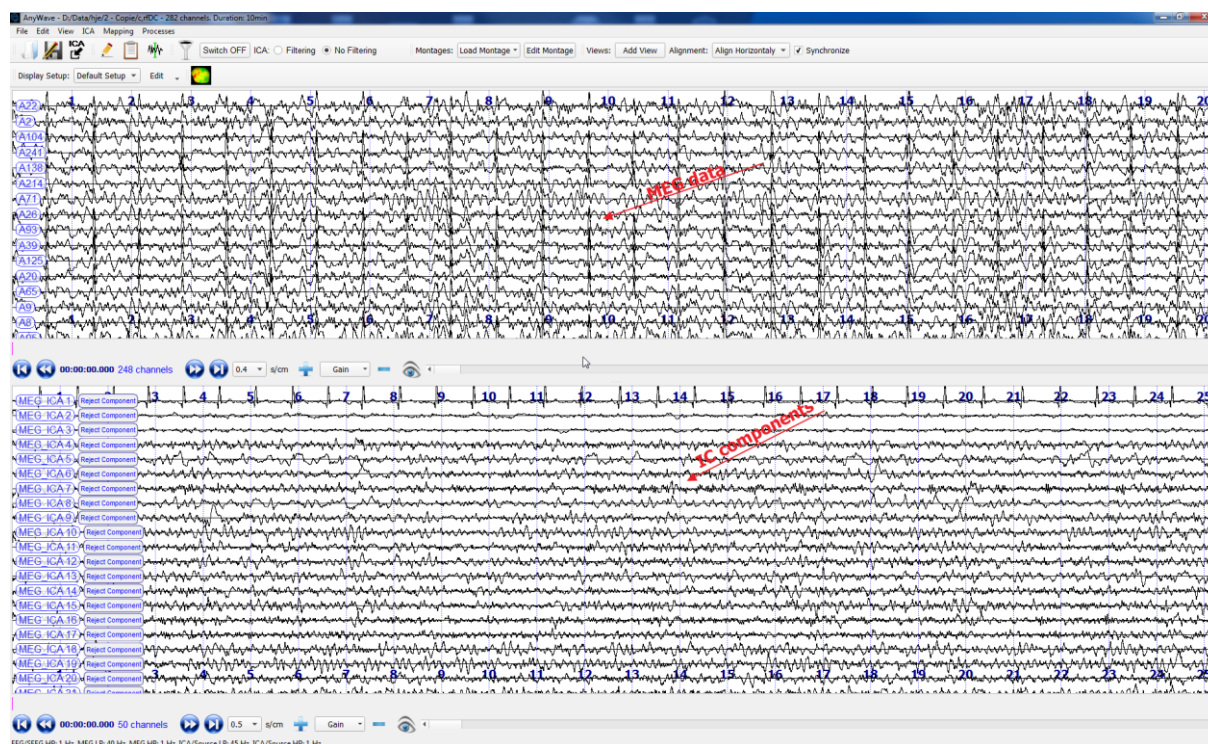
When the ICA computation is done, you can review the components within AnyWave by importing the resulting file (.ica.h5):



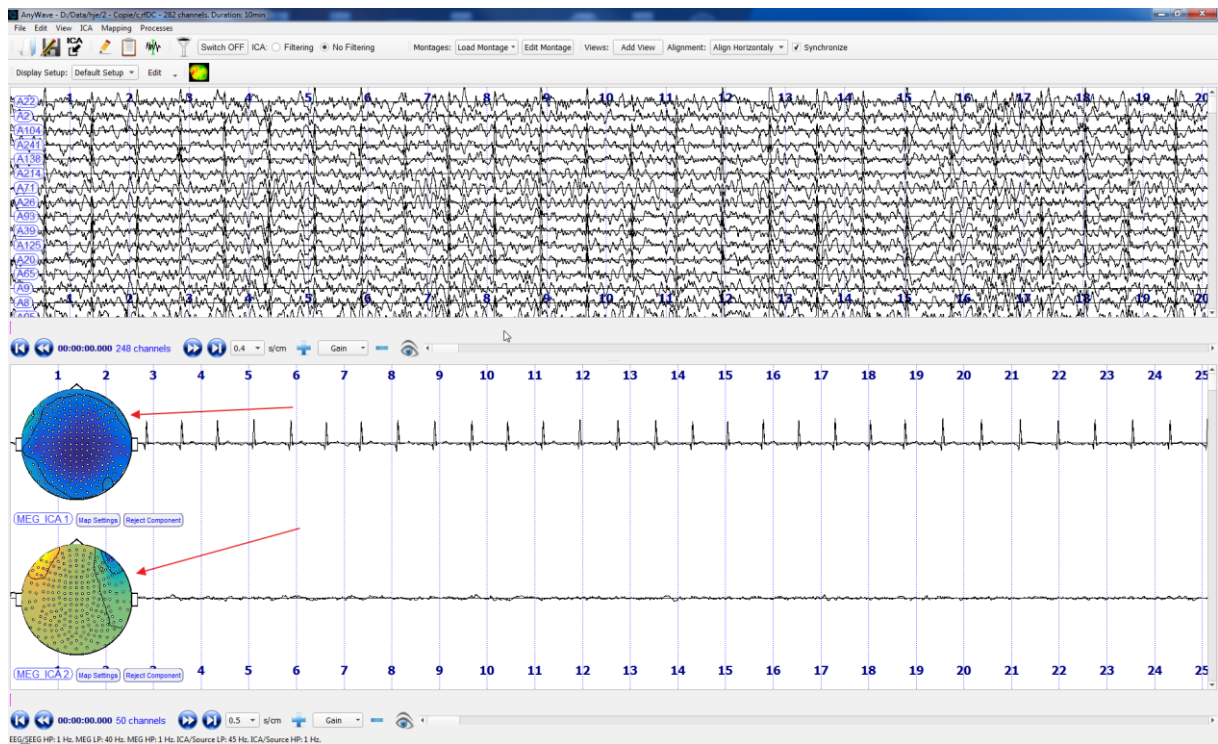
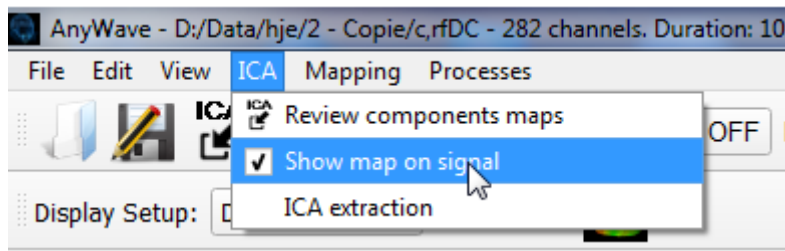
Once the ica HDF5 file is loaded, AnyWave will automatically add ICA virtual channels to the current Montage.

Those channels will represent the time courses of the Independent Components and can be viewed like other channels.

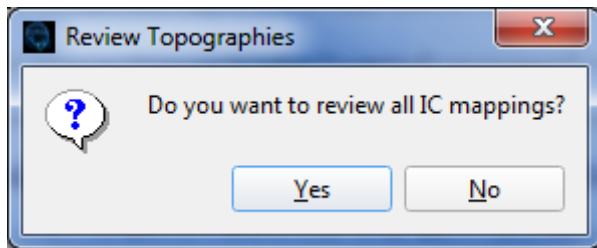
Add a new view and specify that you want to view ICA channels:



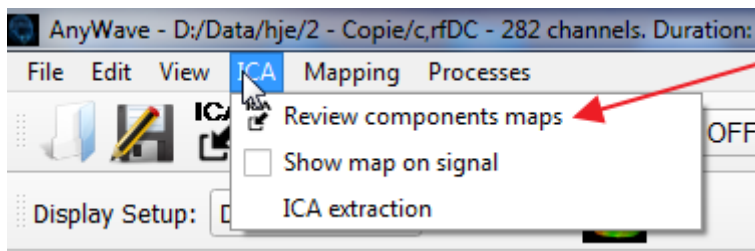
By default, only the time courses are displayed but there is the possibility to see the component map as well with the time course:



Just after the ICA file has been loaded, AnyWave will ask the user if he wants to review the components maps:



This feature is also available under the ICA menu:



This will open a graphics user interface where all the components maps will be shown.

This user interface allows selecting the corresponding ICA channels, rejecting them from the signal or adding them again to the signal.

Removing/adding components

Click on the Reject Component button under the ICA channel maps or time course, or click the Reject button within the review component user interface to remove it from the signal.

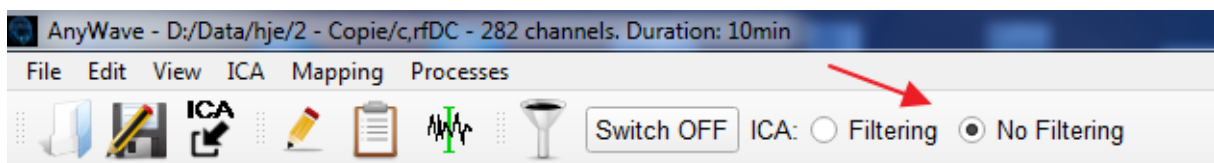
AnyWave will automatically update the original signals, and as long as a component is set to Rejected, it will be removed online from the original data.

Thus, while a component is rejected, if the user exports the data to another file, the data will be saved with the component removed from them.

This is a way to filter the original data by removing artifacted components (heart beats, eye blinks, ...)

If a component was removed but is finally considered as correct, just click on the Add Component button in the view or the Add button in the review components user interface to add it again to the original data.

AnyWave offers a quick way to compare signals with or without some components. If one or several components are rejected, you will see that the ICA filtering is switched to ON in the top toolbar:



This switch permits to manually turn ICA filtering OFF (No Filtering) to see the raw original data.

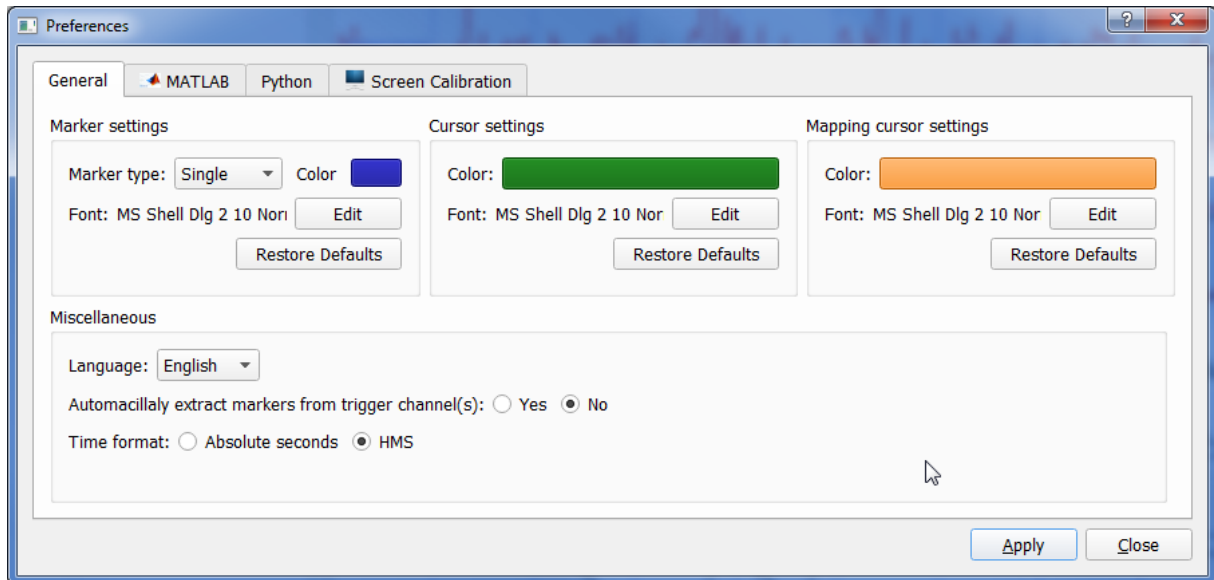
Turning this switch to ON (Filtering) will remove all the components set as rejected. This is a convenient way to quickly compare signals with or without components.

Application preferences

Some general options can be modified in order to change the behavior of AnyWave and improve the user experience.

The user can access the preferences panel by clicking on the *Edit* menu and selecting *Preferences*.

On Mac OS X, preferences are available under the AnyWaveMac Menu.



General

The main part of the preferences panel is dedicated to general options. The user can change the colors used by AnyWave to display markers, cursors and mapping cursors.

Cursors are vertical lines allowing the user to have more information like the real position of a particular point of a signal or the latency between two parts of a signal. By default, cursors are displayed in green color.

Mapping cursors are vertical lines displayed when the user has requested to see 2D or 3D mapping of sensors activities. By default, the mapping cursor is displayed in orange color.

Markers are displayed in red color for *Single* markers and in purple color for *Selection* markers.

Here the user can change the colors and the fonts used by AnyWave to display related information.

Pressing the *Restore Defaults* button will set the default parameters back.

Among the other options that can be modified, there are a set of miscellaneous options:

- Language.
- Signal polarity or EEG Mode.
- Automatic markers extraction.
- Time representation format.

The *language* is quite self explanatory; this is where the user can change the language by AnyWave. Actually, AnyWave can display English or French language.

Automatically Extract Markers: When a data file containing technical channels (Trigger, response, etc.) is open by AnyWave, the user can choose to read the values stored in those channels as markers. With this option set to false, AnyWave will never ask the user to do so when opening a file.

Time Representation: *Absolute Seconds* means that AnyWave will display time information in seconds from the beginning of data. *HMS* will display time information in hour, minute, seconds and milliseconds.

MATLAB

In order to MATLAB scripted plug-ins to be used, the user must specify the path to MATLAB on the system.

AnyWave will try to find it at launch, but sometimes the user must specify the correct path.

For Compiled plug-ins on Mac OS X and Linux systems, the user must also specify the path to the MATLAB Runtime (see section MATLAB Compiled plug-ins above).

Screen Calibration

Beside the general options that can be modified in AnyWave, it is also possible to manually calibrate the screen.

AnyWave displays two segments, which have a fixed length in pixels. Then the user must precisely measure the length of those segments, in millimeters (using a rule could help).

After the measured length in millimeters has been set in AnyWave, the whole display for signals is updated to use the new settings.

That calibration is more often unnecessary, and should be used only if the user notice some glitches on signals displayed.