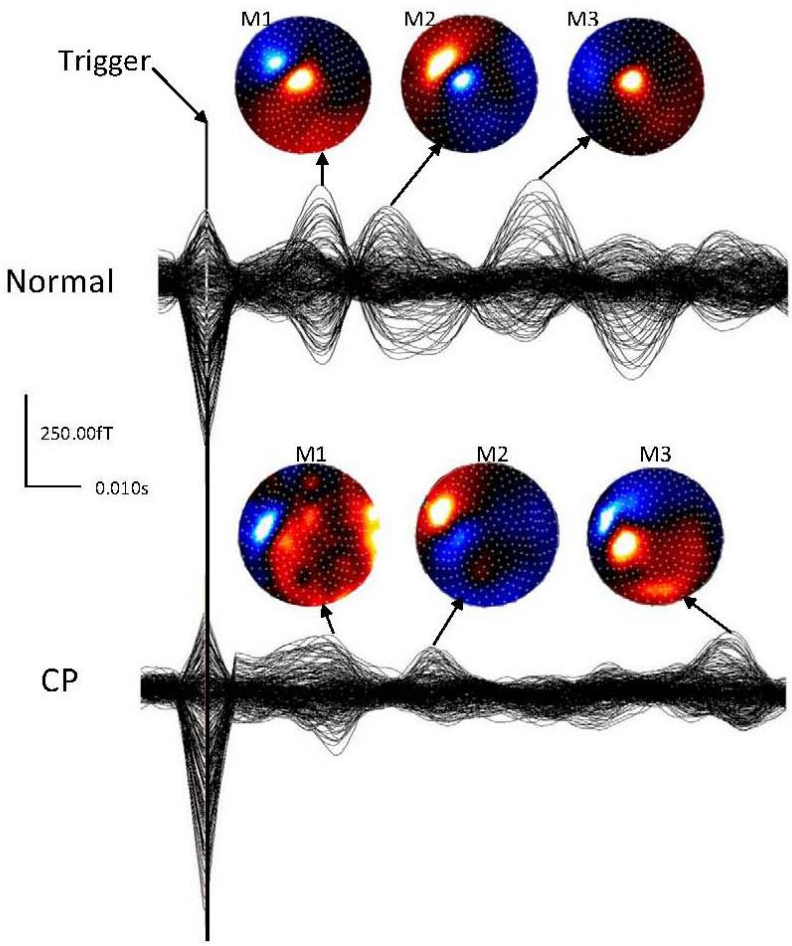
Edit Menu Guide

(*Re-sampling & Marks*)



DISCLAIMER

We have used reasonable effort to include accurate and up-to-date information in this manual; it does not, however, make any warranties, conditions or representations as to its accuracy or completeness. We assume no liability or responsibility for any errors or omissions in the content of this manual. Your use of this manual is at your own risk. Under no circumstances and under no legal theory shall the authors be liable for any indirect, direct, special, incidental, punitive, exemplary, aggravated or consequential damages arising from your use of this manual.

Features and specifications of this software program are subject to change without notice. This manual contains information and images about MEG Processor, its user interface, GUI and its other signal processing algorithms, publications that are protected by copyright.

Sending Your Comments and Critiques: We'd like to hear from you. Your comments and suggestions for improving this document are welcome and appreciated. Please e-mail your feedback to BrainX@live.com

Thank you.

Contents

Warnings and Cautions

This software supports both magnetoencephalography (MEG) and electroencephalography (EEG) data. Though MEG and EEG waveforms appear similar, they have different unit in amplitude. If the MEG and EEG data recorded simultaneously, their time unit or temporal resolution is typically the same.

Modern MEG/EEG systems typically have MEG/EEG sensor/electrode channels as well as other channels. For example, trigger channel, head-localization channels and additional ADC (analog-to-digital) channels. To avoid problems, please pay attention to the channel names and the amplitude value/unit. Their values may be of different orders of magnitude. Unexpected results may occur if their values are mixed in measurements.

When performing waveform analysis, regardless of whether MEG or EEG or both are displayed, ensure that the data are appropriately filtered with DC-offset/linear-trend removal. If the waveforms had very large amplitude (e.g. > 3 pt), it is recommended that you identify possible noise.

There are a set of source localization algorithms in the program. Each source localization algorithm has been designed and tested for specific reasons. To ensure the quality and visibility, all source localization algorithms will generate a volumetric source image, which can be considered as an image with millions of “dipoles” or multi-value-voxel, which is significantly different from the conventional equivalent current dipoles or magnetic source imaging (MSI).

Head movement during MEG recordings may affect the accuracy of source imaging. If subjects move too much during MEG recordings, the MEG results are more than likely poor.

The accuracy of the structural images (MRI/CT) may also affect the MEG results if the conventional magnetic source imaging (MSI) is used. If MRI/CT is distorted, the combination of MEG/MRI/CT will be low-quality. In addition, multiple local sphere, head model or other structural constrained source localization my internally use the MRI/CT images. Any analysis based on those distorted images may yield unexpected or poor results.

The following warnings and cautions appear in this guide. Please ensure you are aware of all the operations and interpretations.

Preface

The Edit Menu provides a set of functions to edit and process MEG/EEG data. It enables to visually mark and classify the data, and identify results of interest for academic or clinical purposes. Importantly, it provides graphic user interface (GUI) for access other function.

Intended Audience

This guide is intended for anyone needing to view or edit data collected using a MEG/EEG system. It assumes the reader is familiar with standard MEG/EEG procedures and with the Windows operating systems.

Document Structure

Documents are generally provided in both Microsoft Word® format and Adobe® Acrobat® PDF (Portable Document Format). All editions are distributed on Flash Driver, CD or websites with the related software, and include bookmarks and hyperlinks to assist navigating the document. Please feel free to send your critiques, corrections, suggestions and comments to MEG_Processor@live.com.

Conventions

Numeric: Numeric values are generally presented in decimal but in special circumstances may also be expressed in hexadecimal or binary. Hexadecimal values are shown with a prefix of 0x, in the form 0x3D. Binary values are shown with a prefix of 0b, in the form 0b00111101. Otherwise, values are presumed decimal.

Units: Units of measure are given in metric. Where measure is provided in imperial units, they are typically shown in parenthesis after the metric units. Magnetic signal strength is given in Teslas (T), the SI unit of flux density (or field intensity) for magnetic fields, also known as the magnetic induction. Typical signal strengths in MEG measurements are in the order of pT (picoteslas = 10^{-12}) or fT (femtoteslas = 10^{-15}).

Edit Menu

The functions in Edit Menu consist of re-sampling waveforms, marking points of interest in the data, and classifying trials, channels, and data segments prior to analysis. This section provides an overview of these operations.

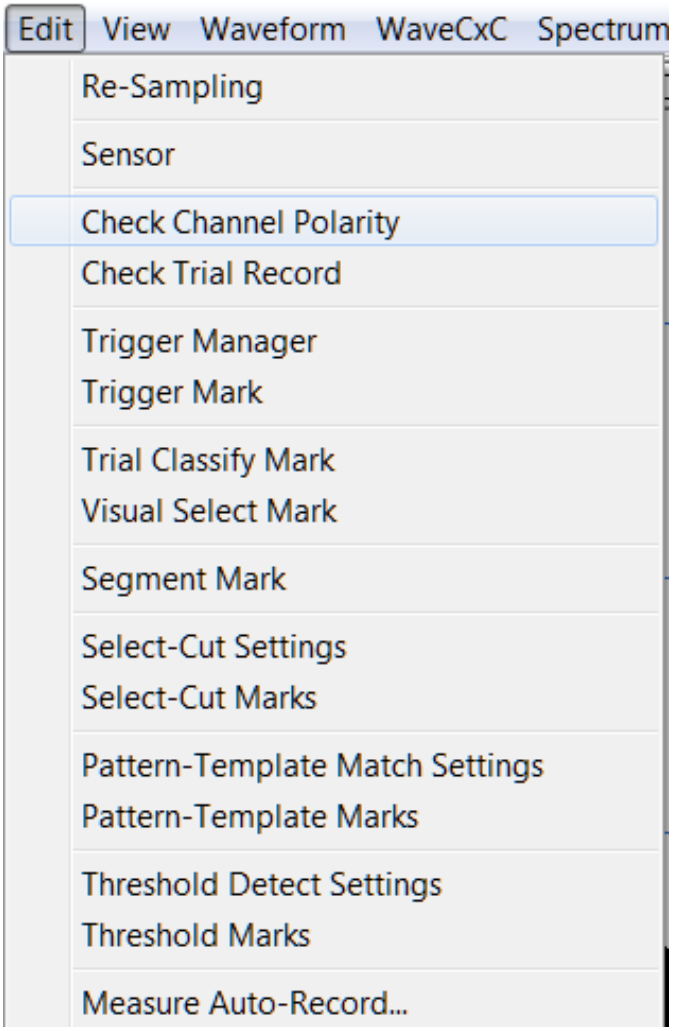


Figure 1. Edit Menu.

Re-Sampling

Re-sampling is very important for analyzing low-frequency signals in high-sampling data because high-sampling generate a huge amount of data, which requires a lot of computer memory. The build-in

re-sampling function enables the data to be re-sampled for specific purposes, such as low-frequency time-frequency transforms.

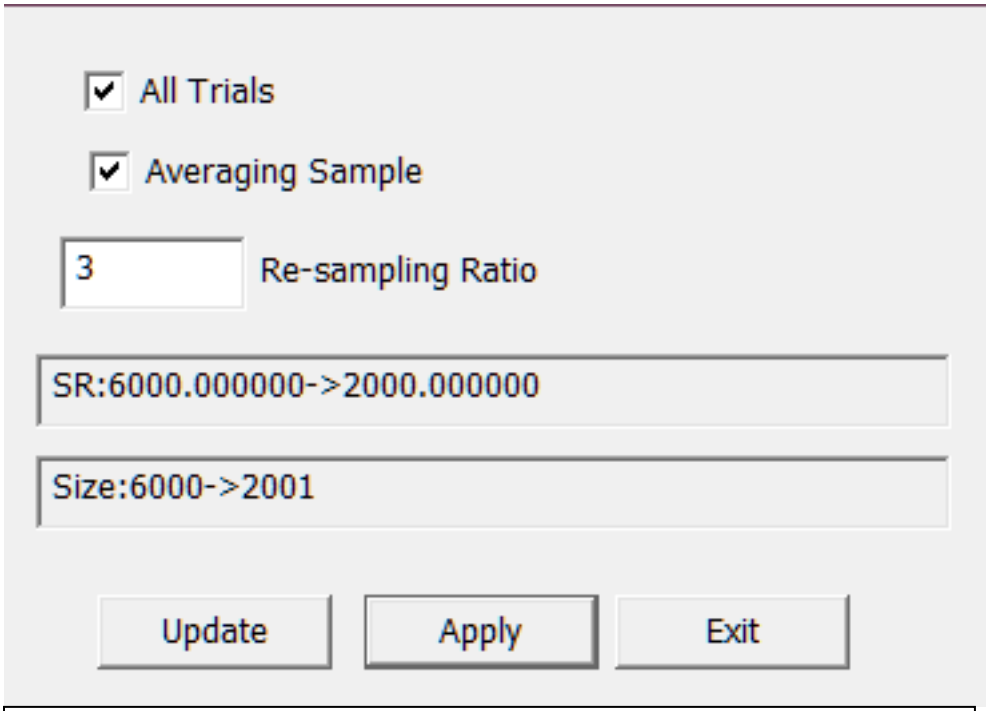


Figure 2. Settings for re-sampling MEG/EEG waveform data.

It is possible to down-sample your data by taking only every nth candidate epoch from the set of qualified events. Resampling is performed on the set of qualified events that have already passed the other selection criteria tests.

During MEG/EEG data re-sampling, the higher re-sampling ratio is, the lower will be in the resulted MEG/EEG waveforms. Consequently, applying a high-resampling ratio will result in low-frequency waveforms which take less computer memory and hard disk.

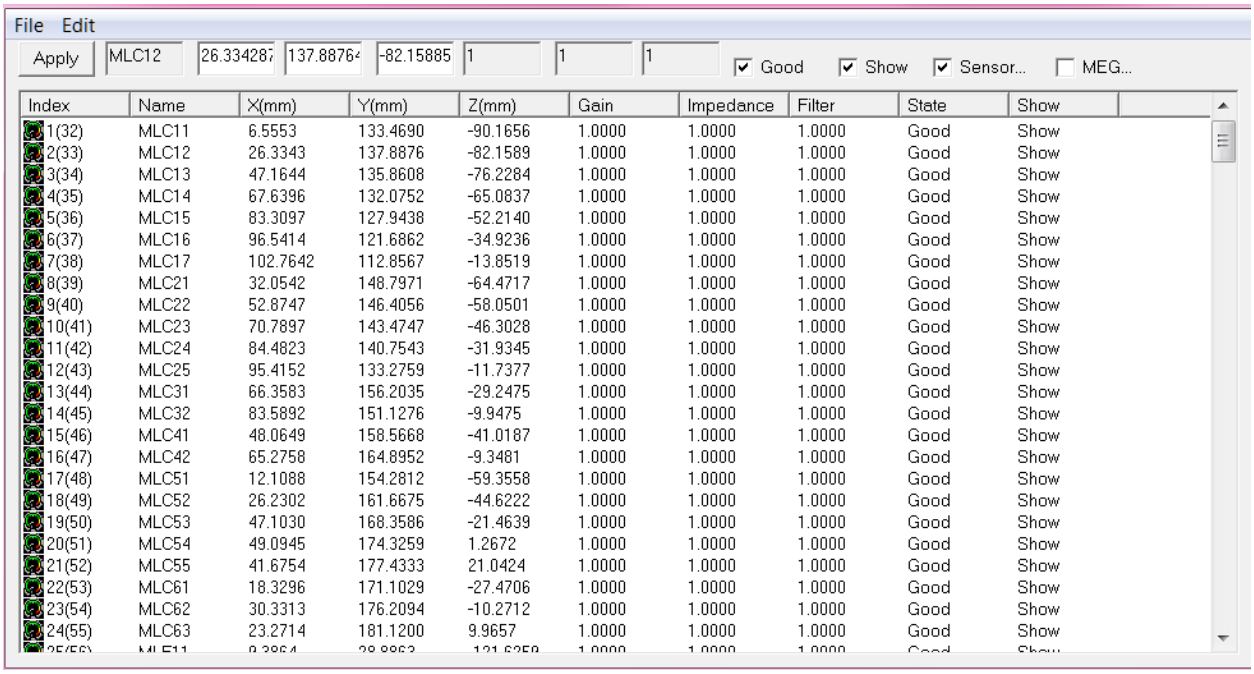
Noteworthy, high-frequency components cannot be analyzed in low-sampled or re-sampled waveforms because there were no high-frequency components in low-frequency data. On the contrary, low-frequency components can be identified in the high sampled MEG/EEG data.

MEG/EEG data can be re-sampled in several ways. According to our experience, using “Averaging Sample” to re-sample MEG/EEG data can generate good waveform without “false” spiking and high-frequency component.

Parameters of MEG Sensor and EEG Electrodes

One dialog or window has been designed to provide the capability to view, edit and change the parameters of MEG sensor and/or EEG electrodes. Since MEG systems typically have fixed sensor array, the positions should not be changed. However, you may set bad channel and hide some sensors due to various reasons such as magnetic noise.

The positions of EEG electrodes may change from subjects to subjects, you may digitize EEG electrode positions and input with the dialog.



Index	Name	X(mm)	Y(mm)	Z(mm)	Gain	Impedance	Filter	State	Show
1(32)	MLC11	6.5553	133.4690	-90.1656	1.0000	1.0000	1.0000	Good	Show
2(33)	MLC12	26.3343	137.8876	-82.1589	1.0000	1.0000	1.0000	Good	Show
3(34)	MLC13	47.1644	135.8608	-76.2284	1.0000	1.0000	1.0000	Good	Show
4(35)	MLC14	67.6396	132.0752	-65.0837	1.0000	1.0000	1.0000	Good	Show
5(36)	MLC15	83.3097	127.9438	-52.2140	1.0000	1.0000	1.0000	Good	Show
6(37)	MLC16	96.5414	121.6862	-34.9236	1.0000	1.0000	1.0000	Good	Show
7(38)	MLC17	102.7642	112.8567	-13.8519	1.0000	1.0000	1.0000	Good	Show
8(39)	MLC21	32.0542	148.7971	-64.4717	1.0000	1.0000	1.0000	Good	Show
9(40)	MLC22	52.8747	146.4056	-58.0501	1.0000	1.0000	1.0000	Good	Show
10(41)	MLC23	70.7897	143.4747	-46.3028	1.0000	1.0000	1.0000	Good	Show
11(42)	MLC24	84.4823	140.7543	-31.9345	1.0000	1.0000	1.0000	Good	Show
12(43)	MLC25	95.4152	133.2759	-11.7377	1.0000	1.0000	1.0000	Good	Show
13(44)	MLC31	66.3583	156.2035	-29.2475	1.0000	1.0000	1.0000	Good	Show
14(45)	MLC32	83.5892	151.1276	-9.9475	1.0000	1.0000	1.0000	Good	Show
15(46)	MLC41	48.0649	158.5668	-41.0187	1.0000	1.0000	1.0000	Good	Show
16(47)	MLC42	65.2758	164.8952	-9.3481	1.0000	1.0000	1.0000	Good	Show
17(48)	MLC51	12.1088	154.2812	-59.3558	1.0000	1.0000	1.0000	Good	Show
18(49)	MLC52	26.2302	161.6675	-44.6222	1.0000	1.0000	1.0000	Good	Show
19(50)	MLC53	47.1030	168.3586	-21.4639	1.0000	1.0000	1.0000	Good	Show
20(51)	MLC54	49.0945	174.3259	1.2672	1.0000	1.0000	1.0000	Good	Show
21(52)	MLC55	41.6754	177.4333	21.0424	1.0000	1.0000	1.0000	Good	Show
22(53)	MLC61	18.3296	171.1029	-27.4706	1.0000	1.0000	1.0000	Good	Show
23(54)	MLC62	30.3313	176.2094	-10.2712	1.0000	1.0000	1.0000	Good	Show
24(55)	MLC63	23.2714	181.1200	9.9657	1.0000	1.0000	1.0000	Good	Show

Figure 3. The window for viewing, editing and change the position of sensors.

MEG Sensor Setup

The MEG Sensor Setup dialog enables precise defining the position, orientation and other parameters. However, this function is designed for trouble shooting and methodological developments. It is rarely used in clinical work and/or neuroscience research.

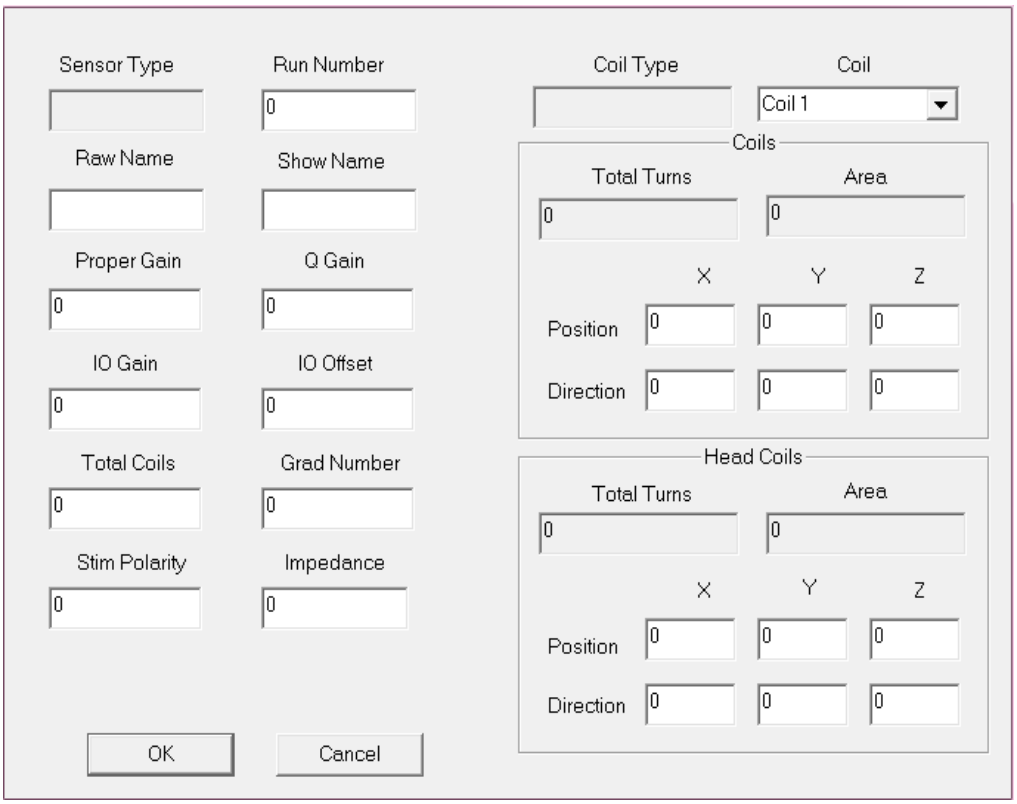


Figure 4. The window for setting up MEG sensors and coils.

Check Channel Polarity

Sensors in MEG systems may have some polarity and coefficients. This function will check and verify this integrity and sanity of the polarity and coefficients.

Check Trial Record

Since functional MEG/EEG recordings typically have many trials. To minimize the use of computer memory and improve the performance, the data of each trial is stored separately in this program. This function will check the integrity and sanity of trial data.

Trigger Manager

Trigger Manager provides GUI to edit and check the triggers recorded during the data acquisition. In functional MEG/EEG recordings, triggers can be responses or feedbacks such as visual-cue finger tapping or sound-cue finger tapping. Some "triggers" may occur during a recording window and become as "junk" triggers, which do not initialize or synchronize the recordings. In this case, trigger manager can help with removing some junk triggers.

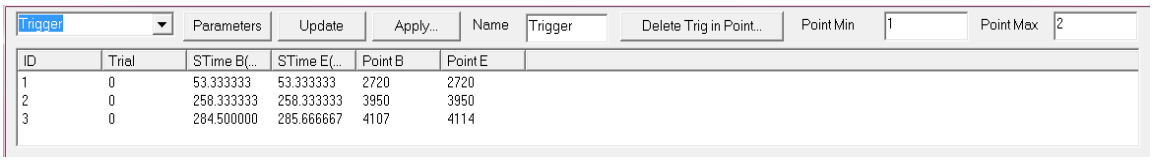


Figure 5. Trigger Manager.

Trigger Mark

Triggers are typically recorded during MEG/EEG data acquisition. However, not all stimulation software can send "triggers" to the MEG/EEG data acquisition system in real-time that can be recorded in the data. Trigger Mark provides GUI to add triggers as marks after the MEG/EEG data have been recorded. One typical scenario is that the MEG/EEG systems have a ADC (analog to digital converter) that provide clues for marking triggers or the stimulation software which has a log file to mark the trigger.

The trigger mark dialog can be used with the trigger manager for refining the triggers in the MEG/EEG data for précising control the averaging. Since functional MEG/EEG recordings, triggers can be responses or feedbacks such as visual-cue finger tapping or sound-cue finger tapping, the combination of trigger mark and trigger manager can be very useful for the study of higher brain function.

It is important to note that you must add at least one kind of trigger groups before picking the trigger point. If there are trigger groups, you need to select one for the software to add trigger.

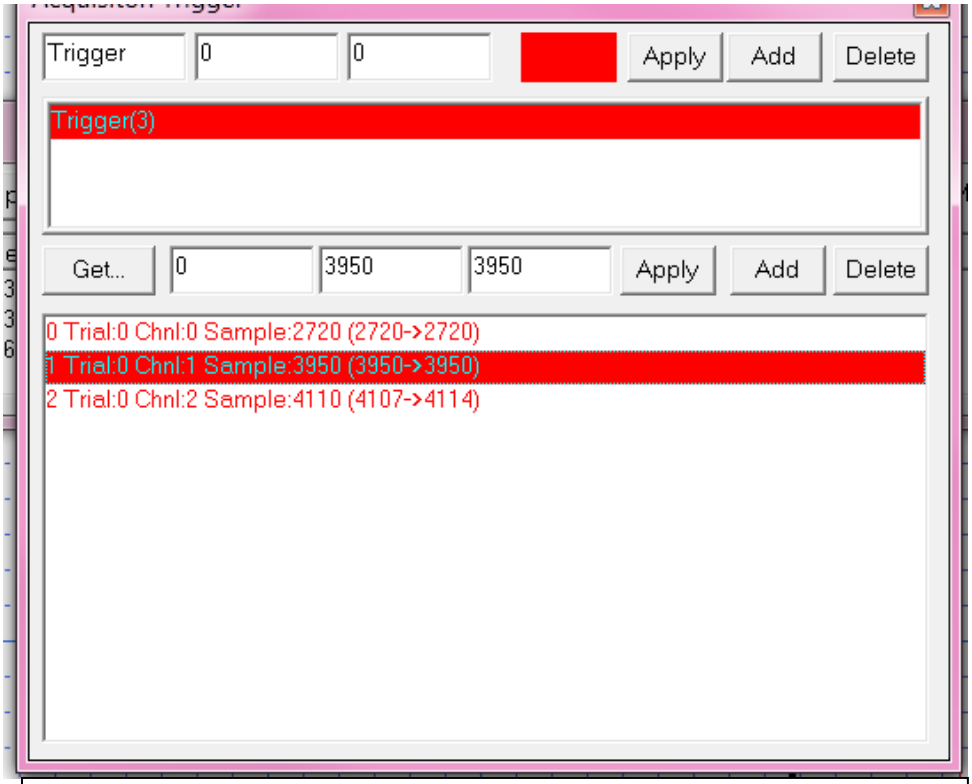


Figure 6. Trigger Mark enables to add "triggers" after MEG/EEG data have been recorded.

Trial Classify Mark

MEG Processor provides a predefined trial classification called "Bad" to classify data containing eye b links or other unwanted artifacts that can skew averaging and analysis results. Any trial with a classification beginning with the letters "bad" in any mixture of upper or lower case can be excluded from analysis — e.g., "Bad-Blink". You can also define other classes to identify trials containing other types of events (see Figure 10).

Adding a Trial Classification

It is important to note that you must add at least one kind of trial classification groups before picking the trigger point. If there are trial clasification groups, you need to select one for the software to add trigger.

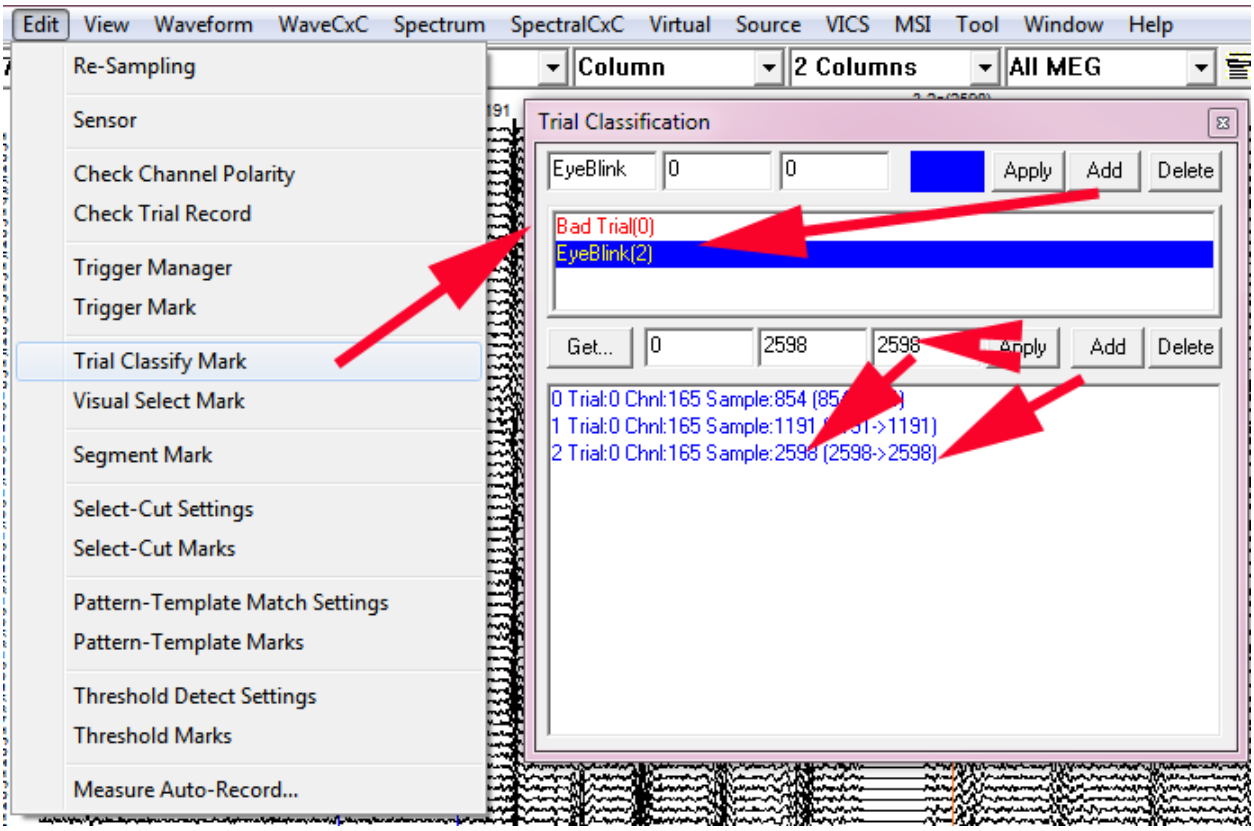


Figure 7. Trial Classification with Markers.

Removing a Trial Classification

1.Trial-by-trial Method: In the main frame viewer, find the trial you want to reclassify by scrolling to it with the double-arrow scroll bars in the control panel, or by selecting from the Trial Combo box and specifying trial. One the trial is displayed, click right Mouse Button and uncheck the “Good Trial” or “Bad Trial”.

2. Select the Edit->Trial Classification menu to open the dialog with a list of defined classes. Click the Remove Button to remove the selected trial classification.

Visual Mark

Select the range of data to classify.

Using the range cursor, select the data segment you want to classify as “noise”. If it is in the visual selection mode, the noisy segment will automatically add to the lists. If not, click the Add button will add it.

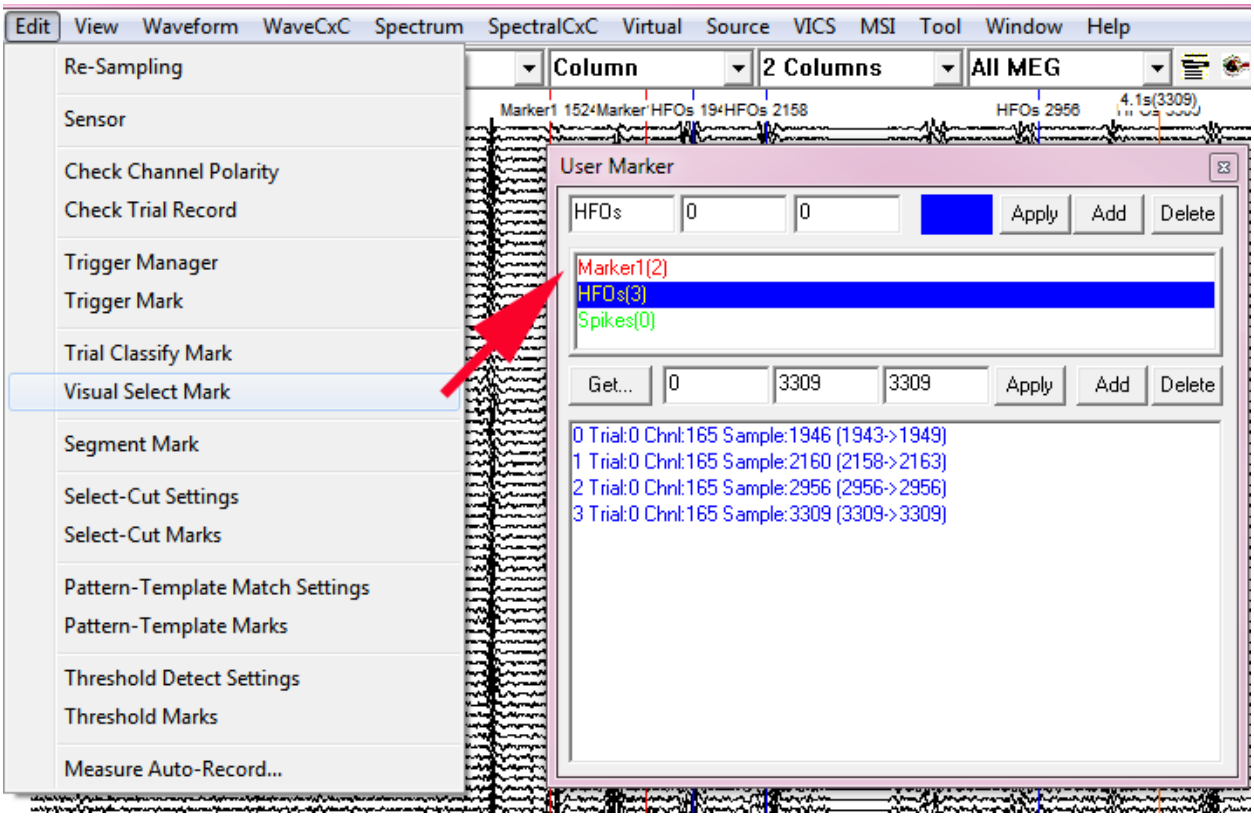


Figure 8. Dialog for MEG/EEG waveform mark.

Edit the mark

In the mark dialog, you may change or edit the data point range, trial number (Figure 11). To apply the changes, just click the Apply button. You may also delete any mark by selecting it in the list and then click the Delete button.

Segment Mark

You can set as many segments of a selected range of waveform data this function. The marked data segments can be used to as data selection in source localization or other analysis such as “active” or “silent” comparison. Select the Edit->Segment Mark menu to open the dialog with a list of defined segment.

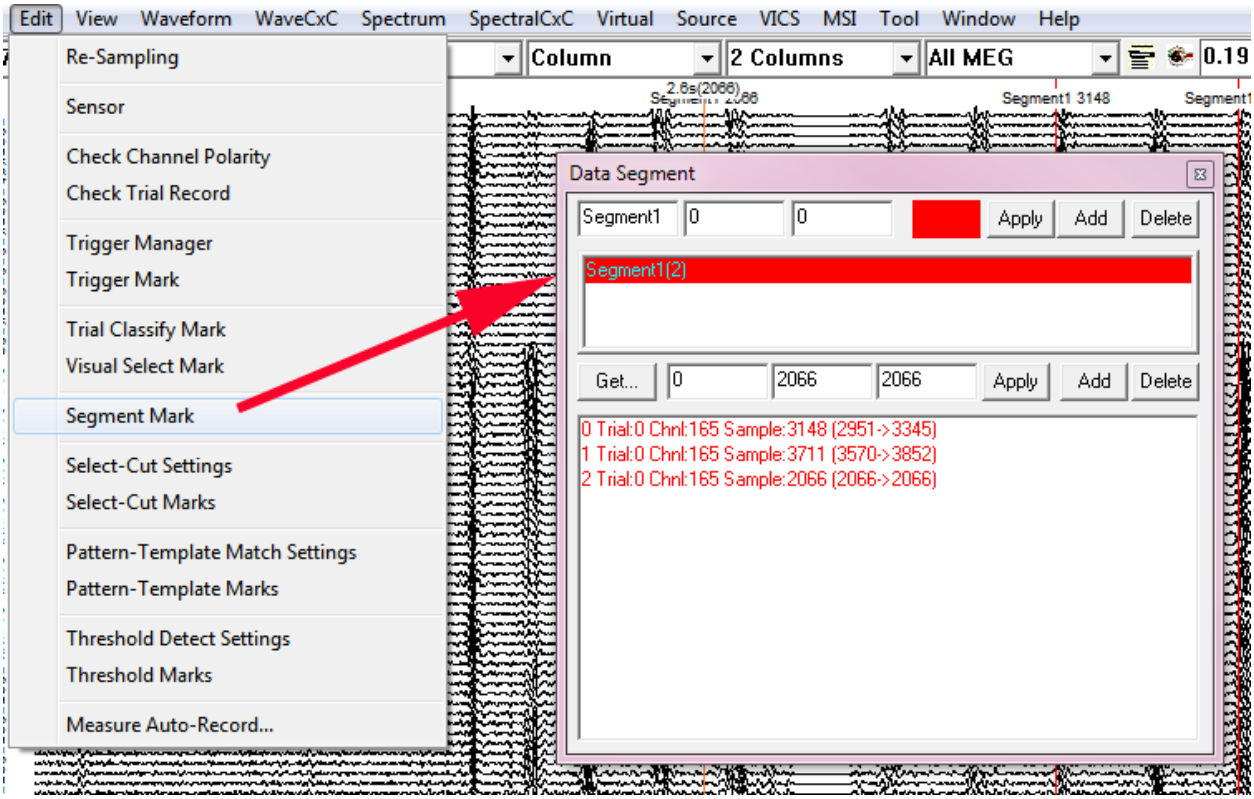


Figure 9. Dialog for MEG/EEG waveform segmentation.

Select the range of data segment.

Using the range cursor, select the data segment you want to classify as “noise” or “bad”. If it is in the segmentation mode, the bad segment will automatically add to the segment lists. If not, click the Add button will add it.

Edit the segment

In the segment dialog, you may change or edit the data point range, trial number (Figure 11). To apply the changes, just click the Apply button. You may also delete any segments by selecting it in the list and then click the Delete button.

Select-Cut Settings

One of the very useful tools for removing bad data is select-cut function. Importantly, the data edit is reversible. Therefore, it provides the flexibility to process priceless data in timely-manner.

Select menu Edit->Select-Cut Settings to define how the work will be done

The “Replace with previous” option will minimize “false high-frequency signals” due to the selection and cut.

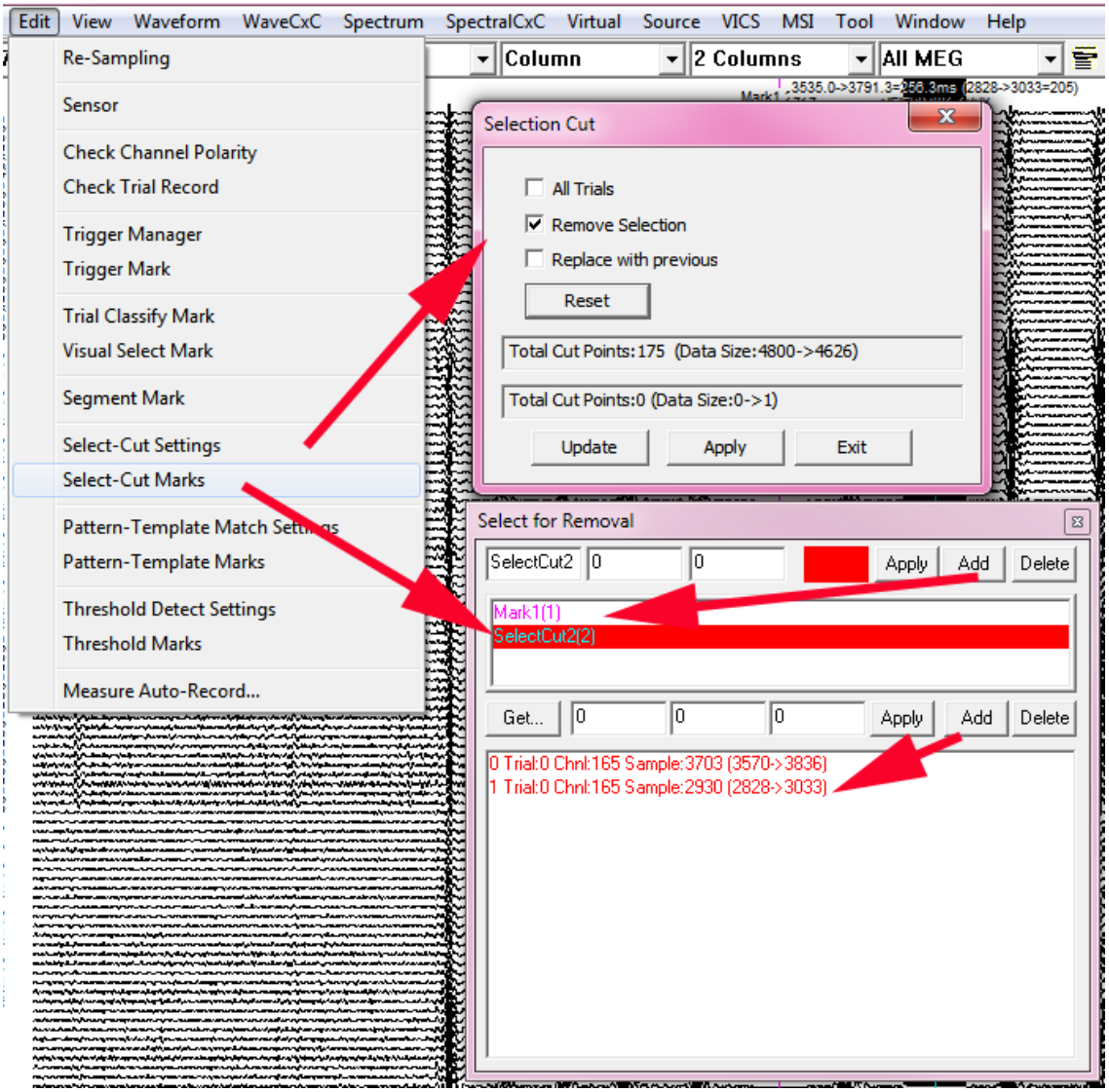


Figure 10. Dialogs for MEG/EEG waveform select-cut.

Select-Cut Marks

One of the very useful tools for removing bad data is select-cut function. Importantly, the data can be restored if necessary.

To perform the task, select menu Edit->Select-Cut Marks to show the selections and then click the right-mouse button.

To make life easier, the Select-Cut GUI is very similar to data segmentation. You can set as many selections of a selected range of waveform data using MEG Processor (i.e., a data segment) to "cut-list" using the following segmentation.

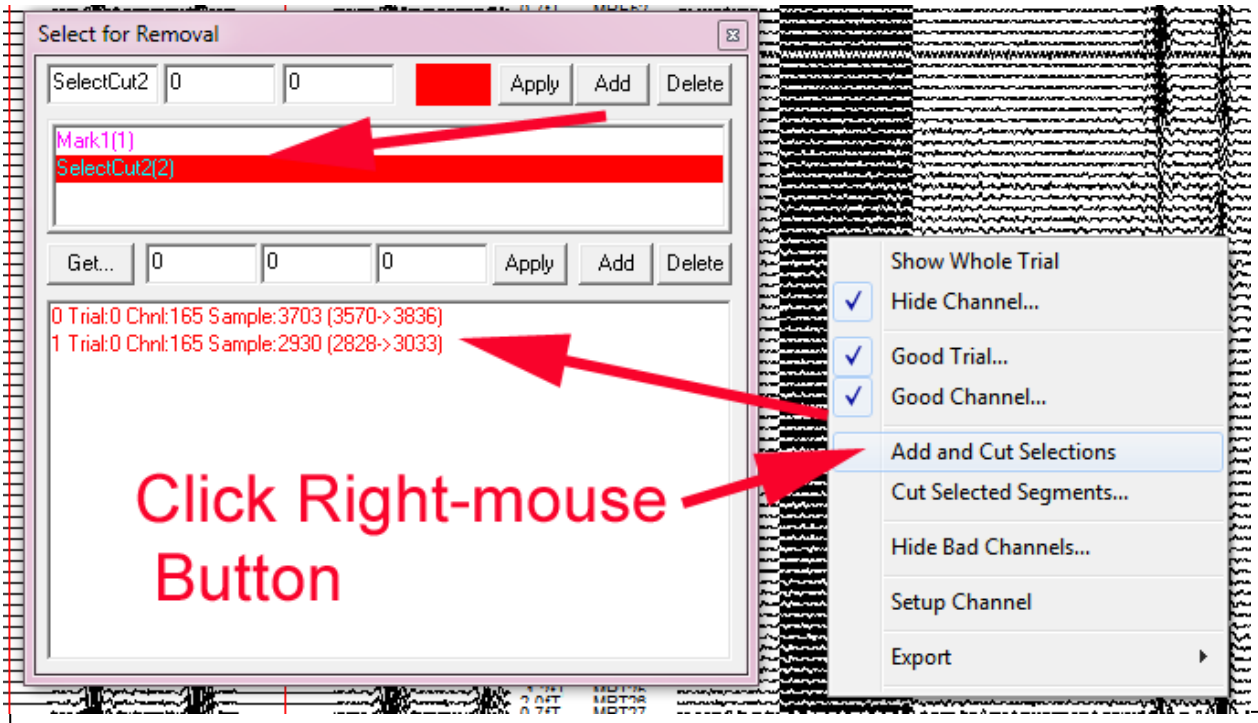


Figure 11. By clicking the right-mouse button and selecting the "Add and Cut Selections" popup-menu, a "piece of bad-data" can be easily selected and cut. Noteworthy, the operation is reversible.

Pattern Template Match Settings

1. Select the channel(s) to perform pattern-template matching.

Select one or more channels, channel groups, or channel types to mark. (For more information, see “Selecting Channels in the Main Window” on page 36.)

WARNING and NOTICE

Different type of MEG/EEG channels (e.g. MEG, EEG, ADC and Trigger) may not be distinguished from each other in terms waveforms. However, because their values are typically of different orders of magnitude, unexpected results may occur if different type of channels are selected for simultaneous threshold detection. To avoid problems, only select one type of channels (MEG or EEG) at a time.

Note: Do not select MEG and EEG channels at the same time.

2. Use the range cursor to select the pattern-template data.

If you want to base the pattern-template on a waveform pattern (e.g. Spike, or spike-and-wave discharge, high-frequency bursts) in the current dataset, select it using the range cursor. Alternatively, you can open a template dataset file to use as the template.

3. Open the Pattern-Template Matching dialog.

From the Main Frame, select the Edit -> Pattern-Template Matching menu option to display the Pattern-Template dialog (see Figure 64 on page 120).

4. Specify weight and correlation values.

Enter values for the weight to apply to MEG and EEG channel types when more than one channel is selected, and for the correlation threshold (the minimum correlation required for a match). For more information about these fields, see page 124.

5. Specify names for the pattern-template matching event and scan window.

Enter the scan event to locate during template matching (the marker set name) and the scan window (the number. of samples centered around this event over which template matching will be performed).

The Scan event and Scan window fields are useful when you want to locate an existing marker (the scan event), then apply the template pattern over an area of data around the marker (the scan window) to search for a similar pattern in the data. For example, you could first run the spike/spike-wave-discharge/rhythmic bursts application to mark all the events in the data, then search for the spike markers and compare the shape of the patterns in the marked samples to the template pattern. To

speed processing, you can specify a scan window around the spike markers, rather than performing template matching over the entire dataset. When a match is found, the template marker will be placed at the midpoint of the matched range.

If you do not specify these fields, the program will apply the template pattern across all data in the current trial (or entire dataset) without looking for any previous markers.

6. Specify the pattern-template data.

The template data can be a range of data in the current dataset that you select using the range cursor, or it can be the data in a template data file.

Range cursor selection: If you have not yet selected a pattern in the current dataset to use as the template, you can use the range cursor to do this while the dialog is open.

After making the selection, click the Set to range cursor button to update the dialog.

Template data file: If you want to use saved template data as the pattern instead, click the Open template data button then select the template dataset to use.

For either method, enable the Update Template (Woody Filter) option if you want to update the template as each match is made to create a running average of the original template pattern and all the matches.

7. Specify names for the marker set and trial classification.

In the Save Marker as field, enter a name for the marker set to use for marking samples that match the template pattern. If you want to classify trials that contain matched events, enter a name for the trial class and indicate whether you also want to classify the trials as BAD. For more information about the trial classification area of this dialog, see “Classify trial as” on page 126.

8. Specify the applicable channels.

If you have already selected the channels on which to apply template matching before opening the Template Matching dialog, they will be listed in the bottom pane. You can also select channels in the strip chart while this dialog is open (or change the existing channel selection). Click the Select Channels button to update the channel list in the bottom pane if you add or change the channel selection.

9. Specify the trial scope.

At the bottom of the dialog, select whether you want template matching to apply to all trials (Scan All Trials option) or only the current one (Scan Current Trial Only option).

10. Begin template matching.

Click the Apply button.

During the pattern-template matching process, the program will create the specified marker set (if it does not yet exist) and add markers to samples that match the template data. If you have enabled trial classification, it will also create the trial classification (if it does not yet exist) and classify trials containing the matched events. For more information on the Pattern Matching dialog, see “Template Match” on page 122.

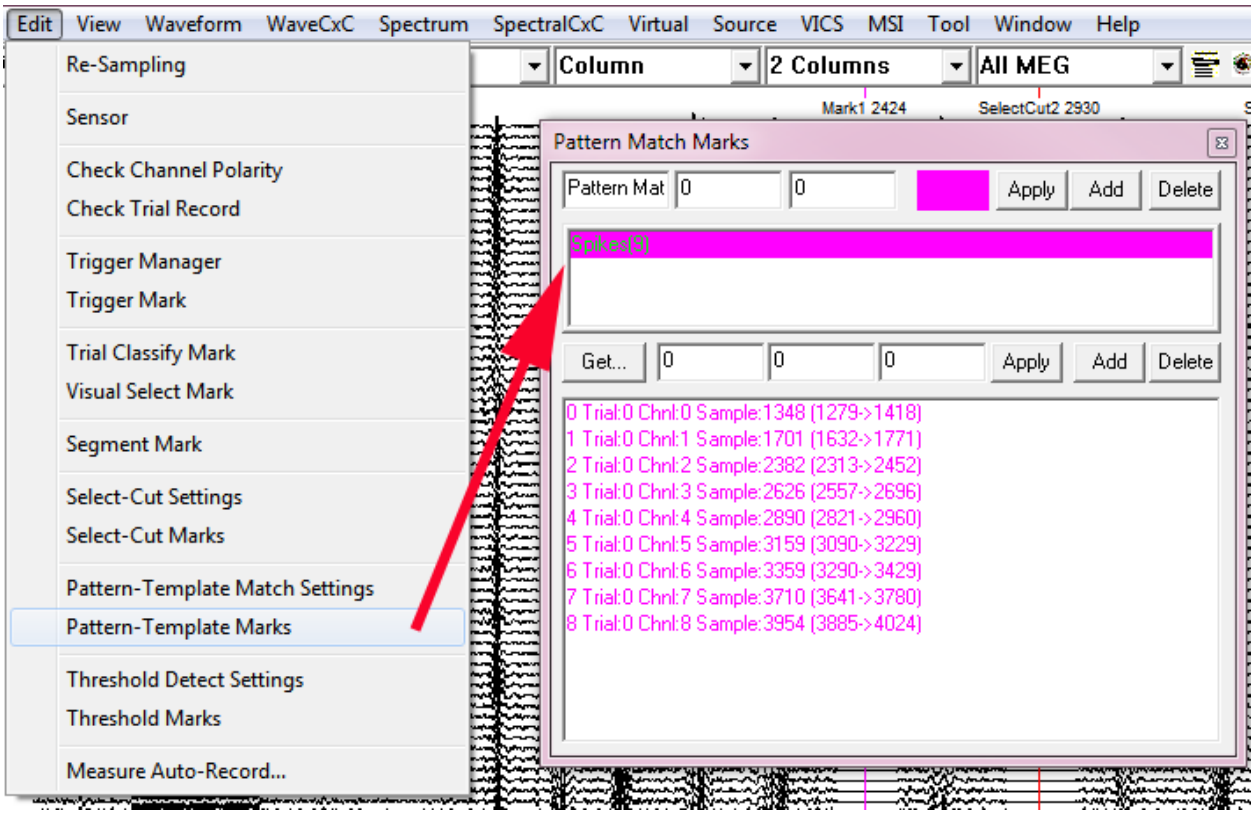


Figure 12. Pattern-Template matched events. The management of the events is similar to marks and segments.

Threshold Detection

1. Select the channel(s) to perform threshold detection.

Select one or more channels, channel groups, or channel types to mark. (For more information, see “Selecting Channels in the Main Window” on page 36.)

WARNING and NOTICE

Different type of MEG/EEG channels (e.g. MEG, EEG, ADC and Trigger) may not be distinguished from each other in terms waveforms. However, because their values are typically of different orders of magnitude, unexpected results may occur if different type of channels are selected for simultaneous threshold detection. To avoid problems, only select one type of channels (MEG or EEG) at a time.

Note: Do not select MEG and EEG channels at the same time.

2. Use the range cursor to select the threshold data.

If you want to base the criteria of threshold on a pattern in the current dataset, select it using the range cursor. Alternatively, you can specify threshold values in the Threshold Detector dialog.

3. Open the Threshold Detector dialog.

From the main window, select the Analyses -> Threshold Detect menu option to display the Threshold Detector dialog (see Figure 64 on page 120).

4. Specify threshold values.

Enter values for the Amplitude Threshold, Derivative Threshold, and Dead Time, or click Get Values From

Cursor to populate these fields with the values contained in the data pattern selected by the range cursor. For more information about these fields, see page 120.

5. Specify names for the threshold marker set and trial classification.

In the Save Marker as field, enter a name for the marker set to use for marking samples that meet the threshold criteria. If you want to classify trials that contain samples meeting the specified threshold criteria, enter a name for the trial class and indicate whether you also want to classify the trials as Threshold-Bad. For more information about the trial classification area of this dialog, see “Classify trial as” on page 121.

6. Specify the applicable channels.

If you have already selected the channels on which to apply threshold detection before opening the Threshold Detector dialog, they will be listed in the bottom pane. You can also select channels in the strip chart while this dialog is open (or change the existing channel selection). Click the Select Channels button to update the channel list in the bottom pane if you add or change the channel selection.

7. Specify the trial scope.

At the bottom of the dialog, select whether you want threshold detection to apply to all trials (Scan All Trials option) or only the current one (Scan Current Trial Only option).

8. Start threshold detection.

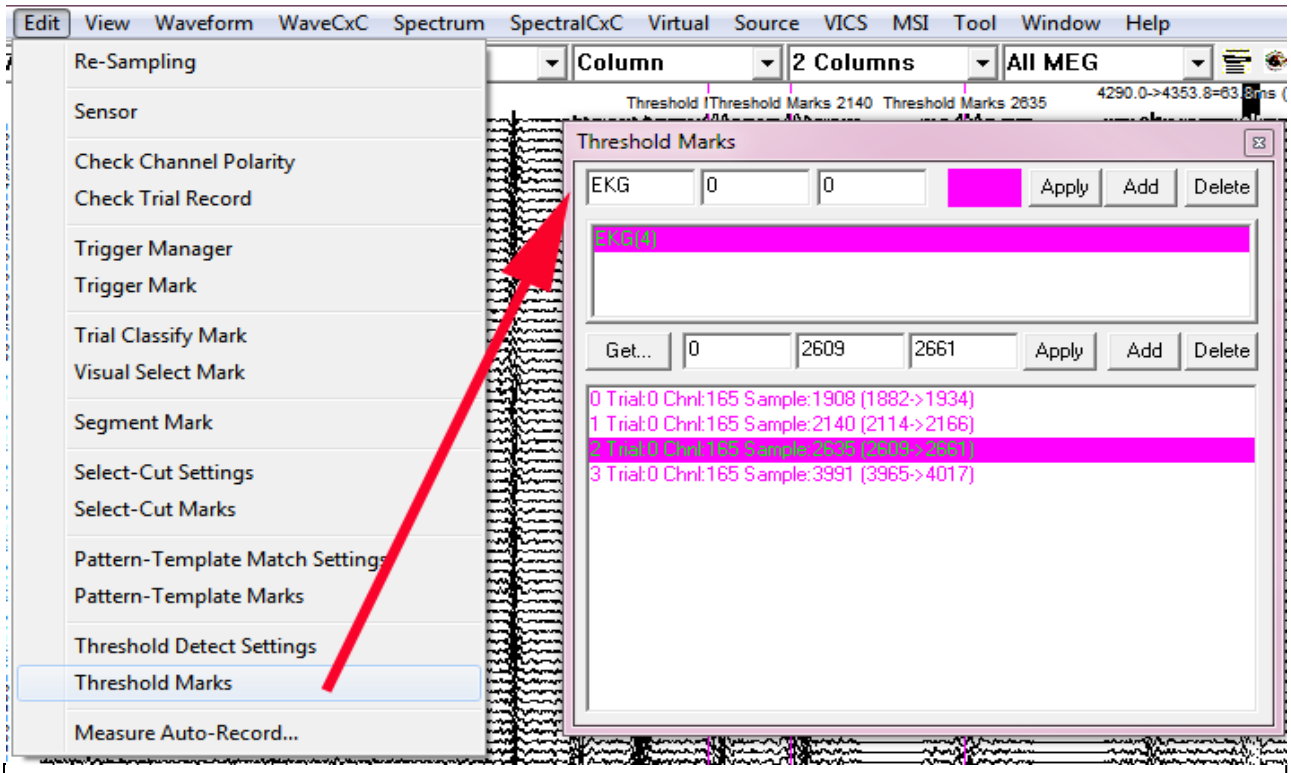


Figure 13. Threshold detected events. The management of the events is similar to marks and segments.

Click the Start button.

During the threshold detection process, MEG Processor will create the marker set (if it does not yet exist) and add markers to samples that meet the threshold criteria. If you have enabled trial classification, it will also create the trial classification (if it does not yet exist) and classify trials containing the threshold events. For more information on the Threshold Detector dialog, see “Threshold Detection” for details).

Measure Auto-Record

To facilitate the measurements of the latency and amplitude of MEG/EEG waveforms, a window for automatically recording the measure results has been designed. In the measurement working mode, clicking on the waveform will automatically measure and store the results of the latency and amplitude of the selected data point.

You may save the measure results and used in other analysis software such as Excel. In addition, you can copy the results ("Ctl + V") to other program for additional statistical analysis.

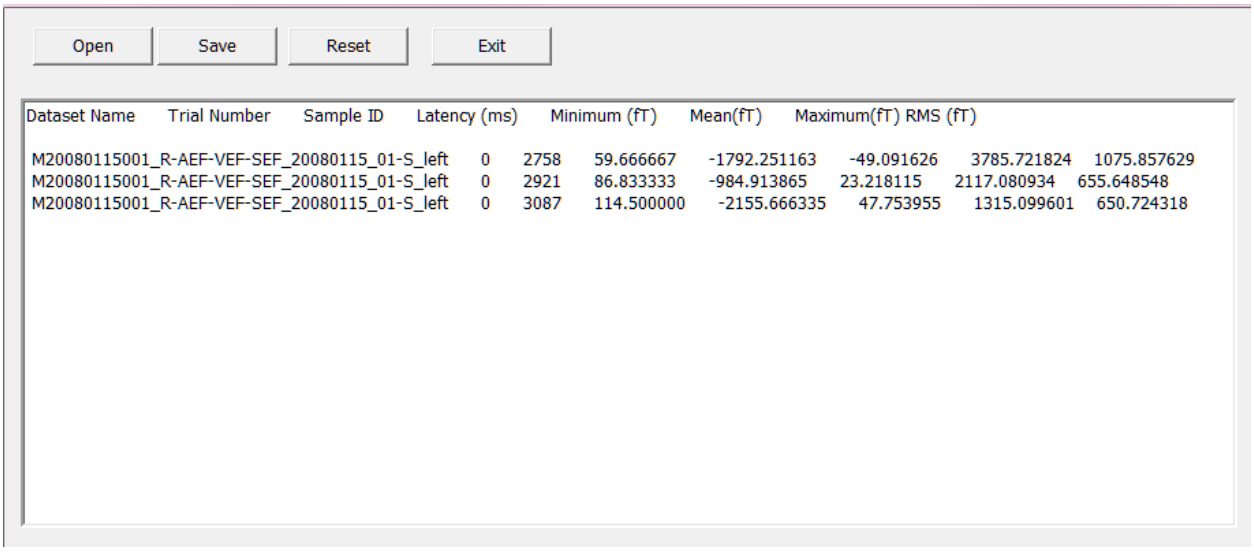


Figure 14. Threshold detected events. The management of the events is similar to marks and segments.

Index