Frequently Asked Questions

1. What kind of unique features does this software have? Is this another MEG/EEG toolbox based on Matlab?

This software package, which mainly based on C/C++, is different from many MEG/EEG toolboxes which are typically based on Matlab/IDL. For example, this software package provides following outstanding features:

- Specially designed data analysis modules to utilizing both low- and high-frequency neuromagnetic/electric signals for characterize brain functions in spatial, temporal and frequency domains.
- Volumetric source imaging with newly developed source localization algorithms (wavelet-beamformer, accumulated source imaging).
- Dynamic magnetic source imaging (dMSI) for visualizing sources in real-time or accumulated mode.
- Voxel multi-coding for precise determination of brain activity/activation while significantly minimizing MEG/EEG inverse problems.
- New signal processing algorithms which are not available in other software packages (e.g. polarity contour maps, accumulated spectrograms, etc.);
- Intuitive graphic user interface (GUI), which provides real-time "toolbar-tips" for ease of use or better usability without memorizing all the commands.
- High-performance and handle a huge amounts of data using assembling codes and parallel computing.
- Optimized functions for analysis of high-frequency MEG/EEG data (e.g. built-in re-sampling function, handle a huge amounts of MEG/EEG data)
- Quantitative assessment of coherence of brain activity/activation at source levels using volumetric coherence analysis, which analyze every possible voxel-pair of the entire brain.
- Outstanding 2D and 3D data visualization tools.

2. Where and How to download the MEG Processor software?

If you are reading this file online, you may already see the MEG Processor program because this file typically comes with the MEG Processor program or software. If you read this file offline, here is the website to download the MEG Processor program:

http://www.mecurer.com

Once you identified the software, which you are interested in, please select it and press the Right Mouse Button. Then, you can select the "Download" Menu. Once you "Click" the "Download" sub-menu, the Browser (e.g. Internet Explorer, Firefox, Chrome…) should start to download the file.

The MEG Program has more than hundreds of files. For you convenient, all files have been "wrapped up" and compressed as a single file for fast and easy transfer. Once you downloaded the compressed file (single file), of course, you need to uncompress it (typically, unzip it). The unzipped

MEG processor program should unzip all files into one fold which has approximately 666 files (in 2012, it may increase or decrease in the future).

We regularly update the software, thus, please check the website for any updates.

3. Do I have to install the software? Is it complicated to install the software?

No. The "green" version of MEG Processor can be used on Windows 7 (64 bit) without installation. The procedure is very simple: (1) copy the fold of the entire MEG Processor to your computer, where you like to store it; (2) run "MEGProcessor" by double-click the "MEGProcessor.exe" file.

For your convenience, you may make a short-cut with the following steps: (1)select the "MEGProcessor.exe" file; then (2) press the right Mouse Button; (3)click the "Create short cut" sub-menu in the "Pop up" Menu; (3) drag the created short-cut to the desktop. You may rename the short-cut if you like.

If you do not like it, you may simply delete the entire fold and the software should go completely without taking any of your computer space. Noteworthy, the software does not change any of the settings of your computer. There is no virus, no malware, and no junk item. Thus, the software is pretty "healthy" and "green".

4. I tried to run the MEG Processor but got an error message – For example, "The program can't start because mfc100u.dll is missing". What's wrong?

You may need to install a small update from Microsoft Company called "vcredist_64" or "vcredist_32". We have downloaded it and put it in the same fold of the MEG Processor. You may select the correction version that matches with your windows and install it

Once you download the file, please install it (since it is from Microsoft Inc., it should be safe) and try again.

You may also check the Microsoft website to find any updates that are needed for running new software developed with Visual C++ 2010, which is the IDE used for compiling MEG Processor (2010-2012).

If you downloaded the new version of MEG Processor *VS2013*, you may also check the Microsoft website to find any updates that are needed for running new software developed with Visual C++ 2013, which is the IDE used for compiling MEG Processor (2013-2014).

5. I tried to run the MEG Processor on Windows XP and Window 7 (32 bit), but got an error message about compatibility. What's the problem?

Our work currently focuses on Windows platform, in particularly, 64-bit Window 7 and Window 8. Therefore, the updated version of MEG Processor has only been tested on 64-bit of windows. If you run our new software on 32-bit windows, it may not work. You need to download the MEG Processor 32 bit version.

Though MEG Processor 32 bit version does work on 32 bit windows. However, please use 64 bit version of our software (we may also move to 64 bit Mac or other OS, but not 32-bits). We consider that 64 bits OS is the future of computer for MEG technology because 64 bits OS supports more memory and can process a huge amount of data efficiently.

Please also note that Magnetic Source Locator (MSL) and BrainX can run on both 32 and 64 bits of Windows. However, BrainX needs different drivers for 32 and 64 bit windows if you would like to access or control the parallel ports.

6. What kind of computer do I need to run MEG Processor?

Though the software package (Dec. 2012) was developed on a workstation with very high configuration (e.g. it has 144 GB memory), the software package has been tested on office desktop computer as well as notebook/laptop with 3 GB memory. Here is an example for desktop computer:

- Windows 7 or 8 (64 bits)
- 3rd generation Intel(R) Core(TM) Processor (2.7 GHz, 8MB L3 Cache)
- 24GB DDR3 System Memory
- 1 TB Hard Drive
- NVIDIA(R) GeForce(R) GT 650M Graphics with 2GB GDDR 5 video memory
- 20-inch LED Display (1920 x 1080, 32 bit color)
- 8X DVD+/-R/RW
- Standard Keyboard

7. The software works well for daily tasks, but it crushes daily for spectral-Cxc and some source localization modules. What's the problem? Why don't you fix the bugs?

MEG Processor was preliminarily developed and optimized for analyzing high-frequency brain activity or high-frequency MEG/EE signals. We are aware that this is a problem in the studies of high frequency brain activity, because the study of high-frequency brain activity requires a high-sampling rate of MEG/EEG data, which produces an unusually high number of MEG data points. Consequently, considerable computing power and time are required to analyze these data points. To ensure it is practically usable, the program loads all the data into memory to ensure the work can be done in a timely manner. The tradeoff is obvious that the program can easily run out of memory and crush!

The solutions we have developed are: (1) re-sampling data in each module for low-frequency analysis in high-sampling rate; (2) utilizing parallel computing to improve performance and limit the use of memory. However, as the computer technology is developing rapidly, we anticipate this problem will be easily fixed in the near future (e.g. using GPU/SDD to improve performance or use Cloud computing to get work done).

Please note that many advanced functions of MEG Processor have been tested on computer workstations with more than 200 GB memory (typical desktop computer has 3-8 GB memory). You may ignore those functions if your computer has limited memory.

All functions with "…Spectral Cxc.." require a lot of memory.

8. Why you use some strange terms such as "CxC"? No one can understand them. You need to change those terms.

The development of MEG Processor aims to take the advantages of high-spatiotemporal resolution of MEG with novel signal processing algorithms and/or methods. At least, we have not found any better terms to replace those "strange terms".

Specifically, "CxC" indicates operations applying to two channels or a channel-pair. An operation of two channels is a channel-cross-channel ("CxC") operation that can produce many possible results. Here are some powerful usages:

1. **Virtual channels**: similar to many software programs, MEG Processor can produce virtual channel by subtracting or adding two physical channels. Instead of manually defining a virtual channel by subtracting two physical channels or a channel-pair, "CxC" can generate all possible virtual channels by using available physical channels with a set of operations. All the operations can be done by a few clicks. Once you try it, you will the power and usefulness of the "CxC" function. It is amazing, subjective and very efficient.
2. **Coherence at sensor levels:** coherence, correlation and association of two-sensor can be done by simply selecting "Covariance" or "Correlation" operation. "CxC" can analyze the relationship of all possible physical channel pair according to the setting of operations.
3. **Covariance matrices for source localization:** many MEG/EEG source localization algorithms require covariance matrices from sensor data. The "CxC" functions enable users to compute, preview and check the covariance matrices for source localization.

> A channel does not necessarily mean a sensor. In this manual, channels includes sensor channels which detect brain signal, reference channels which are used for references or detecting noise, EKG channels and EMG channels.

9a. I tried to run the MEG Processor on Windows 8, but I got an error message about "missing D3dx9_34.gll" something like that, what is the problem?

MEG Processor uses Direct3D to render 3D images. If your computer does not have Direct3D dlls which are included in DirectX from Microsoft Inc., the program will show error messages. Please download the latest version of DirectX from the website or copy the "dxwebsetup.exe" file coming with MEG Processor. You may also download the file from the following link:

http://www.mecurer.com/

Once you download the file, please install it (since it is from Microsoft Inc., it should be safe) and try again.

Please note that MEG Processor supports both Direct3D and OpenGL. MEG Processor (~2012) currently supports Direct3D 9.0.

9b. MEG/EEG signals are generated by the neurons in the brain. As far as I know, neurons fire at a low frequency range (< 100 Hz). How can the brain generate MEG/EEG signals above 100 Hz?

MEG/EEG does not detect electric or magnetic signals from a single neuron. In fact, MEG detects signals from approximately 50,000 neurons, which activate "simultaneously" in a synchronized manner. Therefore, MEG/EEG signals are the spatiotemporal summation. The frequency components may reflect the spatiotemporal changes as well as orientation changes. High frequency signals may be generated by "out of phase" activation from a group neurons. From our point of view, high-frequency MEG signals does not generated by single neuron. Instead, high-frequency MEG signals reflect the spatiotemporal organization of neural activation in a variety of directions.

10. It is well known that the brain generates brain signals below 100 Hz such as alpha (8-12 Hz), typically below 70 Hz. How can the software detect signals in high-frequency ranges?

Low-frequency brain signals such as alpha activity, K-complex and spike-wave discharges do provide very important information about the brain function. Those low-frequency signals have large amplitude and therefore can be easily identifiable in waveforms.

However, according to our observation with thousands of MEG datasets (http://clinicaltrials.gov/show/NCT00600717), low-frequency MEG signals are typically generated from a large area or from extended cortical sources. High-frequency MEG signals are typically generated from a small area or focal cortical sources. In other words, low-frequency signals are generated a large group of neurons, while high-frequency signals are probably generated by a small group of neurons. If the high-frequency signals and low-frequency signals are generated from a similar area or a closed region, low-frequency signals may be spatiotemporal summation of high-frequency signals. Therefore, high-frequency signals encode more spatial information than that of low-frequency signals.

From source localization point of view, high-frequency signals are highly localized while low-frequency signals are diffused. Therefore, to analyze brain activation/activity at source space or source levels, high-frequency neuromagnetic signals would be the key in the future. Yes, I believe MEG can detect brain activity/activation above 100 Hz.

11. According to the textbook, the neuron generates signals below 100 Hz. How can you use MEG to detect brain signals above 100 Hz? Do you know that MEG signals are magnetic parts of the electrical signal generated by neurons in the brain? It's an ill focused area.

MEG does not detect signals from a single neuron. Instead, MEG detects the spatiotemporal summation of magnetic signals from a group of neurons (> 50,000 neurons) which are firing simultaneously in a similar orientation. The frequency of MEG data does not represent the frequency of a neuron. The frequency characteristics of MEG data reflect the spatiotemporal patterns of the activation of a group of neurons or other "cells" which generate electromagnetic signals.

From our point of point of view, high-frequency signals are highly localized while low-frequency signals are diffused. Therefore, to analyze brain activation/activity at source space or source levels,

high-frequency neuromagnetic signals would be the key in the future. We believe the study of high-frequency neuromagnetic signals represent the future of MEG research.

12. The 3D rendering in this program is fast and very powerful. However, as I was playing with it, I saw a black window occasionally. Do you know why?

The 3D rendering engine supports both Direct3D and OpenGL. Direct 3D seems very fast on windows computer.

To visualize the structural and functional components, this program provides three kinds of selections for precisely imaging the data of interest. If the selections are not used appropriately, you will see a "black window" without anything visible.

- Spatial Selection: a 3D selector has been designed to spatially select volumetric data. The selector provides three modes: (1) Select- all (no selection, all voxels or data are visible); (2) Select-out: voxels out of the selected region are visible; (3) Select-In: voxels within the selected region are visible. If you used the 3D selector to select all the data, and then pick the "Select-out" mode", you will see a "black window" because there is nothing to show. In this case, pick the "Select-All" option.
- Data Marks: This program provides at least three kinds of marks (red, blue and yellow) for image segmentation, voxel (pixel) label and analysis/measurement. You may selectively visualize voxels with: (1) special mark(s); and (2) voxels. If you have not mark or label any voxels and try to visualize special mark(s), you will see a "black window" because there is no mark to be visualized. In this case, pick the view "All Voxels".
- Range of Data Value: This program enables the visualization of volumetric data in certain range (from minimum value to maximum value in 3D View Control). For example, MRI/CT images typically have gray scale data in limited ranges. If you select very high or low gray scale value, you will see a "black window" because all available MRI/CT voxels are out of the selected range. In this case, please click the "Autofit" button to automatically adjust the range for visualization.

In fact, another "back window" typically appears when users hide all 3D objects or there are no 3D objects available.

Please note that, this program supports MEG/EEG sensor, sources, MRI/CT images and neural networks. If you perform source scan without MRI/CT image (structural data), the program will use templates to simulate structural data. In this case, it seems the program has structural data but there is nothing visible.

13. is there any publications used this software? As this software has unique functions to detect high-frequency oscillation, can you show me any example?

Yes, many papers used this software. You may find some sample publications related to high-frequency oscillation in the following website:

http://clinicaltrials.gov/ct2/show/NCT00600717

14. I see clear responses in averaged waveform. However, I do not see any high-frequency component with band-pass filter (100~1000 Hz). Where are the high-frequency components?

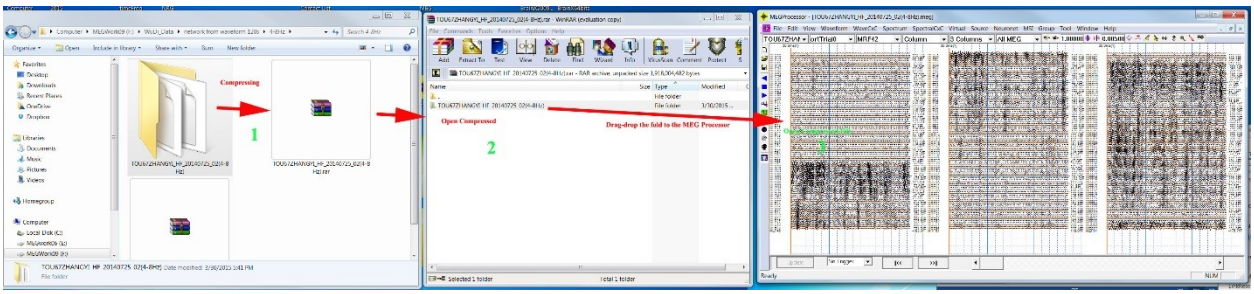
The conventional averaging reveals “time-locked” signals. Once you averaged the waveforms, the high-frequency components have more than likely gone because high-frequency oscillations might not “time-locked”.

In addition to the well-known trigger jitter; there is natural variation of brain responses. High-frequency oscillations may vary in latency and the conventional averaging cannot reveal it. One approach is to use “accumulated spectrogram” and “accumulated source imaging” to reveal those high-frequency components (e.g. Xiang et al. Front Neuroinform. 2014 May 21;8:57).

15. The size of the file appears to be bigger than I anticipated. It takes considerable hard disk space. Is it possible to compress the file and use less space?

To ensure the quality of the results and extract useful information from high-frequency signals, the software uses double-float numbers to represent the numbers. The detailed discussion can be found in previous reports (e.g. Xiang et al. Front Neuroinform. 2014 May 21;8:57). Though double-float generates outstanding results and can accurately get high-frequency components from multi-frequency signals (the amplitude of low-frequency signals are typically much larger than that of the high-frequency signals), the size of the file can be huge.

One solution is to compress the file (or fold of the files) to save space. MEG Processor can open the compressed file. One of the well-tested software is “WinRAR”, which can be freely downloaded. Here are the steps of the compressing and drag-and-drop opening.



16. It is very clear to me that multiple trials can be averaged. Is it possible to merge multiple datasets?

Yes, the program enables users to operate multiple datasets. One of the easy ways is to use the "Merge function", which can be found from the menu: "Group->Drag-Drop Entire Trial". Just make sure you set the two Viewers to the Drag-Drop mode (the cursor should change to drag-drop icon). The two viewers (corresponding to two datasets) should be trials in a dataset that will be merged; another one should be the merged one or combined one.

17. Average specific channels?

Yes, specific channels can be selectively averaged. Average specific channels: (a) the typical average function should average all specific channels in all trials or specific triggers. This function can be found in the Menu (Waveform->Average Trial); (b) if you just like to average one or more selected channels, you may use the "Export function" to get all the data in text file, and then average the channel data using Excel or any software. This function can be found by "Selecting the channel (red color waveform)->Press right mouse button->popup menu->Export->Text File".

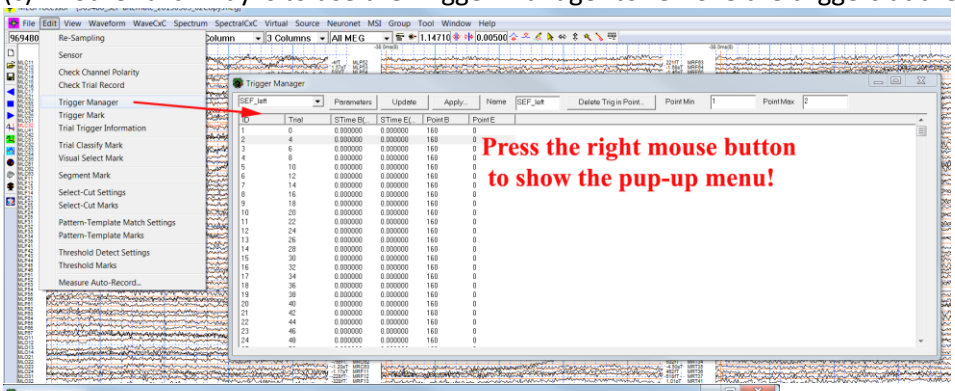
18. Can we reject bad trial(s) during averaging trials?

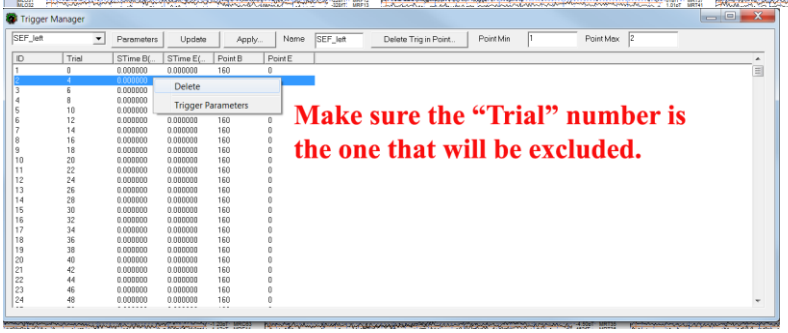
Yes, it is possible to reject bad trial. The steps are:

(a) it is possible to reject bad trials by using "Import MEG/EEG data Pro..". this function is obsolete for many reasons.

(b) The best way is to mark trial(s) as "Bad" by Pressing the Right mouse button and unchecking the "Good Trial". Once you mark the trial as "bad", all data processing (e.g. averaging, source scanning, time-frequency analysis) can automatically reject the "bad trials". In this way, you can easily turn the "bad trial" as "good trial" if necessary.

(c) Another trick way is to use the Trigger Manager to remove the triggers at the trials





19. The program enables me to easily measure the average amplitude of selected time-window. Can I view the amplitude of peaks?

Yes. To view the amplitude of peaks: by default, the main viewer in MEG Processor will show the amplitude of the selected time point or time window (on the right side). I will send you the manual. If

you would like to automatically measure the amplitude, you may use the "Measure Auto-Recording" function, which can be found in menu: Edit->Measure Auto-Recording. Once you have done, make sure to return to Normal View Mode by click the "Arrow" icon in the main view (hovering mouse cursor over the icons, it should show the usage.

20. in my date, the contour map fields of the polarity of the two hemispheres are opposite. What does it mean ?

The field polarity of the two hemispheres: if the two hemispheres were opposite, it imply the source(s) are close to the middle of the brain. Of course, it is necessary to see the contour maps and/or the source data to make clearer comments.

21. Can you software process continuous recording ?

Yes. Our software should be able to process continuous data. In fact, one of our main use of the software is to analyze epileptic data, which are continuous. The software has "accumulated source scan" and time-frequency analysis to processing continuous data. Do you mean to cut "continuous data" into pieces or "segment" as "evoked" or elicited data? In that case, you may use the "Classification" function or the "Drag-Drop Select" function to process the data.

22. In the source imaging, there are multi-parameters for each location. What are the meaning of the parameters (or source ID)?

Electric or Magnetic sources can be computed as Real-time and Accumulated Volumetric Source Imaging. Each type of source imaging has at least six subtypes.

1) Best fit (probability)
2) Highest Source strength
3) Corrected highest source strength (Best fit + Source Power).
4) Normalized Best fit
5) Normalized Highest Source strength
6) Normalized and corrected highest source strength (Best fit + Source Power).
7) Source Moments
8) Accumulated Best fit (probability)
9) Accumulated Highest Source strength
10) Accumulated and Corrected highest source strength (Best fit + Source Power).
11) Accumulated and Normalized Best fit
12) Accumulated and Normalized Highest Source strength
13) Accumulated and Normalized Corrected highest source strength (Best fit + Source Power).
14) Accumulated Source Moments

Normalization of sources: As the source strength of the scanner is 1, (Bcmp x Bmea) can be corrected by dividing with Bcmp.

23. I found that EEG Studio and MEG Processor are very similar. Are there any differences between them?

Yes. The user interface (or GUI) in EEG Studio and MEG Processor are very similar, we tentatively designed the GUI in this way, so that EEG and MEG User can user both of them easily. In fact, we have tentatively enables the exchange of the files between EEG Studio and MEG Processor. In addition, EEG Studio can support MEG data, and MEG Processor can support EEG files. Furthermore, structural data (e.g. 3D MRI/CT data) can be exported from EEG studio and then imported to MEG Processor. All those functions are very useful in clinical and research area because MEG and EEG data can be recorded from the same patient or subjects.

However, there are many differences between them. For example, the contour map, the source localization windows are all different. Specifically, EEG Studio is optimized for EEG data while MEG Processor is optimized for MEG data.

24. Can you tell me more about the relationship between filter, DC offset and re-sample?

The re-sample function (re-digitization) resamples EEG/MEG data from the raw data (the data recorded by the MEG system, no filter and/or DC-offset. The raw data are assumed as the data with original sampling rate".

Since the re-sample function works on the raw data, any filter/ DC-offset applied before re-sample (or pre-resample filter/DC-offset) are removed or discarded. Consequently, filter/DC-offset should be applied after re-sample function.

Of note, any results from the re-sampled data without second filter/DC-offset represent the result of the raw data digitized at the "sampling rate of the resample".

To get reliable results at a frequency range (e.g. 8-12 Hz), a band-pass filter (low-pass 12 Hz, high-pass 8 Hz) and DC-offset should always applied after the resample procedure.

25. Does the removal of any channel effect the results of filtering or re-sampling?

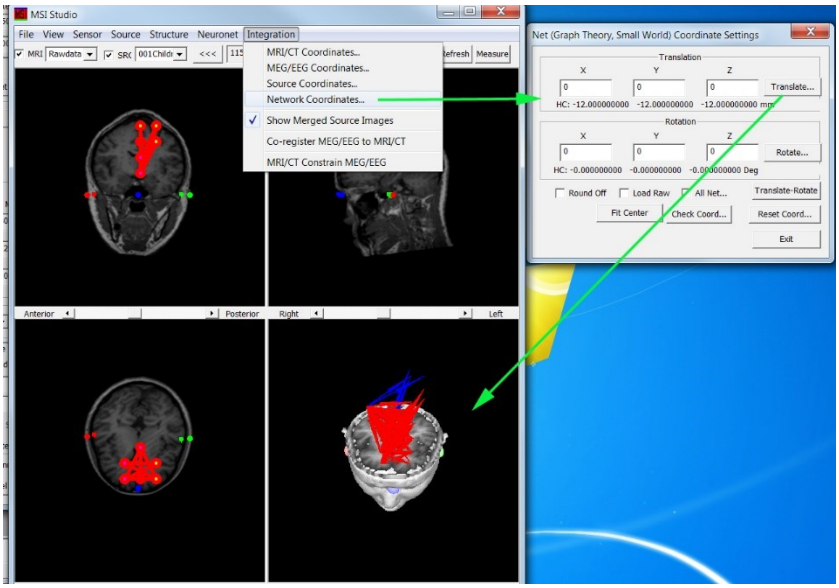
There is no intermingled effect between the removal of channel and resample/filter/DC-offset.

For example, if we remove a "bad channel", the spectral computing will not include the "bad channel" (unless we manually change the option in the setting up dialog). This option does not change, unless we turn the channel to "good" (or add it to the good list).

The removal of any channel (e.g. channel 12) may affect the results of source localization/spectral analysis etc. The filtering/DC offset will also affect the results of source localization/spectral analysis etc. they belong to different category of data analyses.

26: Can I manually adjust the network data and the structural data?

Yes. You may use the Network Coordinates function to perform the work. From MSI Studio->Menu Integration->Menu Network Coordinates..). Please note, some shifts could be resulted from the network scan steps (e.g. 3, 6 or 9). To fix the problem, you may manually shift the network (typically, equal to 3, 6, 9 or any number used in the network scan, the new version of the software should automatically adjust the mismatch). Since the network may need to avoid "diffusive effect" in MEG/EEG source scans, the shift values could be larger than that. In other words, a 6-step scan may need 12 to correct it.

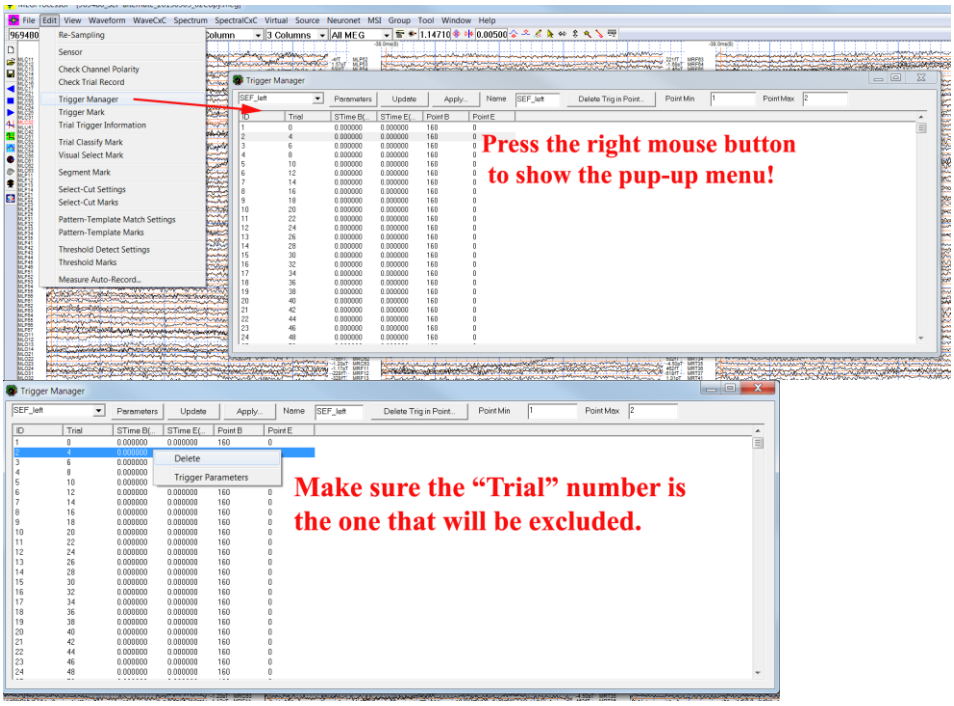


27: Can you tell me more about the triggers and the trials for averaging?

Data averaging is typically based on the triggers. You may edit the trigger to ensure the averaging works the way that suitable for your study.

You may find the Trigger Manager in the Edit Manu from the Main Frame.

For example, in the Trigger Manager, a removal of a trigger may exclude a trial from averaging.



28. Is there any difference between average and accumulation?

Waveform averaging mainly reveal time-locked signals.

Accumulated spectrograms can reveal signals with a variable time-window, which may not be time-locked.

There are two ways to compute spectrograms

(1) Average -> Filter Averaged Trial ->Wavelet Transform-> Averaged Spectrograms

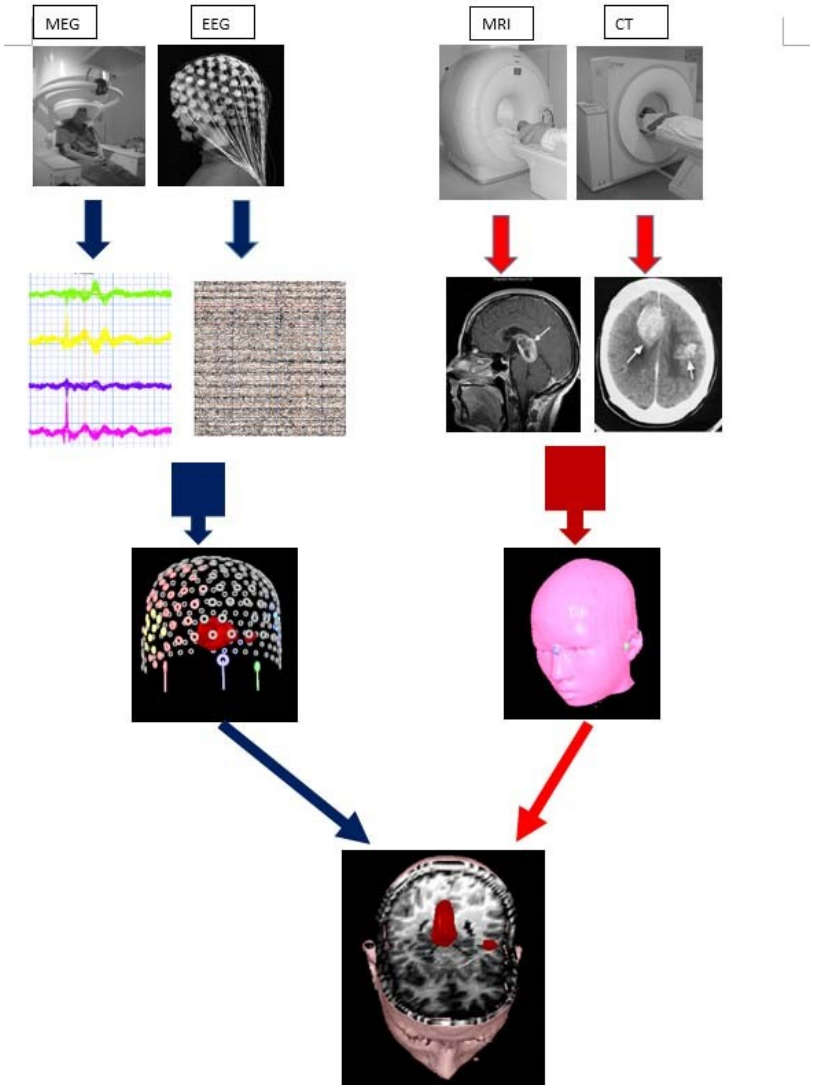
(2) Filter Original Trial (not averaged) ->Wavelet Transform->Accumulated Spectrograms

The second way is the novel way to reveal the signals, which is not time-locked, but phase locked.

29. Can I use the software to integrate EEG/MEG and MRI/CT.

Yes, you can. The emergence of diagnostic imaging technologies in clinical practice such as magnetoencephalography/electroencephalography (MEG/EEG) and magnetic resonance imaging/computed tomography (MRI/CT) provides the capability to capture both structural and functional abnormalities in the brain. However, since each modality or device has its software package or platform, it is difficult and time-consuming for clinicians and researchers to combine both MEG/EEG (functional data) and MRI/CT (structural data) in clinical and research practice. To resolve this problem/gap, we developed a software package, MEG Processor, to support all the modalities. Importantly, the software package can integrate MEG/EEG and MRI/CT data into a single image. The software can not only increase the productivity/efficiency and obtain novel information from each modality alone, but also increase accuracy and minimize errors. It enable clinicians and researchers to

read, visualize, analyze, measure, and write reports in one environment or platform.



30. What shall I do if I found some bugs? Is there anyone who can answer my question(s)? May I send comments and suggestions to the programmers?

Please feel free to send emails to:
support@mecurer.com
brainx@live.com