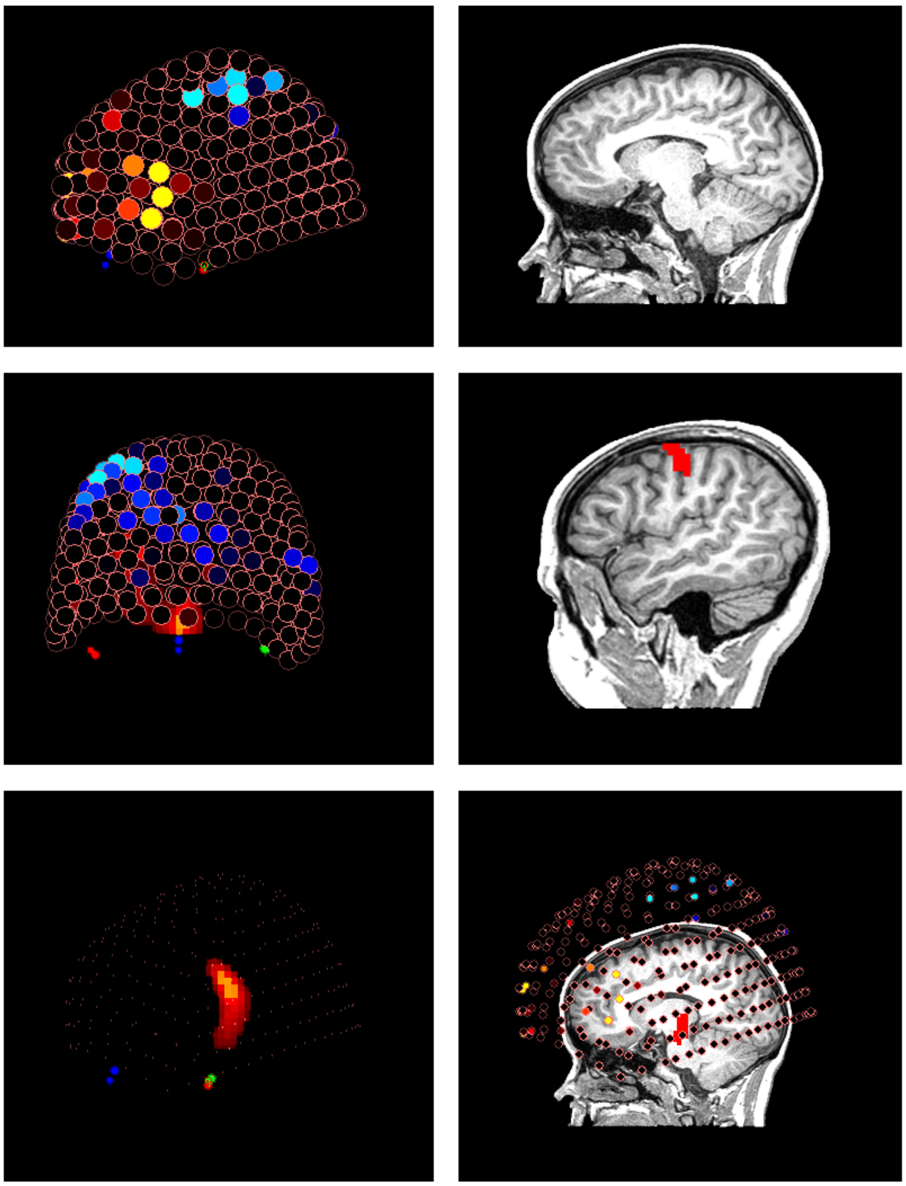
MSI 2D Viewer

Software Guide



DISCLAIMER

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Features and specifications of this software program are subject to change without notice. This manual contains information and images about MSI 2D Viewer, 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 functional and structural images. Functional image data include magnetoencephalography (MEG) and electroencephalography (EEG) data. Structural image data include magnetic resonance imaging (MRI) and computed tomography (CT). 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.

If you use software to convert a DICOM (Digital Imaging and Communications in Medicine) series containing oblique slices with a slice plane that is not orthogonal to the scan direction, the result will be a distorted image. The severity of distortion will depend on the angle of the oblique scan. Such a distorted image should not be used for analysis.

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 magnetic source imaging (MSI) or equivalent current dipoles.

The accuracy of the structural images (MRI/CT) may also affect the MEG results if the conventional 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 co-registration is only as good as how closely the lipid markers correspond to the placement of the head localization coils during an MEG collection, and how accurate the head coil locations are relative to the sensors. Please see the Head Localization Guide for more details on head coil localization methods and accuracies. In addition, if the MRI contains any distortions which may distort the locations of the lipid markers, the co-registration of the MEG data results and the MR image may also be compromised.

For source localizations on the surface of the brain, there is little or no difference in results between the shape data extraction methods (“cortical hull”, “head” and others). However, for deep sources (e.g., those located in the hippocampus or inferior temporal lobes), the cortical hull extraction method results in source localizations that more closely approximate the true model. This method is the default selection in this software.

The accuracy of the multiple local spheres head model used for the mathematical analysis of MEG data is dependent on the accuracy of the MRI itself. If MR images are poor (i.e., distorted), the shape data created in MSI 2D Viewer and the resulting multiple local spheres model created by the local spheres application will likewise be inaccurate. Any analysis based on this multiple local spheres model may yield poor results.

It is a good idea to use input data generated by this software when processing and analyzing data. For example, the multiple local spheres model created by the local spheres model in MSI 2D Viewer has only been tested and validated using shape data files generated by MEG Processor. Use of other software to generate input files for MSI 2D Viewer is at the discretion of the user.

When the source volume is not overlay correctly on an MRI, it is possible due to the source localization methods, MR images and/or co-registration errors. The following warnings and cautions appear in this guide. Please ensure you are aware of all the operations and interpretations.

Preface

This guide describes the operation of the MSI 2D Viewer. The MSI 2D Viewer is one of the core windows for integration of MEG/EEG and MRI/CT. It is used as the primary tool to view structural and functional activity/activation or abnormality for academic or clinical purposes. Importantly, the MSI 2D Viewer provides graphic user interface (GUI) for access other function. In other words, it is also often used to launch other windows such as measurements of source values.

The MSI 2D Viewer application allows you to manipulate an isotropic volumetric image data on 2D "slices" that can be co-registered with 3D coordinate system. You can view source images for superimposition onto individual MRI/CT slices.

Intended Audience

This guide is intended for persons responsible for co-registering source images with volumetric MRI/CT data. The guide assumes the reader is familiar with standard MRI/CT and MEG/EEG procedures. In addition, this guide assumes the reader is familiar with the Windows operating systems.

> MSI 2D Viewer supports up to 6 fiducial points (head shape matching is discussed in other model). To co-register two image dataset, at least three fiducial points are necessary. If the fiducial markers are being imported from an external program, the same unaltered MRI used to compute the fiducial points must be loaded into MSI 2D Viewer. Any alterations to the image that change the image data, such as co-registration or orthogonalization, must be performed after the fiducial markers are loaded.

References

This document assumes familiarity with many terms related to computer operations and neurophysiology. There is also wide use of acronyms.

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: BrainX@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}).

MSI 2D Viewer supports more than one structural datasets. For example, MSI 2D Viewer may overlap source data onto the brain, white matter, gray matter or the entire head. If you have more one MRI/CT data, which can be produced by segmentation, associated with MSI 2D Viewer, ensure that you select the intended one.

MSI 2D Viewer also supports more than one functional datasets. For example, MSI 2D Viewer may overlap source data for somatosensory, motor, auditory and visual stimulation on to the brain. If you have more one MEG/EEG source data associated with MSI 2D Viewer, ensure that you select the intended one.

One important tip is that, source data can be displayed in one, two and multi-color scale. To display multiple source datasets one window, use the one color scale. Of note, it is very important to give each source dataset a unique color.

Changes from Previous Releases

If you used the software before, please read the ReadMeFirst file for late changes that did not make it into this manual and for a list of new functions or options, changes, additions, bug fixes, and known bugs for the application. You can open this file from the main window's Help > New Features menu.

Overview

This guide describes the various graphical elements that make up MSI 2D Viewer and analyze the structural and functional data used throughout the software applications.

Structural Data (MRI/CT)

MSI 2D Viewer creates and uses its own format for viewing volumetric structural and functional images. It has a set of build-in functions to build a three-dimensional volumetric image that is typically created by interpolating an original set of "3D" or "volumetric" MRI/CT data to provide an "isotropic" (equal dimensioned voxel) dataset with known dimensions. The resulting dataset contains a width x height x depth (e.g. 256 x 256 x 256) volumetric (3D) MRI/CT plus additional information. The width, height and depth do not have to be equal in the new version of MSI 2D Viewer (since 2009).

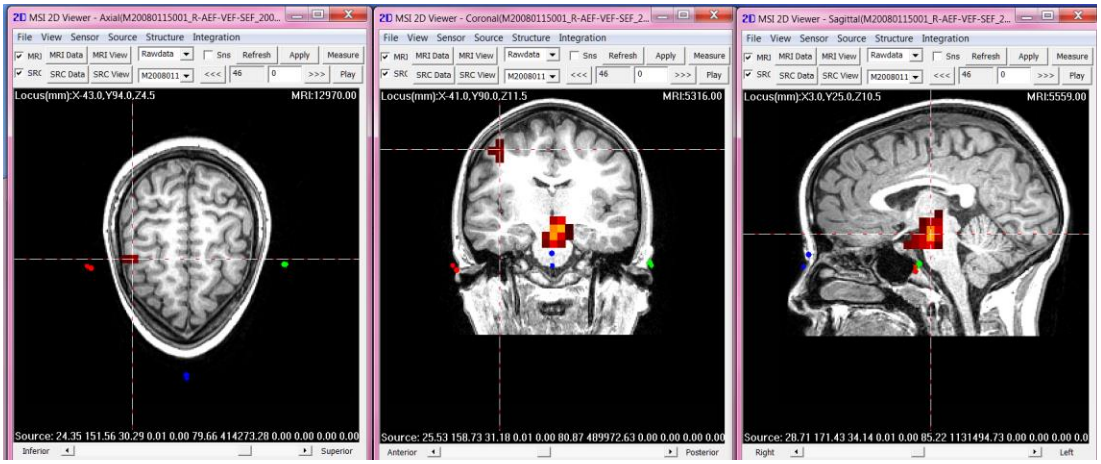

Figure 1. Main Window of Magnetic Source Imaging (MSI) Studio.

The structural data in MSI 2D Viewer also retain information regarding the fiducial landmarks such that any three-dimensional location with respect to the MEG/EEG coordinate system can be automatically co-registered with the corresponding voxel location in the MRI/CT.

Please note that the co-registration of MRI/CT and MEG/EEG requires the fiducial points. If the MRI/CT data does not have three fiducial points, you may set the fiducial points with MSI 2D Viewer. Otherwise, the source location in the MRI/CT images may be not correct.

In MSI 2D Viewer, three fiducial points, left and right pre-auricular points and nasion, are typically used. To simplify the usage, right is typically marked as red, left is typically marked as green and nasion is typically marked as blue.

MRI/CT 2D Viewers

The main window in MSI 2D Viewer displays the volumetric MR/CT image in three orthogonal orientations. These orientations are the coronal, axial, and sagittal views. A slice from each view is shown in the figure below.

Properties of the MRI/CT

The MR/CT images in MSI 2D Viewer may vary slightly according the source files. However, all images have the following properties:

Each slice is identified by its slice number and orientation (coronal, axial, or sagittal).

The MRI/CT is isotropic, i.e., slices are equally spaced in an orientation.

Voxels on the MRI/CT may be defined either in the MEG/EEG head coordinate system or in the MRI/CT coordinate system.

For example, if the MRI data are from CTF MEG system, the images have the following properties

Each view contains 256 slices.
The MRI is isotropic, i.e., slices are equally spaced in all orientations.
Each slice is identified by its slice number and orientation (coronal, axial, or sagittal).
The MR image is displayed in grey scale.

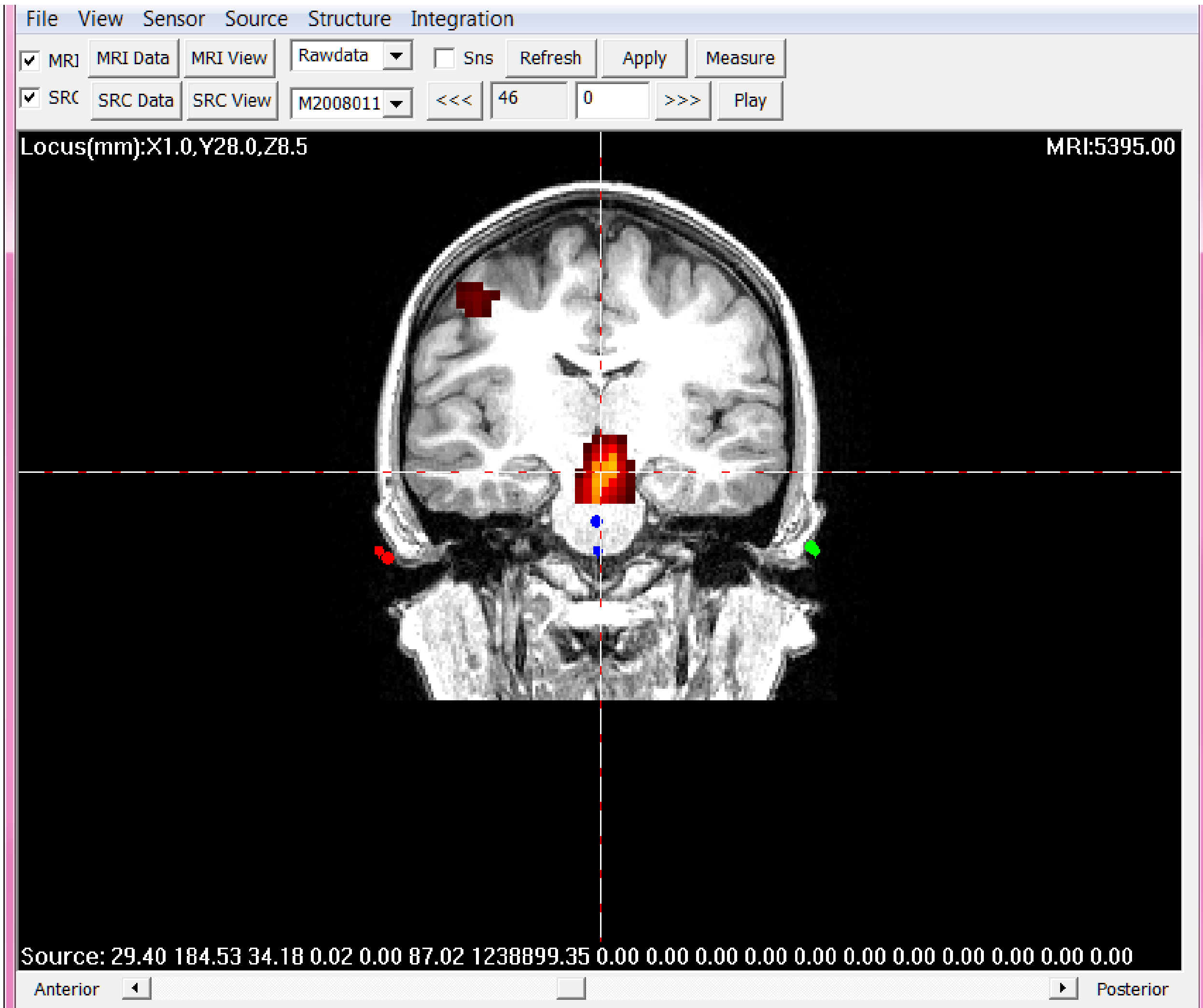

Figure 2. MSI 2D Viewer. The two lines indicate the selection of the mouse. The numbers in the top right indicates the voxe (pixel) value of MRI/CT images under the selection of the mouse.

Manipulating the MRI/CT

MSI 2D Viewer provides various functions that change the display of the MR/CT image. In some cases, these changes can be saved as a new MRI data file. The MRI may be manipulated in the following ways:

1. The MR/CT image can be show/hide for better viewing sensors/sources.
2. The voxel value and coordinates of MR/CT image can be measured by a mouse clicking
3. The MR image may be viewed in either neurological or radiological orientation.
4. The MR image may be viewed with colors inverted.
5. Brightness and contrast are adjustable in the image.
6. Voxels can be marked onto the MRI when it is converted to DICOM format.
7. Fiducial markers can turn on and off.
8. The thresholded black-and-white image can be displayed.

Displaying the Slices

Any three unrelated orthogonal slices can be displayed by clicking the slider bar below each image. Click until the desired slice number appears for each view.

1. You can also display the three intersecting slices of any 3D point.
2. If the point is one of the fiducial markers or the sphere origin, click the corresponding toggle button in the main window.
3. If the point is a dipole, selecting the dipole displays the three intersecting slices where the dipole is located.
4. If the point is a marker, selecting the marker displays the three corresponding intersecting slices.
5. If you want to locate the slices for a point displayed on one of the three views, enable Lock views to cursors, and then click the mouse on the point of interest. The other two views change to the slices that intersect this point.

MSI 2D Viewer uses these cardinal directions as axes in an internal coordinate system where sagittal = X', coronal = Z', and axial = Y', forming an additional left-handed coordinate system which is translated and rotated with respect to the head coordinate system, and which has its origin at the upper left anterior corner of the volume .

Upon defining the landmark or "fiducial" locations set by the placement of the head localization coils, an internal representation of the MEG head coordinate system is defined using the same convention as that of the MEG acquisition software described above. This information, combined with the voxel resolution in each direction, is used to construct an internal transformation matrix (T) to automatically convert any three-dimensional location in the MEG head coordinate system to any voxel location in the MRI. Thus, a point P(x, y, z) specified in the MEG head coordinate system (see Figure 3) can be converted to the MRI voxel P'(x', y', z') by multiplication.

Superimposed Objects/Items

A useful feature of MSI 2D Viewer is the ability to import graphical representations of various MEG/EEG data interpretations or analysis. These are co-registered and superimposed on the MRI/CT. As well, graphical markers can be defined or imported, then viewed on the MRI.

The following graphical objects may be superimposed on the MR image:

1. Fiducial points
2. Head localization coils
3. Shape data points
4. Source volume
5. Virtual Sensor Locations
6. Best-fit sphere
7. Dipoles
8. Markers

These objects/items share the following common properties:

1. They do not alter the MR image data, but are instead graphical objects overlaid on the MR image.
2. They are stored internally and separately in the program.
3. They may be manipulated simultaneously or independently depending on the function. For example, when you set the fiducial points of MRI/CT, it only changes the fiducial points of MRI/CT. However, when you click the co-registration function, it uses both MRI/CT and MEG/EEG fiducial points to change both MRI/CT and MEG/EEG data.
4. Each object is optional and does not need to be defined to view the MRI/CT data. However, default values are always present for best-fit sphere and the fiducial points.
5. Any combination of these objects may exist together (from none to all).
6. They are displayed in color, while the MRI/CT is displayed in grey scale.
7. With the exception of the fiducial points, these objects are defined in the MEG head coordinate system.

The sections that follow describe each of these graphical objects in detail.

Fiducial Points

Fiducial points are also called fiduciary points. In this menu, we typically refer them as fiducial points. The nasion, left ear, and right ear landmarks are collectively called the fiducial points and together form a coordinate system defined relative to the subject’s head. The section “MEG/EEG Head Coordinate System” describes this coordinate system in detail.

In the example MRI shown in Figure 4 on previous page, the landmarks are identified with the placement of lipid markers. The center of each lipid marker is defined in MSI 2D Viewer as a fiducial point using the Set Fiducial command.

If lipid or some other physical markers were not placed on the fiducial landmarks during the recording of the MRI/CT data, the location of the fiducial landmarks must be determined by locating the closest slices which best correspond to the locations of the head localization coils. The accuracy of the resulting fiducial points depends on the operator's experience. Alternatively, the head localization coils may be digitized before or after an MEG/EEG recording session while the coils are still on the subject's head along with the subject's head shape. You may have software that co-registers the MRI/CT with these digitized points to derive the voxel locations of the head coils. These results may be imported into MSI 2D Viewer using the Fiducial Markers Dialog. Digital photos are also useful for checking the accuracy of fiducial points.

When MEG/EEG data are collected, the head localization coils are placed on the same three landmarks and the sensor locations are defined relative to these landmarks. Hence, source results that are derived from MEG/EEG data and the MRI/CT can be described in a common head coordinate system by co-registering the MRI/CT coordinate system with the MEG/EEG head coordinate system through the definition of the three fiducial points on the MRI. The fiducial points can be defined in MSI 2D Viewer.

The co-registration is only as good as how closely the lipid markers correspond to the placement of the head localization coils during an MEG/EEG collection, and how accurate the head coil locations are relative to the sensors. In addition, if the MRI/CT contains any distortions which may distort the locations of the lipid markers, the co-registration of the MEG/EEG data results and the MR/CT image may also be compromised.

Fiducial Points Properties

Fiducial points have the following properties:

1. They are defined in the three-fiducial points coordinate system.
2. They have position coordinates defined in units of voxels, slice numbers and location in millimeters.
3. The nasion fiducial point is displayed with a blue dot/circle/square, the left ear fiducial point with a green dot/circle/square, and the right ear fiducial point with a red dot/circle/square.

> The color coding in MSI corresponds to the color coding used on the head coils.
> Nasion = blue, Left Ear = green, and Right Ear = Red.

Head Localization Coil Positions

The position of each head localization coil is displayed in the MSI 2D Viewer as a hollow circle in the slice in which it occurs. Head localization coils have the same color as their corresponding fiducial point.

You cannot directly jump to the location of the head coils using the "GOTO" controls in the main window. However, whenever an MRI/CT fiducial marker is displayed, the corresponding head coil marker will also be displayed, even when it is not on the current slice in the view. This allows you to visually judge the consistency of co-registration. A head coil marker and corresponding MRI/CT fiducial marker are coincident if and only if they coincide (i.e., appear aligned) in all three views. For example, it is possible for a fiducial marker and corresponding head coil marker to appear aligned from one view's perspective, but not from another's. For each fiducial marker, it is therefore necessary to check co-registration in each of the Coronal, Sagittal, and Axial views. When the head localization coil and fiducial marker are displayed together, the fiducial marker shows as a solid point within the hollow circle along with its descriptive label. See the green "Left Ear" label, fiducial point, and localization coil circle in Figure 6 for an example. If the head localization coil is displayed in a different slice from the fiducial point, only the hollow circle displays along with the appropriate label ("LE", "RE", or "NA").

Head Localization Coil Properties

The nasion head localization coil position is displayed with a hollow blue circle and a line, the left ear head localization coil position with a hollow green circle and a line, and the right ear head localization coil position with a hollow red circle and a line.

Source Volume

A source volume is a false-colored volumetric image produced by source localization software. An example source volume is shown below.

Source volumes cannot be created in MSI 2D Viewer, but are instead computed using source localization module or software then transferred or loaded into MSI 2D Viewer. Source volumes cannot be edited or saved using MSI 2D Viewer, either. However, peaks may be marked and the brightness, transparency, and level of detail are adjustable.

Source Volume Properties

A source volume has the following properties:

1. The size of the volume is variable and set during the source computations.
2. The image is displayed in color — blue for negative values and red for positive values.
3. Voxels and ranges are defined in the MEG head coordinate system.

Dipoles

A dipole, or equivalent current dipole, is a model used to represent certain neurological activities.2 Dipoles are created and modeled using the MEG/EEG System source modeling programs, and the resulting dipole locations can be superimposed on the subject's MRI/CT using MSI 2D Viewer. The figure below shows how dipoles are displayed in MSI 2D Viewer. Dipoles cannot be created in MSI 2D Viewer. They are loaded from a dipole file. However, you can save a dipole file in MSI 2D Viewer, because it is possible to edit the dipole parameters and combine the dipole files. The Dipoles window in MSI 2D Viewer provides a means of viewing and sorting the dipoles in a spreadsheet format.

Dipole Properties

Dipoles have the following properties:

1. Each dipole has a position and orientation. Displaying the orientation is optional.
2. A dipole has a magnitude.
3. A dipole has a color, shape, size, and label.
4. A dipole has an associated error and latency information if it is the result of a dipole fit.
5. A dipole may be categorized as good or bad.
6. The dipole parameters are defined in the MEG head coordinate system.
7. An optional error volume may also exist for any dipole.

Dipole Error Volume

When performing an analysis of clinical data, regardless of which software programs are used, ensure that you review the “goodness-of-fit” and “confidence volume” for the data results. If the error is unusually high, it is recommended that you repeat the measurement. If an error volume for a dipole was computed in MEG Processor, the confidence ellipsoid is displayed surrounding the dipole.

MEG Best-fit Sphere

A spherical conductor with concentrically uniform conductivity is one type of conductor model used in the MEG Processor dipole source modeling programs. The best-fit sphere is the sphere which best approximates the subject’s head shape. An example of a best-fit sphere is shown in the diagram below. Although it is also possible to define the best-fit sphere in MEG Processor, MSI 2D Viewer is better suited to create the sphere because it allows you to position the sphere relative to the physical features of the MRI. The best-fit sphere is saved in the head model file as well as the dipole file. The sphere’s parameters can also be loaded from these files. For more information on the best-fit sphere, see the Source Scan Guide.

EEG Spherical Shell Modeling

Both MEG and EEG source modeling require a best-fit sphere to be defined, ideally using the subject’s MRI as a guide. Only one conducting shell exists for MEG because the conductivities are not part of the magnetic field equations. For EEG, the conductivities are part of the electric field equations, and up to four concentrically spherical conductivities may be specified in the EEG System’s source modeling programs. However, MSI 2D Viewer only displays a single sphere and a single shell. When a dipole file is loaded with EEG sphere information, only the smallest shell is displayed. This shell usually represents the brain layer. To define the best-fit spherical shells for EEG using MSI 2D Viewer, determine the smallest shell location and radius, then load the results into MEG Processor to define the additional three shells.

Best-fit Sphere Properties

The best-fit sphere has the following properties:

1. It has position coordinates and a radius.
2. Its conductivity is assumed to be concentrically uniform, and for EEG, four spherically concentric conductivities may be defined.
3. It is defined in the EEG head coordinate system.

Using MSI 2D Viewer

MSI 2D Viewer is functional module which can be launched within a program like MEG Processor. Specifically, MSI 2D Viewer is a dynamic-link library (DLL). DLL is an executable file that acts as a shared library of functions. Dynamic linking provides a way for a process to call a function that is not part of its executable code. The executable code for the function is located in a DLL, which contains one or more functions that are compiled, linked, and stored separately from the processes that use them. DLLs also facilitate the sharing of data and resources. Multiple applications can simultaneously access the contents of a single copy of a DLL in memory. For example, when you drop a MRI file on to MEG Processor, the MRI data can be displayed in MSI 2D Viewer right away.

Co-registering Using Fiducial Landmarks

After creating a structural data set from the original data files, the location of the fiducial landmarks used in the head localization software must be defined for correct “co-registration” between the head coordinate system and the MRI/CT coordinate system. This is achieved by moving the cursor to each of these locations, using the Set Fiducial option in the popup menu, then selecting the appropriate fiducial point submenu (Nasion, Left Ear, Right Ear) corresponding to the individual head localization coils used during MEG acquisition.

This procedure, which must be done for all three coil locations, may be repeated as many times as necessary from any view, including the “Zoomed” view to improve viewing detailed structures in the images.

When you quit MSI 2D Viewer, you may save your changes by clicking the Save button

Creating a Best-fit Sphere Head Model

MSI 2D Viewer can be used to create a “best-fit” single sphere based on the anatomy of the patient’s head for the purpose of source modeling routines.

When creating a volumetric structural file, a default sphere is created with a specific origin in the MEG/EEG head coordinate system as well as a default radius. Use the main window's Popup menu and select Show Sphere to make this sphere visible.

If you are viewing a slice that does not intersect the sphere origin, you will see the sphere surface that intersects that slice, but no origin marker will appear in the image. However, if you click the Sphere Origin menu for the sphere, all views will be updated to the slice numbers that contain the sphere origin, which is shown as a square box. Alternatively, you can scan through the slices until the origin appears.

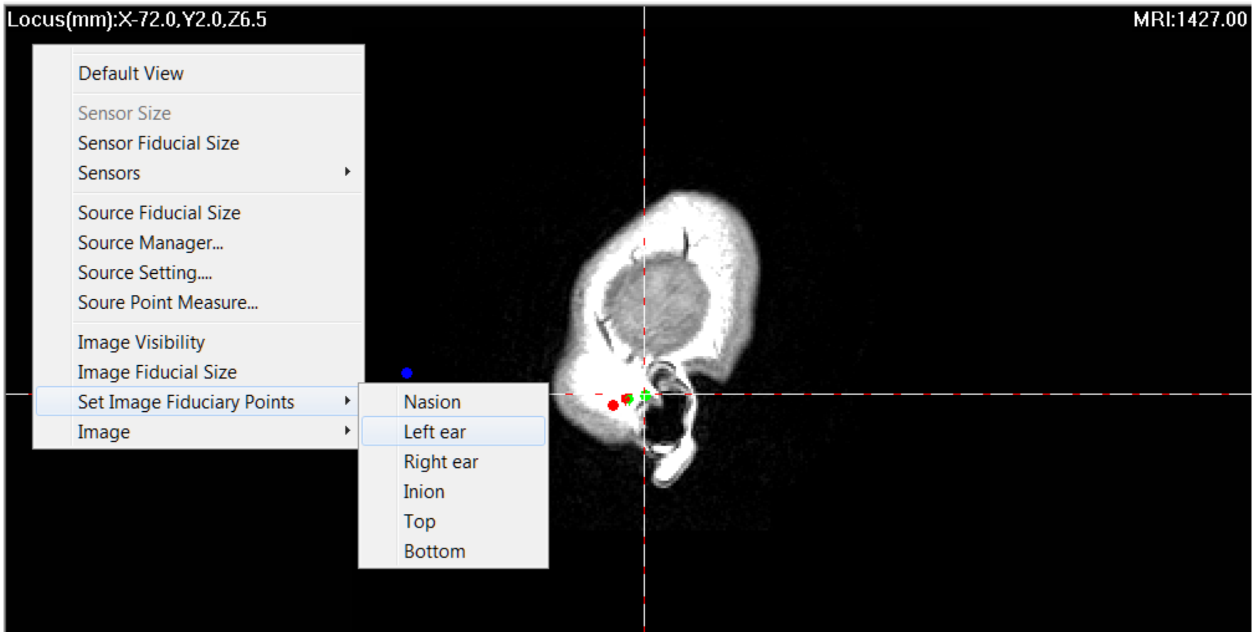

Figure 9. Setting Fiducial Points (e.g. left ear). First, find and select the pixels corresponding to a fiducial point (typically identified by lipid marker in patient's MRI).. Second, using popup menu (right mouse button) to select Set Image Fiducial -> Left Ear (or other submenu) after cursor has been positioned over desired location. Third, after releasing mouse button, resulting location of fiducial point is marked by color-coded dot. At least three fiducial points are necessary to define a head coordinate system.

Extracting Shape Data

A source analysis cannot be performed on the data until shape data for the patient are created. The shape data can be extracted from the MRI/CT using two methods — the cortical hull (brain) extraction method and the head (scalp) extraction method.

Using Markers

The program allows you to insert three-dimensional “Markers” anywhere in the volumetric image. To use the Popup menu in the main window, select Set Marker to insert a marker at the current cursor location. The marker is shown as a small, yellow, filled circle with a numerical label indicating its order in the list of all existing markers. Delete Marker in the Popup menu deletes the currently selected marker that is shown in green. Clear Markers deletes all markers. Stepping through the entered markers using the marker’s buttons changes the currently selected marker and switches the current slice in each view to the one containing that marker.

Multiple local spheres

As of Release 2006, it is no longer necessary to define a best-fit single sphere or save the head model. The source modeling functions in MEG Processor have the capability of employing a multiple local spheres head model that is typically computed using the shape data.

The accuracy of the multiple local spheres head model used for the mathematical analysis of MEG/EEG data is dependent on the accuracy of the MRI/CT itself. If MR/CT images are poor (i.e., distorted), the shape data created in the program and the resulting multiple local spheres model created by the program application will likewise be inaccurate. Any analysis based on this multiple local spheres model may yield poor results.

Displaying Dipoles

You can use MSI 2D Viewer to import the three-dimensional location of dipole sources produced by the MEG System’s source modeling software to superimpose them on the MR/CT image. (This assumes that MRI-MEG co-registration has already been performed. Importing dipoles allows the output files of the source modeling program to be read directly into this program for display on the MRI/CT data. You can load multiple dipole files, and will be given the option of discarding the previously entered dipoles when opening a subsequent dipole file. If the previous entries are not discarded, the dipoles are added to the list of current entries. This program has no limit to the number of dipoles that can be loaded. After loading a dipole file, the dipole is shown as a small filled circle, square, or triangle with a “tail” indicating its direction vector. The dipole is selected using the scroll buttons shown in the figure. The dipole strength is reflected in the length of the tail. The List button can be used to select more than one dipole at a time. The option Current slice only shows all selected dipoles that lie within the currently viewed slice.

Latency values displayed in Waveform viewer will automatically be sent to MSI 2D Viewer. If the Synchronization option is enabled in the Tools Menu, the appropriate dipole will be automatically selected based on a match in latency between the two windows.

Dipole cluster and volumetric source

MSI 2D Viewer can automatically handle Dipole cluster as well as volumetric source imaging.

As of Release 2004, it is no longer necessary to show dipoles or dipole clusters. The source modeling functions in MEG Processor have the capability of generating multi-items for each voxel in volumetric source images. In other words, each voxel in the volumetric source image may contain the dipole information such as location, orientation, dipole moment and latency. Consequently, dipole modeling and dipole displaying will be obsolete. We keep some functions for back compatible.

Displaying volumetric source images (or Source Image)

MSI 2D Viewer can also be used to import and display color-coded "volumetric source images" produced by source localization or source scan software.

Once the volumetric source images are computed by source localization function, the source volumetric images are then available for this MSI 2D Viewer to superimpose source images on individual 2D MRI/CT slices. The MR/CT and MEG/EEG source images' axes are aligned automatically as described in "Co-registering Using Fiducial Landmarks". In 2D viewers, for source images with higher or lower resolution than the original MR/CT image, the source slice coinciding or closest to the currently viewed slice is displayed.

A false-color scale is enabled for the display of the volumetric source image intensity in each slice. The current maximum intensity level can be adjusted in the Maximum field. The data range of the intensities that are to be displayed can be specified by moving the slider bars to apply a threshold to each color scale. This allows you to view only a range of amplitudes between the threshold setting and the current maximum value to mask out low-amplitude levels in the image. Note that the source image shows the display of both positive and negative color scales (e.g., for the display of differential images). For source images that contain only positive values (e.g., current density images), only the positive (red) color scale is enabled.

In addition, the Transparency slider and other options can be changed by accessing the Color Options dialog through MSI 2D Viewer main window. This dialog can be used to make the MR/CT image visible through the source image overlay image using spatial dithering.

The source voxel intensities can be analyzed for peaks that can then be marked on the source display by using the Mark Peaks option. Only values exceeding an Absolute Threshold will be analyzed and a Minimum Separation in centimeters between the identified peaks can be enforced.

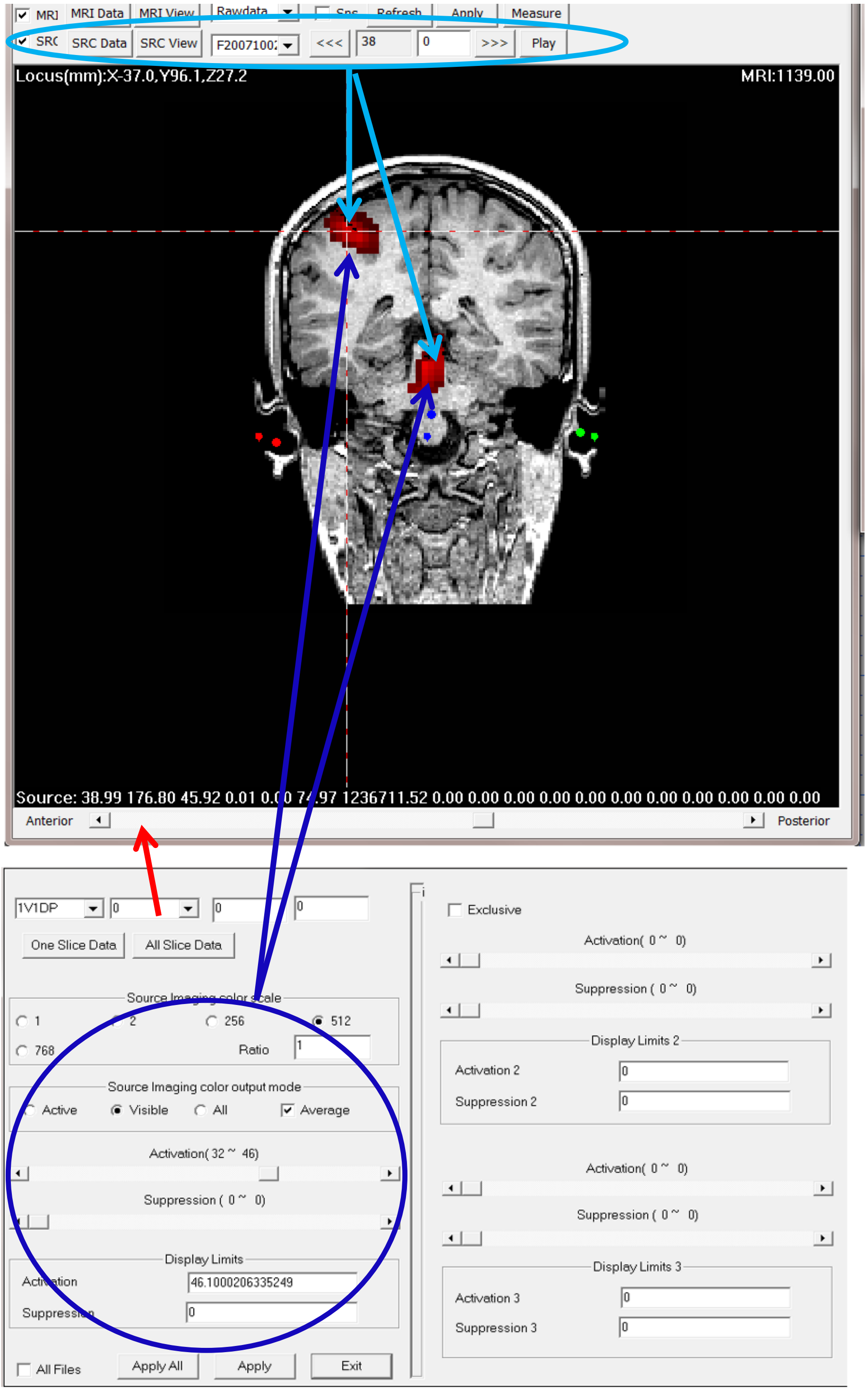

Figure. 10. Volumetric Sources overlapped on MRI (MSI). Each point in source data may have multiple values (shows in the bottom of the images). The parameters under the "blue circle" define the display of the sources. In the "cyan circle", the "SRC" indicates volumetric sources that are viable for display. To update the available data, click "Refresh" button.

Source Data Information

When source data have been computed and the current slice in the view contains one or more sources, the quantitative data in the source data for each pixel can be displayed at the bottom of an MSI 2D Viewer. The pixel is selectively determined by mouse-clicking, the selection of the pixel is shown as two-cross line. The cross-point is the position of the pixel whose values are shown in the bottom.

Head Motion Information

When source analysis has been performed on data containing Continuous Head Localization (CHL) information, the maximum head motion that occurred in the analyzed data may be displayed at the bottom of an MSI 2D Viewer if the information is loaded and the current slice in the view contains one or more sources. This head motion value is the maximum head movement that occurred in the data (that were selected for source analysis), relative to the default head position saved with the dataset during head localization. If there are multiple dipoles in the view, the head motion is the greatest amount for the entire source displayed.

If the head motion is within the specified tolerance (set before the data are recorded and saved with the data), it is displayed in white at the bottom of the view. When source analysis has been performed on non-CHL data, only source data name will be showed.

Fiducial Mismatch Information

When source data are available, the degree of mismatch between the fiducial points in the MRI/CT and source fiducial points in the data can be displayed at the bottom of the view. The mismatch value is the maximum of the distances between each MRI/CT fiducial point and its corresponding head coil. The default tolerance is 5 mm. If the mismatch is within tolerance, it is displayed in white. If the fiducial mismatch exceeds the specified tolerance, a warning message is displayed in red.

Main Window GUI Guide

The MSI 2D Viewer main window is the principle window used to manipulate MEG sensor or EEG electrodes, MRI/CT images, and MEG/EEG sources.

> The GUI in the main window may vary slightly among different version of the MSI 2D Viewer due to its differences in functionality and complex. Consequently, the information displayed in the windows may also vary slightly among the versions of the software.

Cursors

The cursor changes with the work modes, such as rotating, zooming and moving all the 3D objects. By paying attention to the cursor, you may complete a "complicated task" easily. For example, you may show the "3D Selector" of MRI/CT data to cut the "brain" in many ways.

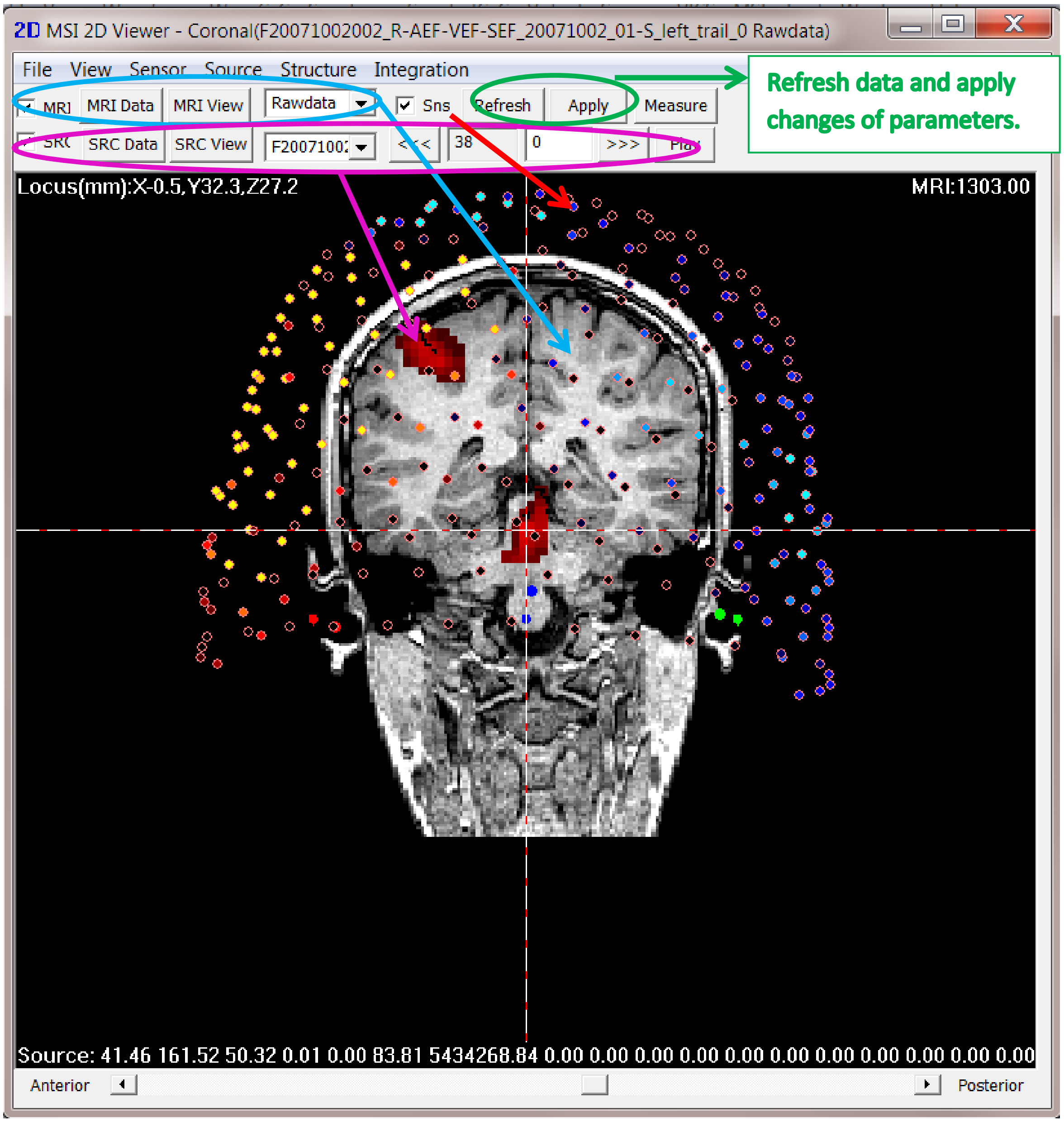

Figure 11. The graphic user interface (GUI) of the main window in MSI 2D Viewer.

Popup Menu in 2D Viewers

When an MEG/EEG, Source images and/or MRI/CT data have been loaded into MSI 2D Viewer, you may specific view and set certain image parameters via a Popup menu. Clicking the right mouse button when the cursor is positioned over one of the image windows displays the menu. The Popup menu options are described in Figure 11. Many of the actions define landmarks on the MRI/CT and require you to locate a point on the three 2D views to label. Use the cursor to locate the point you want to label.

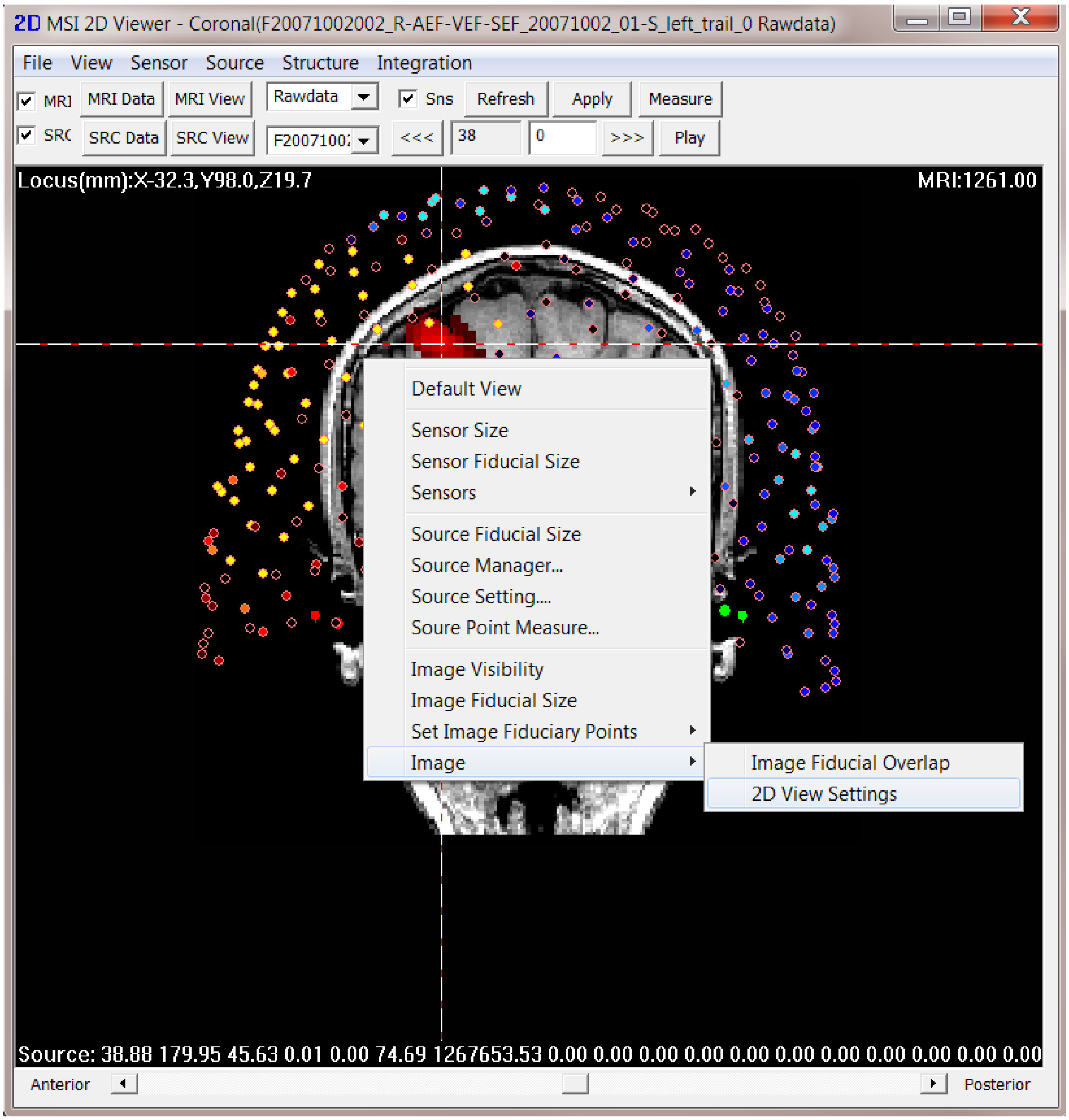

Figure 12. Popup menu and the use the menu functions.

Set Fiducial

When pop-up menu is displayed, choose the Set Image Fiducial Points submenu and then select one of the six choices defines the current cursor position as the selected fiducial landmark. See "Co-registering Using Fiducial Landmarks" for details.

To co-register MRI/CT data with MEG/EEG data, at least three fiducial points are necessary. Typically, the nasion, left ear and right ear are used to define the head coordinate system. Consequently, the nasion, left ear and right ear are essential fiducial points. Other fiducial points are options.

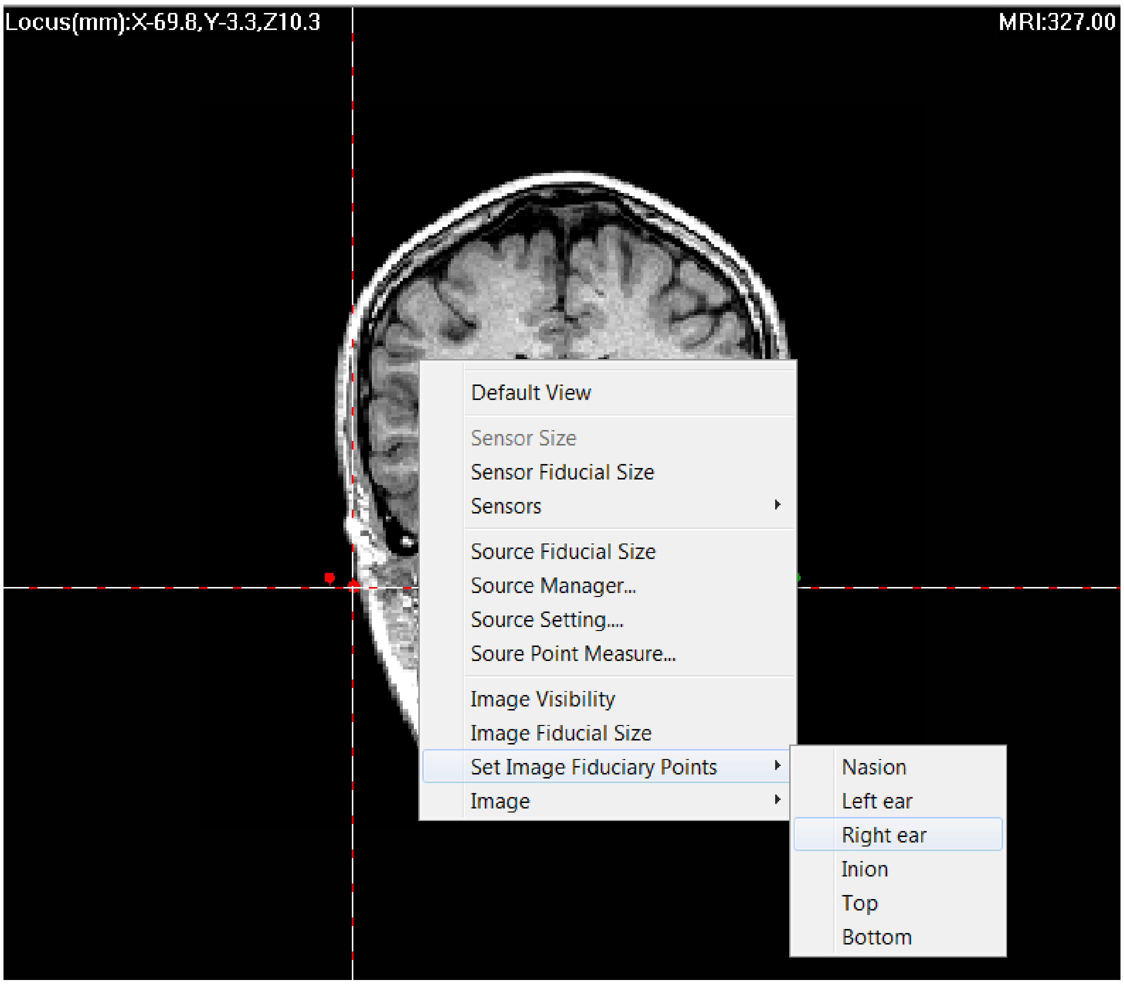

Figure 14. Popup menu and the submenu for setting of fiducial point. At least 3 points are necessary for defining a 3D coordinate system. To define a fiducial point, (1) find the marker on 2D MRI and select the point, (2) select the corresponding submenu of fiducial points. The selected point, which is indicated by the cross-point of two selection lines, will be defined a fiducial point.

Fiducial Points

Use this dialog to inspect and modify the fiducial markers. The existing fiducial markers are displayed in units of voxels (or equivalently the slice numbers of the sagittal, coronal, and axial slices) for the current MRI. New values can be entered in the editable fields. The fiducial markers may also be imported by clicking the Read File button and selecting a *.fid file to open.

This dialog is used mainly for importing fiducial markers that have been determined by an external program, rather than for defining them from MSI 2D Viewer. Units of voxels (equivalent to slice number), which are universal and absolute units, are required to ensure that the location of the fiducial markers are interpreted in the same way between the external program and MSI 2D Viewer. To define fiducial markers within MSI 2D Viewer, use the Set Fiducial command from the Popup menu of the main window.

Fiducial Marker Coordinate Fields

Nasion

Text edit fields to set the sagittal, coronal, and axial slice numbers (or voxels) at which the position of the nasion is located.

Left Ear

Text edit fields to set the sagittal, coronal, and axial slice numbers (or voxels) at which the position of the left ear is located.

Right Ear

Text edit fields to set the sagittal, coronal, and axial slice numbers (or voxels) at which the position of the right ear is located.

Navigation GUI Controls

The MSI 2D Viewer main window contains GUI controls for navigating the MRI/CT slices as well as MEG/EEG source slices. Change the slice displayed in each 2D view individually by using the corresponding horizontal scroll bar positioned below the view, or use one of the controls described below to change all three views simultaneously to show a specific point of interest.

Display Controls

The display controls in the main window are shown below:

Figure 15. Display Controls in MSI 2D Viewer.

"MRI" Check Box

The "MRI" check box and the closest combo box define if the MRI/CT data will be showed and which MRI/CT data component(s) will be showed.

"MRI Data" Button

To show the structural data manager, click the "MRI Data" button. This program supports multiple structural datasets and/or data items (e.g. Brain, skull or white matter). The structural data manager provides a set of functions to manipulate the structural data. For example, to define if the MRI/CT data will be showed and which MRI/CT data component(s) will be showed.

"MRI View" Button

To show the structural view controls, click the "MRI View" button. This program supports gray scale and color scale display. Since MSI 2D Viewer is to combine MRI/CT data and MEG/EEE source data, gray scale MRI/CT data are typically displayed. The main reason is that, the color scale MRI/CT data may significantly affect the display of color-coded sources.

MRI/CT Combo Box

This program supports multiple structural datasets and/or data items (e.g. Brain, skull or white matter). The MRI/CT combo box, which is close to the "MRI Data" and MRI View" buttons, provides an easy access to the items in the structural manager. You may select the item of interest to display.

"SRC" Check Box

The "SRC" check box defines if the source (SRC) data will be showed. If this check box is unchecked, several other functions (e.g. the flip or animate of time slices of the source data) will be automatically disabled.

"SRC Data" Button

To show the MEG/EEG sources ("SRC") or functional data manager, click the "SRC Data" button. This program supports multiple functional datasets and/or data items (e.g. low-frequency and high-frequency brain activity). The functional data manager provides a set of functions to manipulate the functional data. For example, to define if the functional data will be showed and which functional dataset component(s) will be showed.

"SRC View" Button

To show the functional view controls, click the "SRC View" button. This program supports multiple color scales in data presentation. You may adjust the low and high thresholds to obtain a good view of data.

Source Combo Box

This program supports multiple functional datasets and/or data items (e.g. brain activity in different frequency bands). The source combo box, which is close to the "SRC Data" and SRC View" buttons, provides an easy access to the items in the structural manager. You may select the item of interest to display.

Dynamic Source Imaging

If there is more than one time-slice in the source images, the source images can be showed one-by-one or be animated as a movie. The "Play" button will start the animation of dynamic source data.

"Sns" Check Box

The "Sns"(sensor) check box defines if the MEG sensors or EEG electrodes will be displayed. The display of sensors provides a view of the entire sensor-array (dewar) and its spatial relationship with MRI/CT and/or source data.

"Refresh" Button

This button will refresh the 2D viewer. This function is particularly important when the window of MSI 2D Viewer is shown and the MRI/CT data or MEG/EEG data or sources are changing out of the MSI 2D Viewer. The "Refresh" function will update and synchronize all the data.

"Apply" Button

You may also manually type a number and click "Apply" to define specific slice or data item to be displayed.

"Measure" Button

Launch the source analysis window. Of note, click on the 2D viewer will measure the voxel values of the point, which is currently selected with two-select line in the 2D viewers. The “Measure” button will launch a window to show more detailed information. In addition, it provides the capability to save and copy the data. Consequently, users can perform quantitative and/or statistical analysis easily. For example, you may copy and paste the measured data to Microsoft Excel file for additional analysis.

MRI/CT Manager

By clicking the “MRI Data” Button, a window of MRI/CT Manager will be launched. The MRI/CT manager window allows renaming, deleting and selecting the display items.

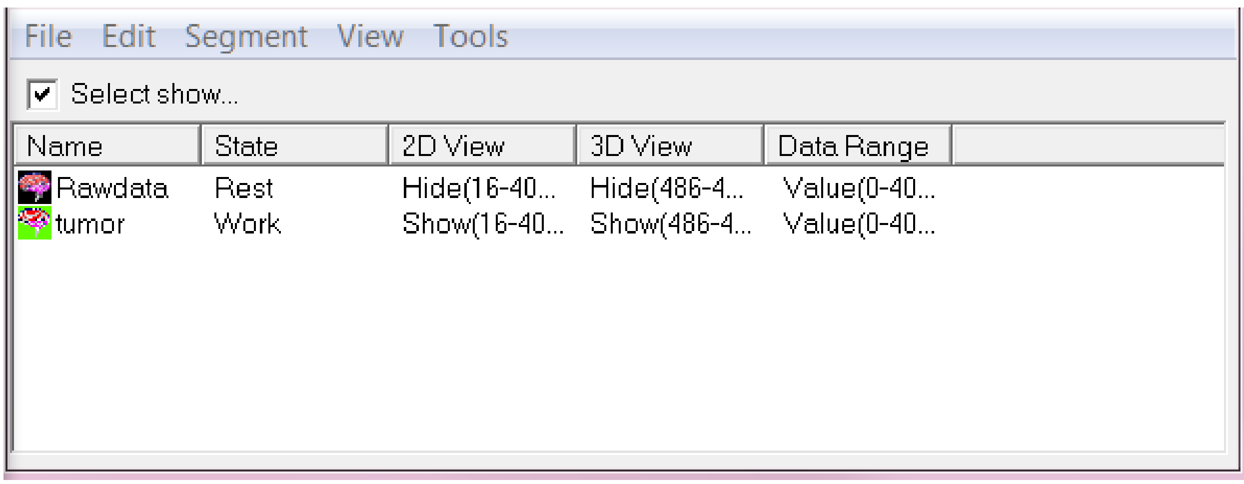

Figure 14. MRI/CT Manager.

MRI/CT View Settings

By clicking the “MRI View” Button, a window with MRI/CT view setting will be launched. MRI/CT Adjusts the grey scale brightness to improve the visibility of the original image.

Color Scales

On the top of the window for MRI/CT View Settings, there are several selections of color scales. In MSI 2D view, gray scale (g256) is typically used because the color scale in MRI/CT can be confused by source data color scales. Therefore, by default, MSI 2D Viewer displays MR/CT images in black and white and source overlays in color. However you may use this dialog to change the color scale of these displays to generate display that meet your requirements.

Show Marks

On the top of the window for MRI/CT View Settings, marks can be shown or hidden. Typically, marks are used to data segmentation and/or pixel/voxel measurements. Marks are typically hidden in MSI 2D Viewer.

View Center Point

Define the center of the MRI/CT data to better visualize pixels or voxels in the original image.

View Range

Define the range of the MRI/CT data to better visualize pixels or voxels in the original image.

Data Range

Shows the possible range of data values in the MRI file, where the minimum “0” is black and the maximum “4509” is white. By default, a minimum of two levels (black and white) and a maximum of 4509 levels may be set.

The software can reverses the grey scale color table so that black is mapped to white and white to black. This function is rarely used.

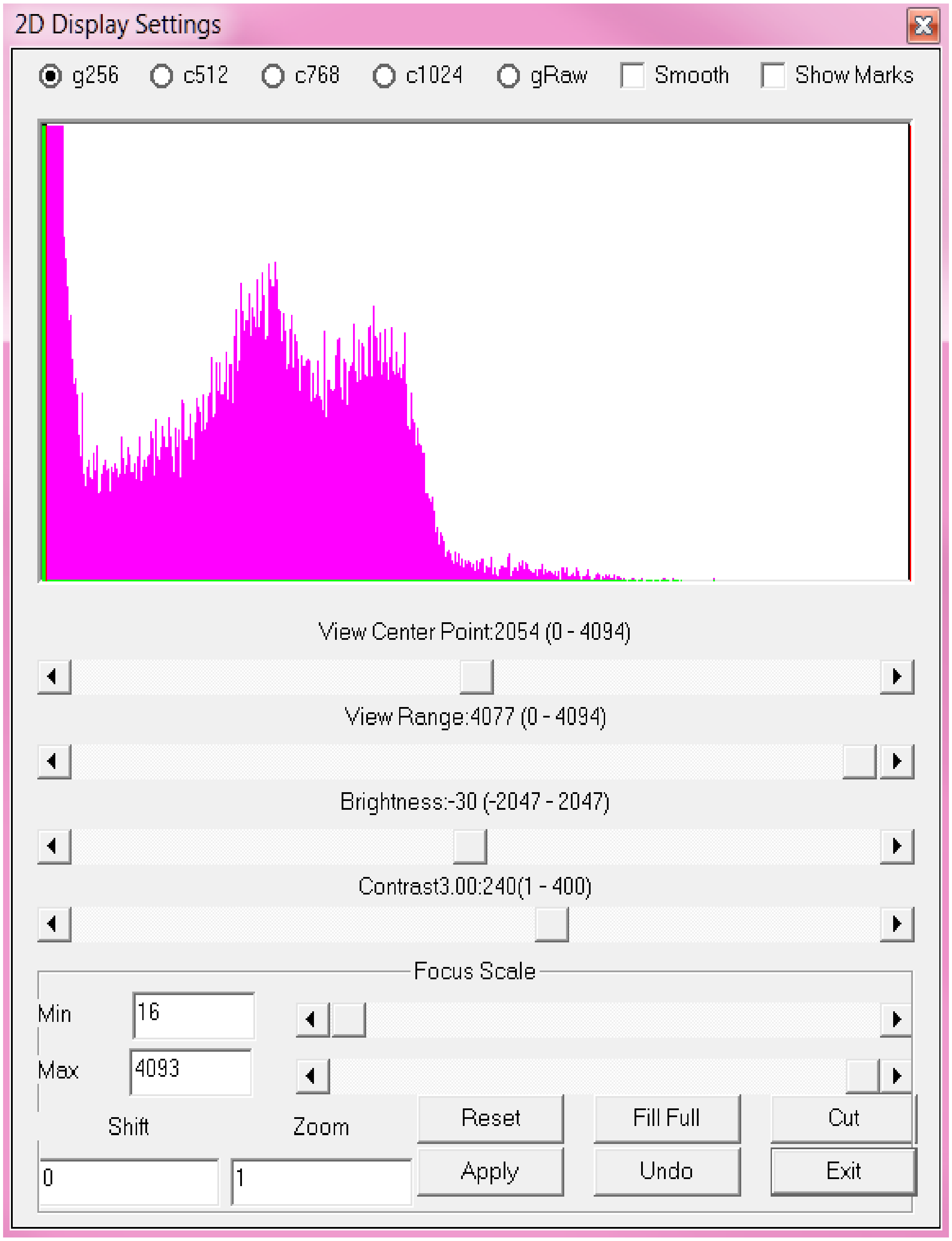

Figure 14. structural image (MRI/CT) 2D view settings.

Brightness

Adjusts the grey scale brightness to improve the visibility of the original image.

Contrast

Adjusts the grey scale contrast to improve the black/white contrast in the original image

Minimum ("Min")

Adjusts the minimum threshold of pixel value to improve the visibility of the original image.

Maximum ("Max")

Adjusts the maximum threshold of pixel value to improve the visibility of the original image.

Display Clipping Value

Displays the clipping value, or cutoff point, at which the data will be hidden. MSI 2D Viewer displays MRI data as white in the main window views. The clipping value is automatically calculated based on the Display variables. You can change the clipping value manually for this session by entering a new value or moving the histogram slider bar (see below). Manipulating the clipping value allows you to bypass "noise" by lightening or darkening the image. The MRI views in the main window display the results immediately so you can see the effect of your change. To revert the clipping value to its original setting, click the "Undo" button.

Note that changing the clipping value in this dialog only applies to the current session. It does not change the Display variables in the configuration file. The next time the MRI/CT file is loaded, the clipping value may be automatically recalculated based on the variables in this file.

Histogram

The histogram displays the frequency distribution of data values in the MRI/CT image. The slider bar is another way to change the clipping value manually for the session. When you move the slider bar, the Display Clipping Value setting changes, and vice versa. The main window views also display the results of the new setting. The purpose of designing the "links" between viewer, histogram and slide bars is to enable users to precisely control the display as well as the data.

Display Clipping Value Calculation Settings

Shows the current values in the configuration file for the Display variables. You can change these settings manually by entering new values and clicking the Recalculate button. This will calculate a new clipping value based on your changes. (Note that this does not modify the actual variables in the configuration file. The next time the MRI is loaded; these fields will once more display the values from the file.)

Reset

Recalculates the clipping value based on the values in the data as well the fields for displaying. The algorithm for calculating the clipping value

Based on the values is as follows:

1 Calculate the frequency distribution histogram using the data range in the MRI/CT data

2 Start calculations from the maximum data value and proceed to the minimum value (0).

3 Use the Length value as the length interval for the first calculation step.

4 Sum the number of data values falling into the current length interval and check if it is larger than the Limit value.

5 If it is larger, use the lower limit of the current length interval as the clipping value.

6 If it is smaller, define the next length interval as follows: (a) use the lower limit of the previous length interval as the upper limit; (b) subtract (previous length interval + Length) from the upper limit to calculate the lower limit. (With each iteration, the length interval increases by one Length.)

7 Repeat the last three steps until the clipping value is determined.

Color Scale Settings

These settings define the color palette of source overlays. The default color scale defines shades of blue for negative values and shades of red for positive values. The larger the absolute numerical value of the voxel, the darker the shade used.

Color Scale Levels

Text edit field to set the number of colors in the color palette. A minimum of two and a maximum of 64 may be used. If only one polarity is represented in the image, only shades of one color (red for positive and blue for negative) are set for the color levels.

Color Scale

Sets the color scale to any of the predefined color-plate.

Transparency

Sets the transparency of the colour overlay image. A setting of 1 displays an opaque image and a setting of 100 displays a transparent image (i.e., no image).

Invert

Reverses the mapping for the colour table so that the lightest colours are mapped to the darkest and the darkest to the lightest. The larger the absolute numerical value of the voxel, the lighter the shade used.

Image Orientation

This menu option displays the following submenu:

Use this submenu to change the viewing orientation of the head between radiological and neurological. This action reverses the head direction so that the left side of the head appears on either the right or left side of the images in the coronal and axial views.

Radiological

This orientation displays the left side of the head on the right side of the image.

Neurological

This orientation displays the left side of the head on the left side of the image.

Source Manager

By clicking the “SRC Data” Button, a window of MRI/CT Manager will be launched. The MRI/CT manager window allows renaming, deleting and selecting the display items.

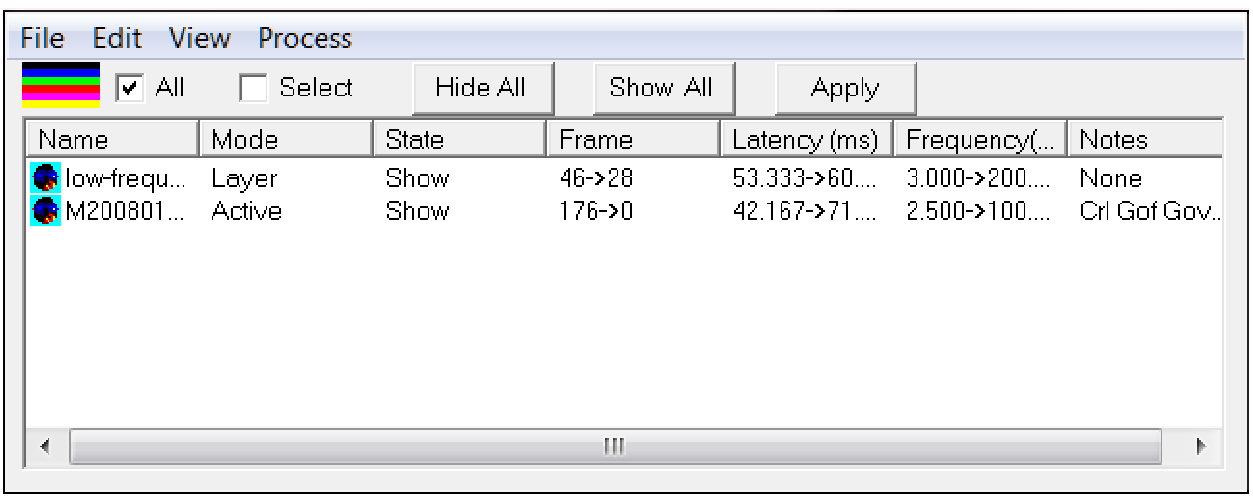

Figure 14. MEG/EEG source data (functional image) manager.

Source View Settings

By clicking the “MRI View” Button, a window with MRI/CT view setting will be launched. MRI/CT Adjusts the grey scale brightness to improve the visibility of the original image.

Selection of Voxel Number

During MEG/EEG source scan, each 3D grid or position may have more than one value. For volumetric source images that have more than one value in each point, the window of source view settings provides a combo box for select one, two or three values to show at the same time.

By default, the program will use one value for one pixel or voxel. This option is typically used in traditional software. The option of two or three values for each pixel or voxel is a new way to visualizing functional data from MEG/EEG.

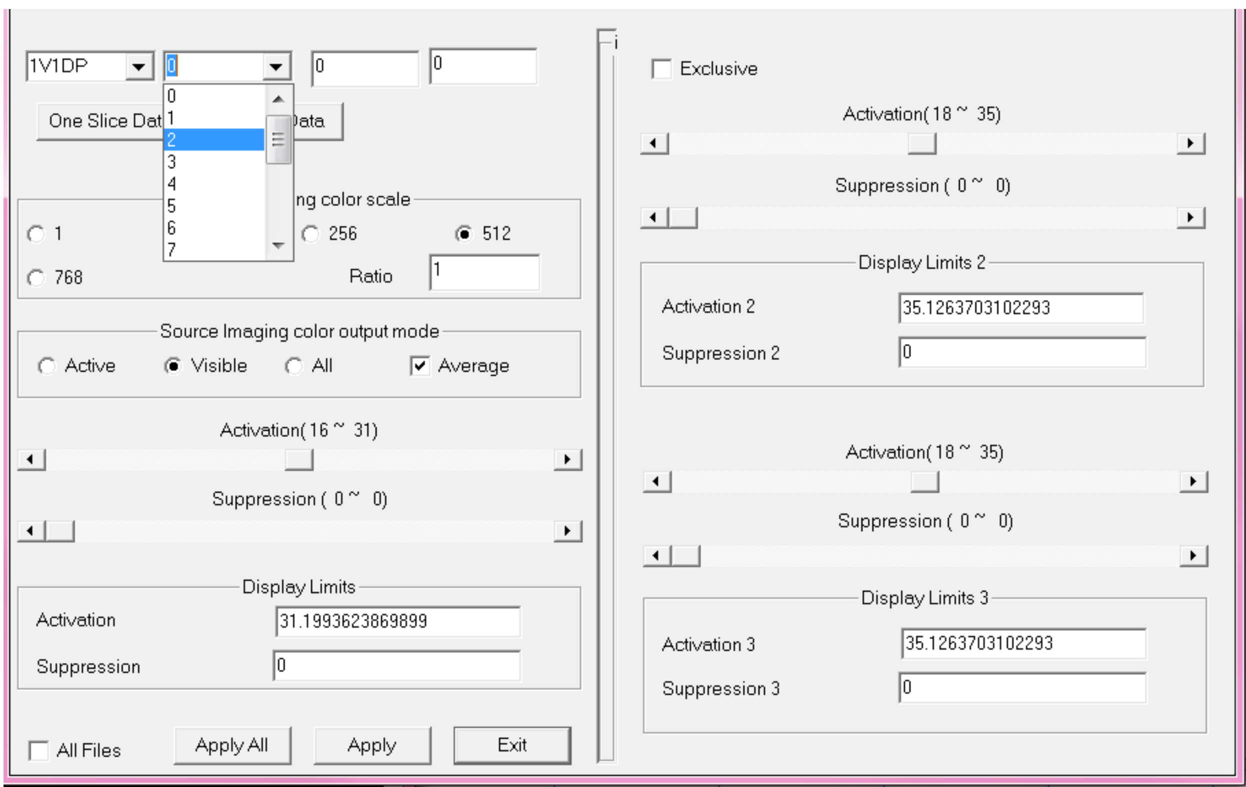

Figure 14. Source data view settings.

Thresholding the Source Image

The horizontal scroll bar located above each color gradient allows you to control the number of colors displayed on the source image overlay. The location of the slider bar along the color gradient defines the threshold. By moving the slider bar away from 0, the image voxels representing values smaller than the threshold are not displayed. In this way, only key features represented by large absolute values are visible on the source image overlay, allowing the MRI/CT to be more visible. Between these color gradient controls and the Transparency setting in the Color Settings dialog, you can adjust the source image to display both the MRI and source volume effectively.

Source Analysis Window

The source analysis window provides GUI to quantitatively measure the voxel points beyond certain threshold. In addition, the window allows to measure the voxel value in a point or a region of interesting. grey scale brightness to improve the visibility of the original image.Type the desired source peak marker number in the source Peak text edit field. The total number of source peak markers set is displayed to the right of this edit field. To execute the change, press <Enter>.

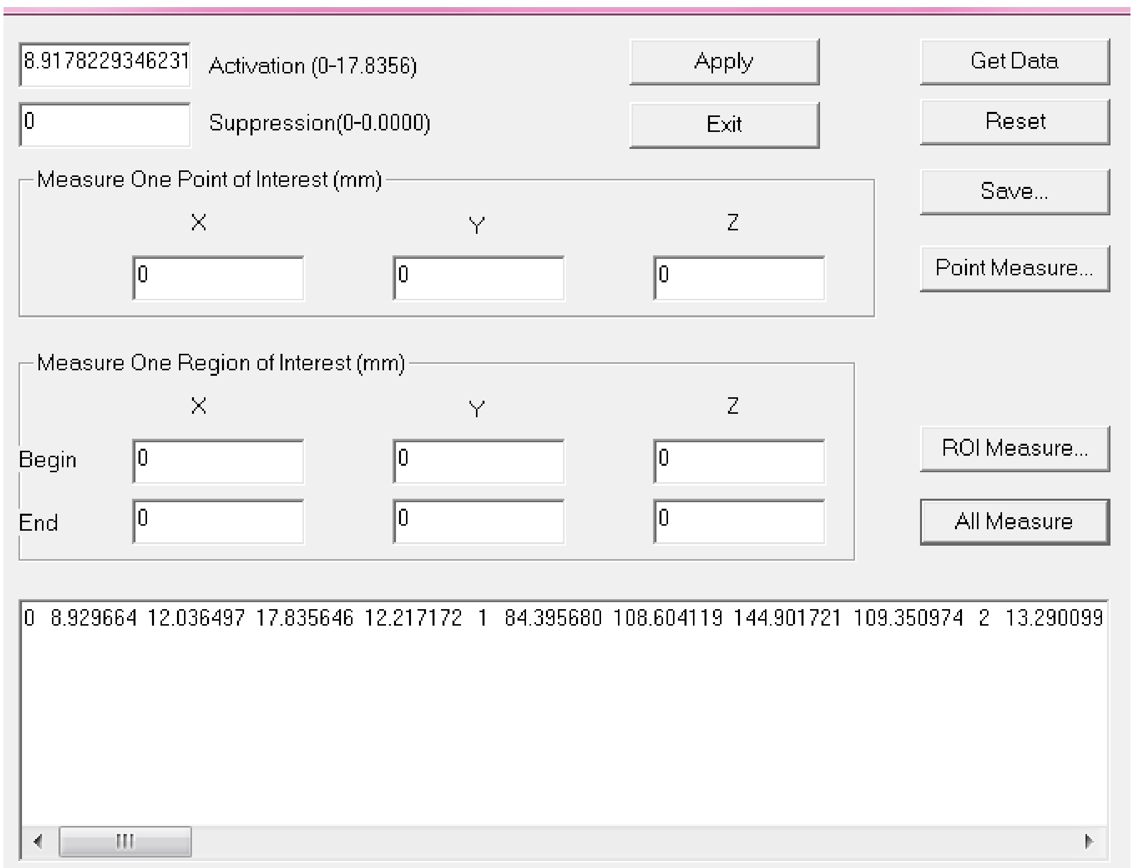

Figure 14. Source data view settings.

Source Peak Manager

Volumetric source data may have a set of focal increase of spectral or peaks. Source Peak Manager provides GUI to manipulate the source peaks.

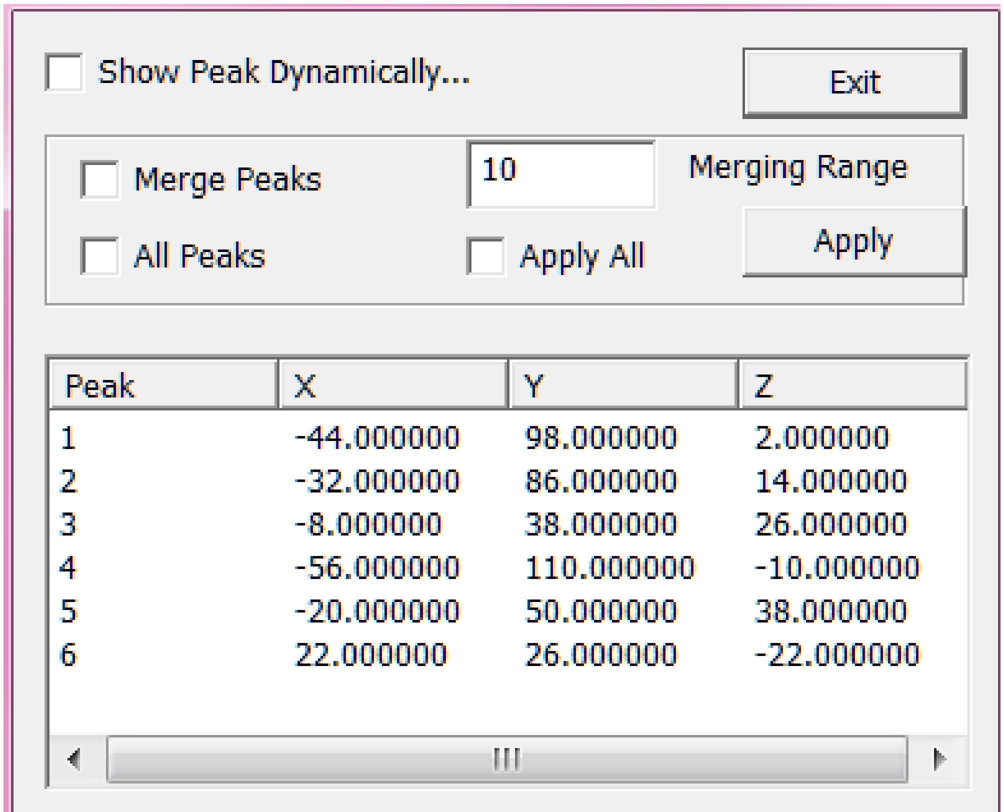

Figure 14. Source Peak Manager.

File Menu

It provides an easy access to exit this software module. In professional version. The File menu provides actions for opening and saving the files used by MSI 2D Viewer, importing an MRI file from and exporting it to DICOM format, and sending an MRI file to PACS. This menu also contains commands to print and get information about the MRI.

View Menu

The View menu provides special operations on the MRI/CT viewing. Select View Menu from the MSI 2D Viewer main window to display the submenus.

Since the View menu deals with the display or showing of MEG sensors, functional and structural data, the functions in the menu typically do not change the data. Instead, the functions in this Menu change how the data will be presented. Some functions in this Menu can also be found in the Pop-up Menu for convenience; those functions are described in the Pop-up Menu section.

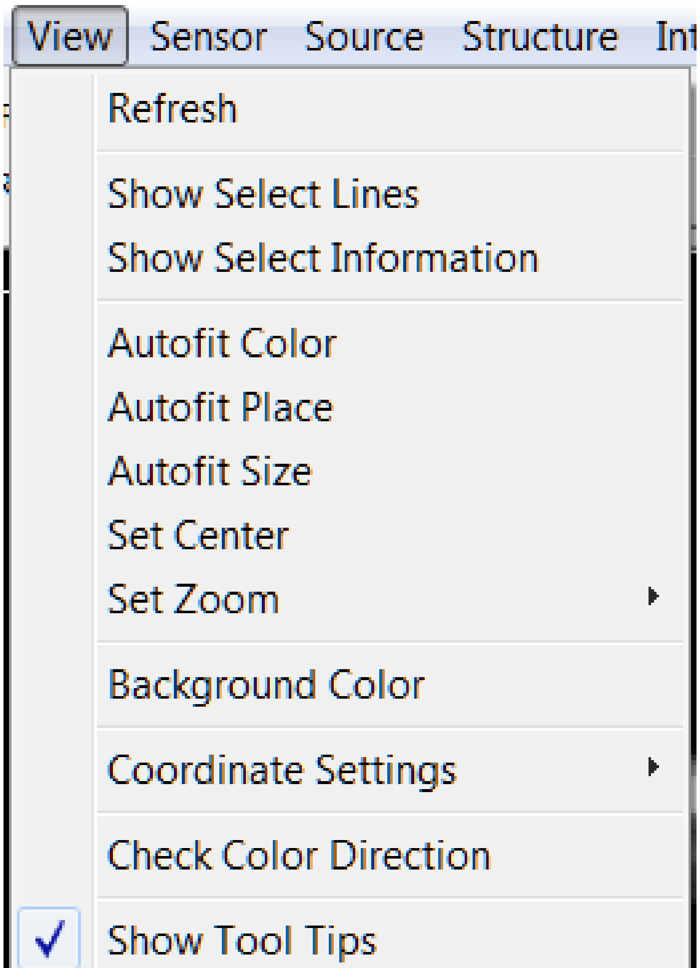

Figure 16. View Menu for manipulating the display of the functional and structural data.

Refresh

Refresh the display. For example, when the structural and/or functional data have been modified, it is important to refresh the data.

Show Select Lines

Show/hide the 2D selection lines. The cross of the selection lines is used to measure the underlying data and also used to define the fiducial points.

Show Selection Information

Show/hide the information in the top and bottom of the viewer. The values of the information can be obtained by using the position of the cross of the selection lines.

Autofit Color

The program automatically calculates the amplitude of the MEG sensor data and then define the color scales.

Autofit Place

The program automatically calculates the place of the structural/functional data according to the window size and the spatial size of the data.

Autofit Size

The program automatically calculates the zoom so as to adjust the size of the structural/functional data according to the window size.

Set Center

Set the center of the display for all structural and functional data.

Set Zoom

Set the zoom of the display for all structural and functional data. Of note, the zoom ratio is applied to all objects on the 2D Viewer.

Background Color

By default the background color is black. By selecting the “Background Color” menu, a color dialog will show up and provide GUI for picking the suitable color as background.

Background Color

By default the background color is black. By selecting the “Background Color” menu, a color dialog will show up and provide GUI for picking the suitable color as background.

Coordinate Settings

The program supports both Direct 3D and OpenGL coordinate system. You may change the coordinate system if necessary.

Check Color Direction

Check Color Direction is designed to check the rendering of the pixel data. This function is designed for experienced users for verifying results.

Show Tool tips

To help users to use the functions, the program has “Tool Tips” for some important controls (such as button, check box). When mouse move over on a controls such as button (no pressing), a tool-tip window will pop up to show some information about the usage of the corresponding button. This function is designed for beginner. You may turn it off if it is annoying.

Sensor Menu

As indicated by its name, the Sensor Menu provides functions dealing with the display of MEG sensors or EEG electrodes. The functions in the menu are also straight forward.

Show Sensors

Show/hide MEG Sensor or EEG electrodes on 2D and 3D viewers. If this function is disabled, many other functions (e.g. Show Sensor Active”) are automatically disabled.

Show Sensor Active

Show the amplitude of waveform data on the sensor with colors. When the selection of the cursor on the waveform changes; the color on the sensor will also change. It is actively reflecting the amplitude of the waveform at the current cursor position.

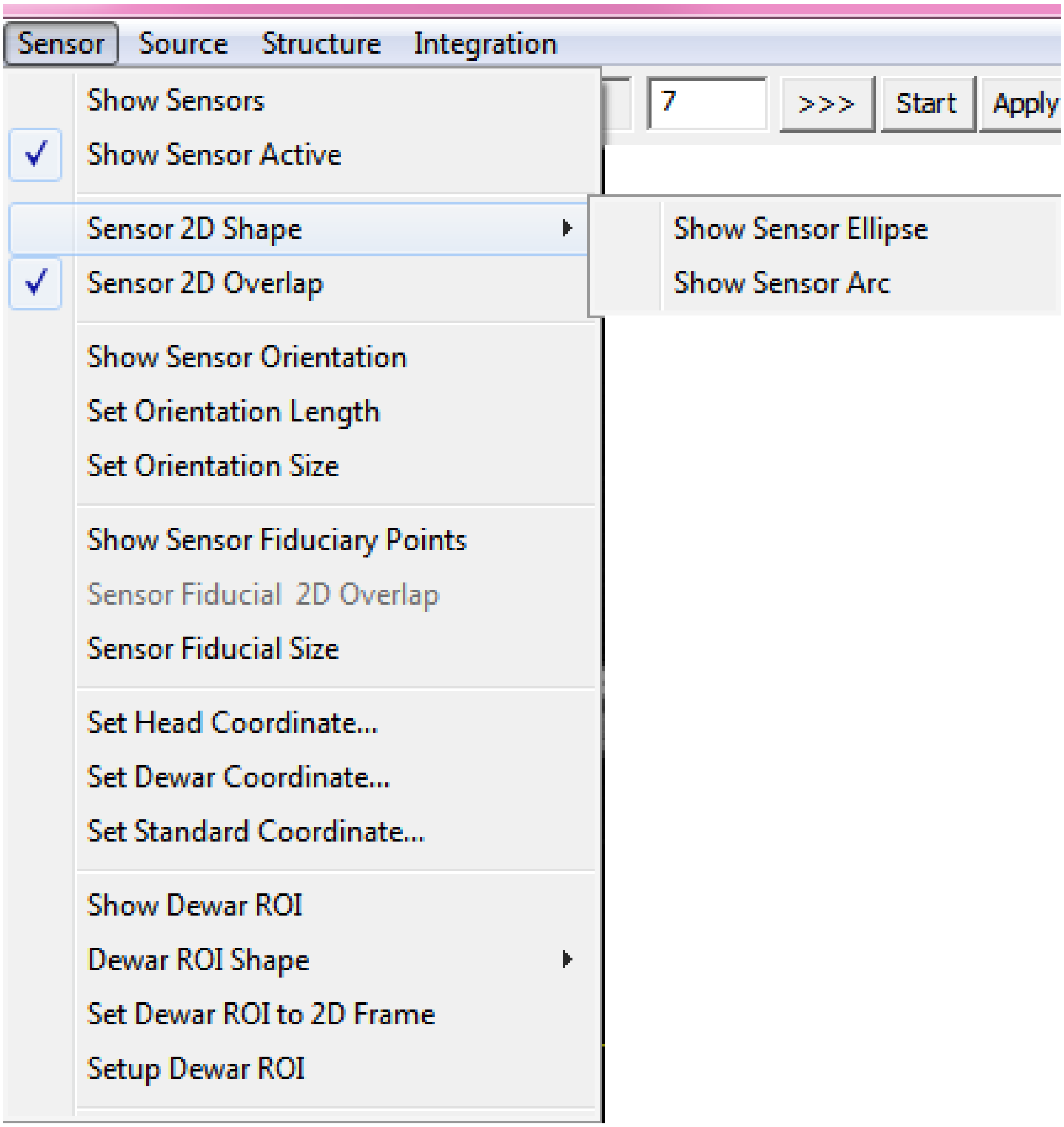

Figure 17. Sensor Menu for manipulating the display of MEG sensors or EEG electrods.

Sensor 2D Shape
Show sensor in either ellipse or arch.

Sensor 2D Overlap
Show sensor located on all slices in 2D View. If it is unchecked, only sensor s at the current 2D slice view will be showed.

Show Sensor Orientation

Show/hide the orientation of sensor, which is important for MEG data but not EEG because MEG sensors are sensitive to tangential oriented signals. However, for demonstration purposes, it is not necessary to show the orientation.

Set Sensor Orientation Length and Set Orientation Size

Set the sensor orientation length and size by pressing-left mouse button and moving up and down. To get better results, the "Show Sensors" function must be turn on.

Show Sensor Fiducial Points

Show/hide the sensor fiducial points that were typically determined during MEG recordings. If this function is disabled, the Sensor Fiducial 2D Overlap and the Sensor Fiducial Size were automatically disabled.

Sensor Fiducial 2D Overlap

Show sensor fiducial points located on all slices in 2D View. If it is unchecked, only sensor fiducial points at the current 2D slice view will be showed.

Sensor Fiducial

Set the sensor fiducial size by pressing-left mouse button and moving up and down. To get better results, the "Show Sensors Fiducial Points" function must be turn on.

Set Head Coordinate

Show sensors at head coordinate system in 2D View. This function is designed for advanced users.

Set Dewar Coordinate…

Show sensors at Dewar Coordinate in 2D View. This function is designed for advanced users.

Set Standard Coordinate

Show sensor at standard head coordinate system in 2D View. This function is designed for advanced users.

Show Dewar ROI

Show the region of interest (ROI) of the Dewar, which can be used to scan sources without MRI/CT. This function is designed for advanced users.

Dewar ROI Shape

Show the region of interest (ROI) of the Dewar in either rectangle or sphere. This function is designed for advanced users.

Set Dewar ROI to 2D Frame
Set the frame defined by the region of interest (ROI) of the Dewar to the 2D viewer. This function is designed for advanced users.

Setup Dewar ROI
Setup the region of interest (ROI) in sensor space or at sensor level. This function is designed for advanced users.

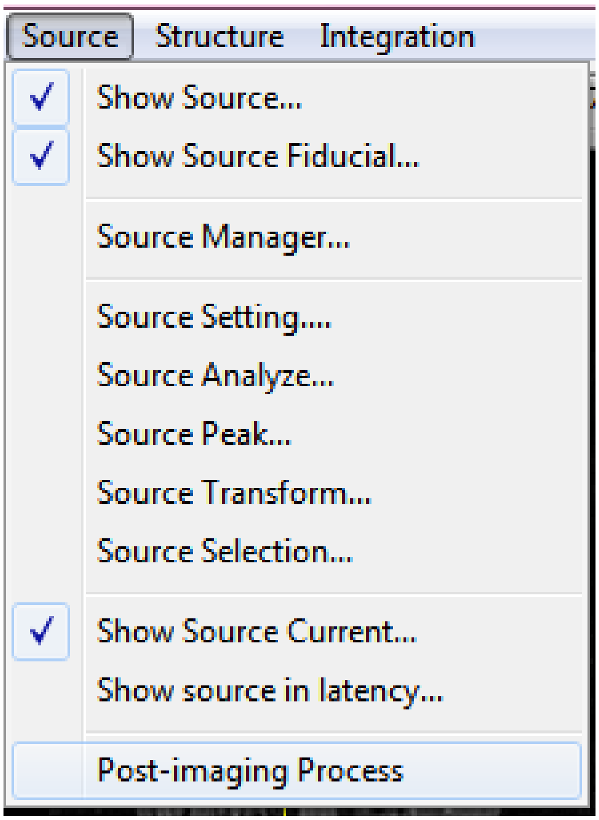

Figure 18. Source Menu for manipulating MEG/EEG source data.

Source Menu

As indicated by its name, the Source Menu deals with MEG/EEG source data or functional source images. The functions in the menu are also straight forward.

Show Source
Show/hide MEG/EEG sources on 2D and 3D viewers. If this function is disabled, some other functions (e.g. Show Source Current") are automatically disabled.

Show Source Fiducial

Show/hide source fiducial points on 2D and 3D viewers.

Show Source Fiducial
Show/hide source fiducial points on 2D and 3D viewers.

Source Manager
Launch the window for managing source data. MSI 2D Viewer can theoretically support more than hundreds of sources which are practically limited by a computer's memory. You may delete, rename and edit the source data in Source Manager.

Source Settings
Launch the window for the settings for displaying source data. Since MSI 2D Viewer supports multiple source images, the Window of Source Settings deals with the currently selected dataset in the Source Manager. Noteworthy, each point at volumetric source data has multiple values. The meaning of each value depends on the source localization algorithms. You may needs to choose the right one for your study.

Source Analysis
Launch the window for analyzing the voxel values of source data. Since MSI 2D Viewer supports multiple source images, the analysis window deals with the currently selected dataset in the Source Manager. Of notes, each point at volumetric source data has multiple values. The meaning of each value depends on the source localization algorithms. You may needs to choose the right one for your study.

Source Peak
Launch the window for analyzing the peaks of source images, which typically represent the highest or lowest value in several areas. Since MSI 2D Viewer supports multiple source images, the analysis window deals with the currently selected dataset in the Source Manager. Of notes, each point at volumetric source data has multiple values. The meaning of each value depends on the source localization algorithms. You may needs to choose the right one for your study.

Source Transform
Launch the window for transforming the entire source images. This function is designed for advanced users only, which involves different coordinate systems.

Source Selection
Launch the window for selecting some parts of source images for analysis. This function is designed for advanced users only.

Show Source Current
Show only the currently selected dataset in 2D and 3D Viewers.

MSI 2D Viewer can show more than one source datasets at once. It is typically applied to 3D Viewer with one-unique color plate (or bar) for each dataset. For example, multi-frequency analyses may generate multi-source images. Each source image may unique color to show the spatial distributions of a frequency.

Show Source in latency

Show source data in a selected latency range in 2D and 3D Viewers. This function is typically linked to the waveform window so that the correlation between source data and the waveform can be better understood.

Post-imaging Process

This menu launches the window for post-imaging process, which is designed to process the source images when the data have already been scanned or localized. This is relative to the source data processing during source scanning or source localizing. This function is designed for advanced users only.

Structure Menu

The structure menu provides access to manipulate the structural images such as MRI and CT data. MSI 2D Viewer has both 2D viewers and a 3D viewer for easy to identify and measure the functional/structural changes as well as their correlations.

Show Images

Show/hide structural images such as MRI and CT on 2D and 3D viewers. If this function is disabled, some other functions (e.g. Image 2D Visibility) are automatically disabled.

Show Image Fiducial Points

Show/hide the fiducial points of structural images on 2D and 3D viewers. If this function is disabled, some other functions (e.g. Show 2D Fiducial Overlap) are automatically disabled.

Manager

Launch the window for managing structural data. MSI 2D Viewer can theoretically support more than hundreds of structural dataset which are practically limited by a computer's memory. You may delete, rename and edit the structural data in Structural Manager.

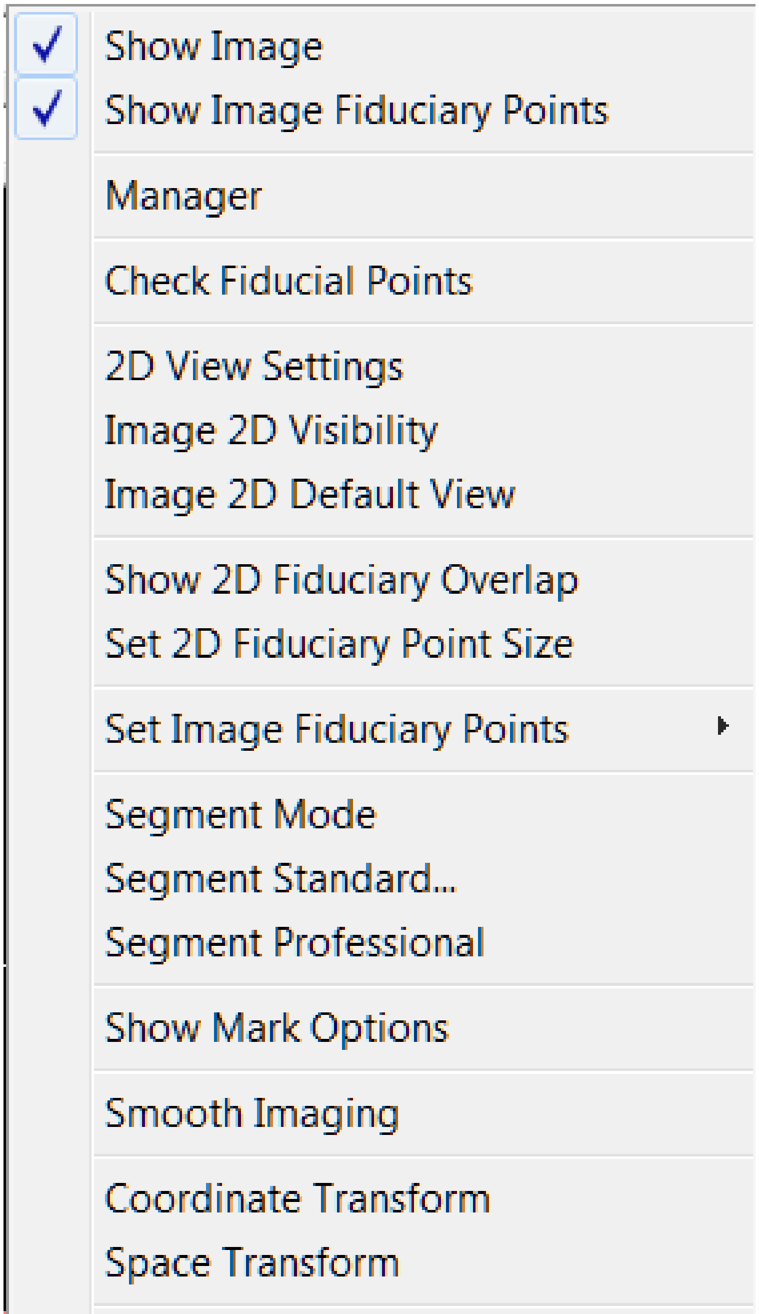

Figure 19. Structure Menu for manipulating MRI/CT data.

Check Fiducial Points

Check the fiducial points in the structural dataset. For example, checking if there is left-right reversal.

2D View Settings

Launch the 2D view setting dialog for defining how the structural images will be displayed.

2D View Visibility

Change the working mode to visibility: press-the left mouse button and move up-down-left-right to adjust the visibility.

2D Default View

Automatically adjust the visibility with the default settings.

Show 2D Fiducial Overlap

Show the fiducial points on the 2D view in all slices. If it is unchecked, the fiducial points will show only on the slices which the fiducial points are exactly localized on.

Set 2D Fiducial Point Size

Change the working mode to setting fiducial size: press-the left mouse button and move up-down to adjust the size of fiducial points.

Set Fiducial Points

The functions are similar to that in the 2D pop-up menu. To use this menu, choose the Set Fiducial submenu and then select one of the three choices defines the current cursor position as the selected fiducial landmark. See "Co-registering Using Fiducial Landmarks" for details.

Set Fiducial Points

The functions are similar to that in the 2D pop-up menu. To use this menu, choose the Set Fiducial submenu and then select one of the three choices defines the current cursor position as the selected fiducial landmark. See "Co-registering Using Fiducial Landmarks" for details.

Coordinate Transform

Launch the coordinate transform window. This function is designed for experienced user only.

Space Transform

Launch the space (the distance between two voxels) transform window. This function is designed for experienced user only.

Integration Menu

The Integration menu provides functions and options for MSI 2D Viewer to integrate MEG/EEG sensor/electrodes, source data and structural data (MRI/CT) in one coordinate. Select Integration from the MSI 2D Viewer main window to display the following menu:

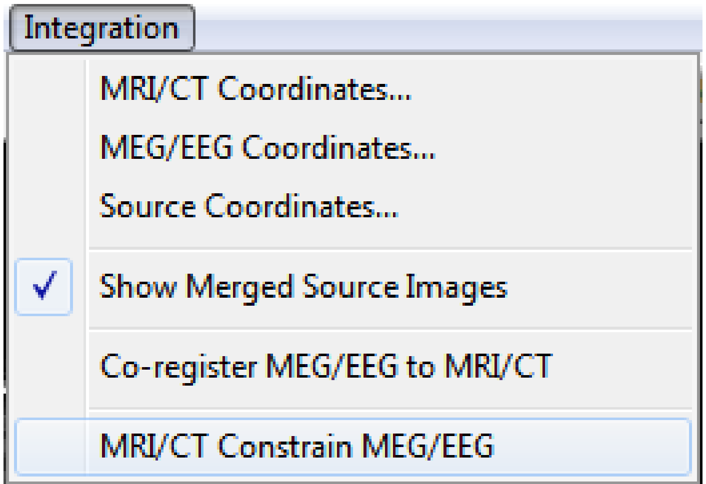

Figure 20. Integration menu for integration of all functional and structural data.

MRI/CT Coordinates

This menu option displays the window for MRI/CT Coordinate Settings. This window provides fields for setting the head center as well as the rotation.

MEG/EEG Coordinates

This menu option displays the window for MEG/EEG Coordinate Settings. This window provides fields for setting the head center as well as the rotation.

Source Coordinates

This menu option displays the window for Source Coordinate Settings. This window provides fields for setting the head center as well as the rotation.

Show Merged Source Images

This menu option enables the source images to be merged into the structural images to form a integrated source imaging with both structural and functional information.

Co-register MEG/EEG to MRI/CT

This menu option checks the fiducial points in all images and then co-register MEG/EEG to MRI/CT. The MEG/EEG data may be translated and rotated.

MRI/CT Constrain MEG/EEG

This menu option provides the capability to constrain the MEG/EEG data with structural image data.

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