Introduction

The 'EEG analysis suite' consists of a group of Matlab routines that were developed to aid in the organisation and analysis of data acquired with the Neuroarchiver tool for telemetric EEG recording. Neuroarchiver saves data in the 'ndf' format which produces filenames like 'M1325848902', where the number after 'M' is the 'unix time' when the file was generated. Neuroarchiver has several analysis routines or 'processors' to extract information from the raw data:

- Power spectrum: 'analysispowerbands' cuts the data into user-defined epochs (we use 4s) and determines the respective power for each of a number of user-defined bandwidths. The result is written to a text file called 'M*_analysispowerbands.txt' (* represents the same unix time as the source ndf).
- Metrics: The Event Classification Processor or 'ECP1' segments the raw data into user-defined epochs (we use 1s) to determine 6 metrics:
    - 'Event power' (power in the 4-160 Hz band)
    - 'Transient power' (1-4 Hz)
    - 'High frequency power' (60-160 Hz)
    - 'Spikeyness' (event power (range/standard deviation)$^{1/4}$)
    - 'Voltage asymmetry' (-(peak voltage – average voltage))
    - 'Intermittency' (low- frequency power of the rectified high-frequency signal).

  Baseline power is defined as the lowest Event power in the last 20 minutes. Whenever the event power passes a user-defined threshold (we use 5 times baseline), that epoch is considered to contain a potential event which can then be classified. The metrics files are saved as 'M*_ECP1.txt'.

- Events: The 'Batch Classifier' compares all potential events to a user-defined event library, classifies them and saves the result as 'M*_Events'.

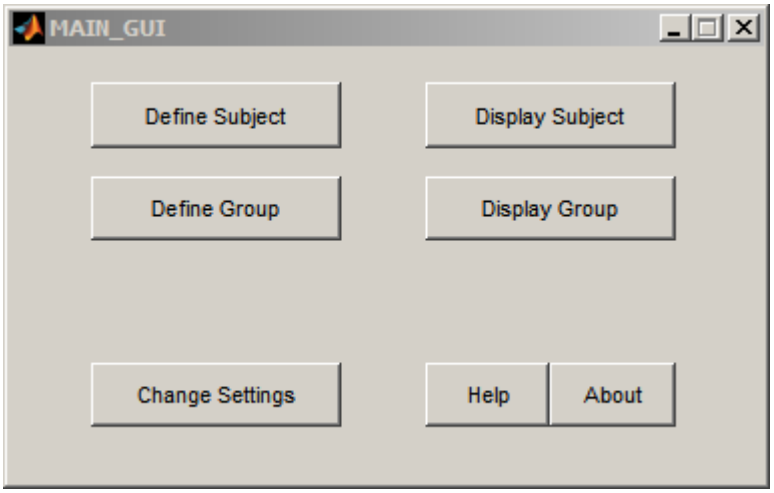
For organisational ease, it is best to create a 'telemetry_data' folder containing subfolders for 'ndf', 'powerbands', 'metrics' and 'events'. As this program cannot deal with spaces in file and folder names it is advised to use underscores. The Matlab routines described here serve to organize all these representations of the data into individual subjects, combine into groups according to condition or treatment and then average or otherwise process the data. Similarly, Mablab produces Raw Data Session (rds) files for each batch of powerband, metrics or event files that is loaded for processing. These rds files are later used to create Subject Definition Files (sdf) and Group Definition Files (gdf). To avoid data getting misplaced it is best to create 'rds' (subdivided in 'powerbands', 'metrics' and 'events'), 'rdf' and 'gdf' subfolders in the 'saved' folder.

Neuroarchiver can simultaneously record up to 14 channels but often less channels are used. When reading data, the EEG analysis suite will interpret the first string of data of any time stamp to be channel one, the second to be channel 2 etc.. To avoid mixing up of data it is therefore strongly advised to instruct Neuroarchiver to work with channel: '1 2 3 4 5 6 7 8 9 10 11 12 13 14' when running any processor.

A full description of the Neuroarchiver tool can be found on the Open Source Instruments website: http://www.opensourceinstruments.com/Electronics/A3018/Neuroarchiver.html

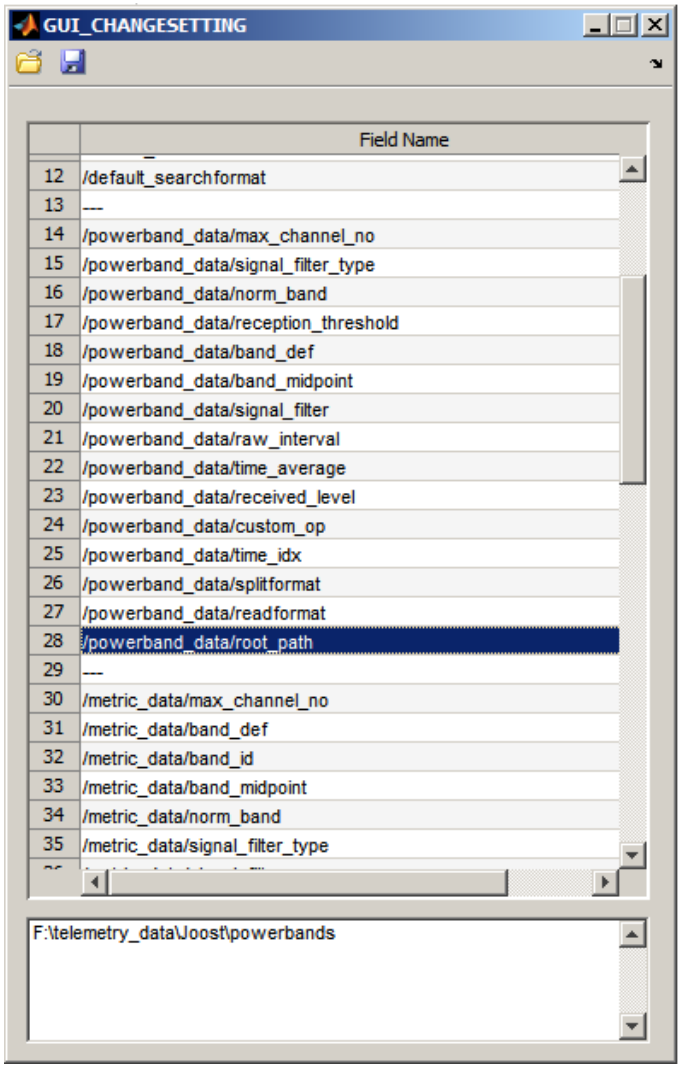
1. ***Open and run main_gui***

   Each button will open a new window for tasks described in sections below. Closing the MAIN_GUI window by clicking the 'x', will close all opened windows and any unsaved data will be lost

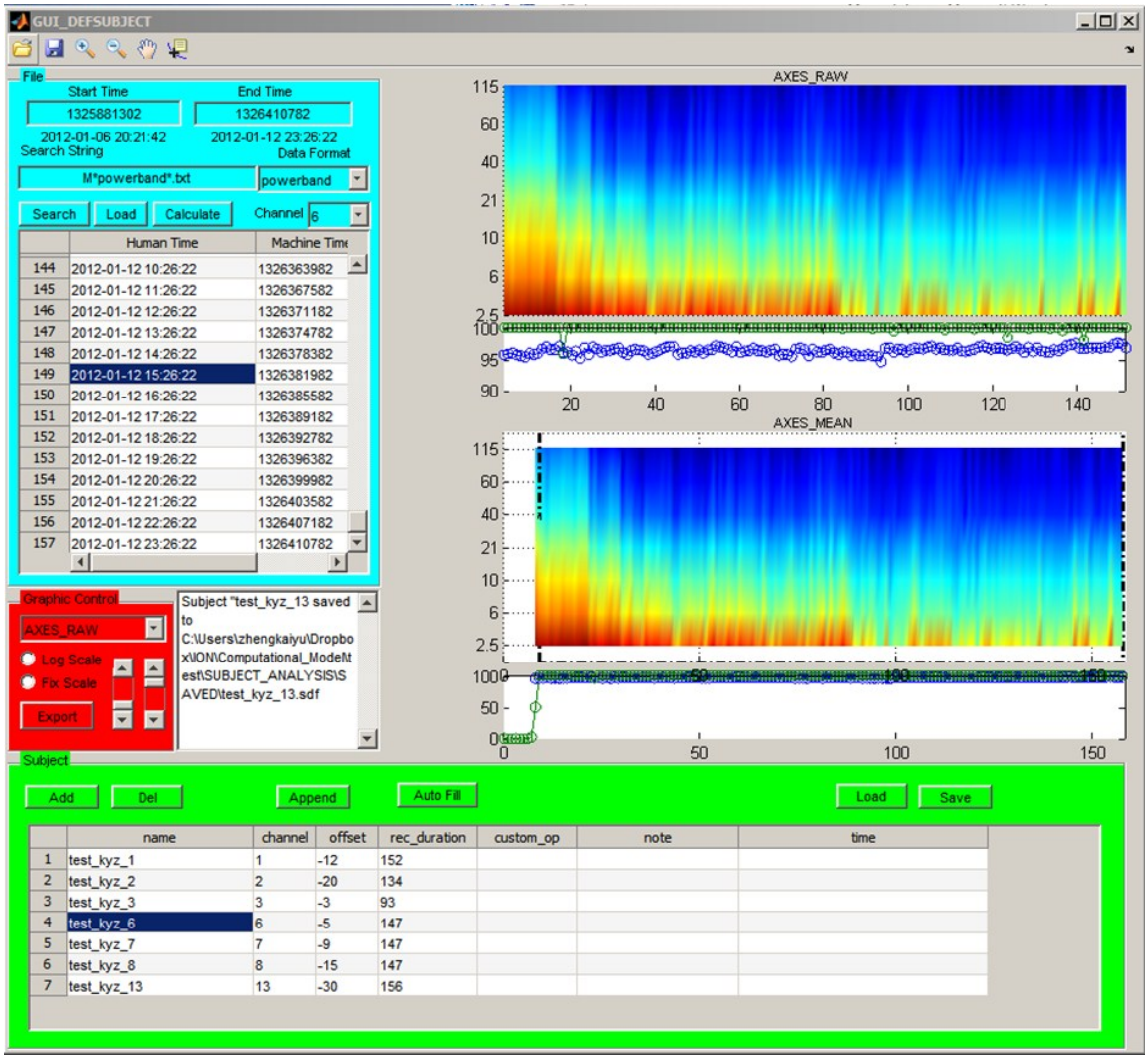


2. *Change Settings*

The ‘Change settings’ window has two sections. The top section is a table listing all the fields of the program options. The bottom section is a text edit box displaying the value of the selected field (in case multiple fields are selected only the first value is displayed). Change the value of the field accordingly (Refer to appendix 1 for list of valid inputs).
For most operations the default settings will suffice. However, before using the program, the ‘root_path’ has to be set for ‘powerbands’, ‘metrics’ and ‘events’ so that the program can find the relevant neuroarchiver data (see example window). To change a ‘root_path’, click the corresponding parameter in the top section, click in the bottom section and hit ‘backspace’ followed by ‘ctrl’+’enter’. This will bring up an explorer/finder window where the appropriate folder can be selected.
Settings can be saved and loaded via the ‘open’ and ‘save’ buttons at the top left corner.
Close the window by clicking the ‘x’ at the top right corner. In order to for new settings, which influence the data calculation (e.g. normalisation band) to take effect, data will have to be re-calculated. Don’t forget to close the ‘change settings’ window once all changes have been made.



3. *Define Subject*



Subjects/animals are defined using powerband, metrics or event files. These files are generated by Neuroarchiver processors/routines. In principle, every type of data can be used to define a subject. It is advised to use powerband data as it contains information about the quality of the recording (for instance drift due to a moving electrode is easily spotted), which could come in handy in the definition process. Metrics are an intermediate data format and not very informative for defining subjects. Event data does not contain much information about recording quality but consumes very little RAM and can therefore save time, especially on slow computers.

Start by entering the time period that will encompass the subject data in either 'Neuroarchiver time' format or 'human time' format (Mxxxxxxxxxx.ndf or YYYY-MM-DD-HH-MM-SS or simply YYYY-MM-DD). Human time can be entered using '–', '/' or ':' as separators. The top row will automatically display Neuroarchiver time and the row below will display the corresponding human time. Depending on the amount of RAM available it is advised not to load more than one week in one go. For longer recordings it is better to define subjects by their first week, save, and then append data one week at a time.

Next, enter the string format, depending on the data format of choice, using '*' as wild card to specify the filename format (depending on the custom-defined name of the used Neuroarchiver processor, e.g. M*_powerbandanalysis*.txt). Click the 'Search' button to look for files containing the chosen string in the time interval you have specified. The search process will look into all subfolders under the root folder that has been selected. The default root folder for raw data can be changed from 'Change Settings'.

Once the search has finished, a summary will be displayed in the 'Information' box showing how many files have been found and how many duplicate files exists in the found list. The list of found files will be displayed in the top table with information about human time, Neuroarchiver time and filename. Now select the desired data format (powerband, metric or event) before clicking the 'Load' button to load the corresponding data files. Once data are loaded, individual files can be viewed simply by clicking any one of them in the file table. Corresponding data are displayed in the top panel (panel raw).

Next, click on 'Calculate' to generate mean values which will be calculated according to the chosen settings (such as hourly means ('1' in '/powerband_data/time_average setting') and no normalization band ('0' in '/powerband_data/norm_band'). The 'information' box will indicate when calculations have finished. Selecting a channel will now also display the mean data in the bottom panel (panel mean). To save time it is best to save the Matlab data files, especially for large time periods. To do this click the 'save' icon at the top left. To re-open, click on the 'open' icon next to it. Remember that only one raw data format is loaded at a given time.

It is now possible to quickly cycle though the data by selecting any file and channel. Raw data for each hour, depicting every single epoch, is displayed in the top panel. Hourly averages for the whole selected period are displayed in the lower panel. The x-axis displays the time in hours. The y-axis displays categories or the middle value of each of the defined powerbands (displayed values can be changed in '/powerband_data/band_midpoint' but the values are ultimately defined by the 'analysispowerbands' processor file). The main plot is a heat map of the data in log10 scale with blue and red representing low and high values respectively. Metrics are also displayed as heat maps. Events are displayed as squares with the area of the square proportional to the value. The actual values can be plotted using 'Display subject'. The lower display of each panel displays different information depending on the type of analysis:

- For power band analysis, the reception quality is depicted by the blue signal which indicates the percentage of time data was received (above a lower threshold (default 0.01 in '/powerband_data/received_level') to separate random noise from genuine signals. This is not to be mistaken from the higher threshold (default 0.80 in '/powerband_data/reception_threshold') which separates good reception quality from low quality signals). The green signal indicates the percentage of time reception was above the reception quality threshold.
- For Metrics, the reception quality is depicted by blue trace. The raw data shown in the top panel shows that metrics reception level can only have three levels of possible values, L, N and U. L stands for Loss. N stands for no event. U stands for an unclassified event (Since the ascii codes for L, N and U are 76,78 and 85 respectively,

entering ’77’ or ‘80’ for example in ‘Settings’ will cause the percentage of time with either good reception quality or events occurring to be depicted). The green trace in the plot is the mean baseline value.

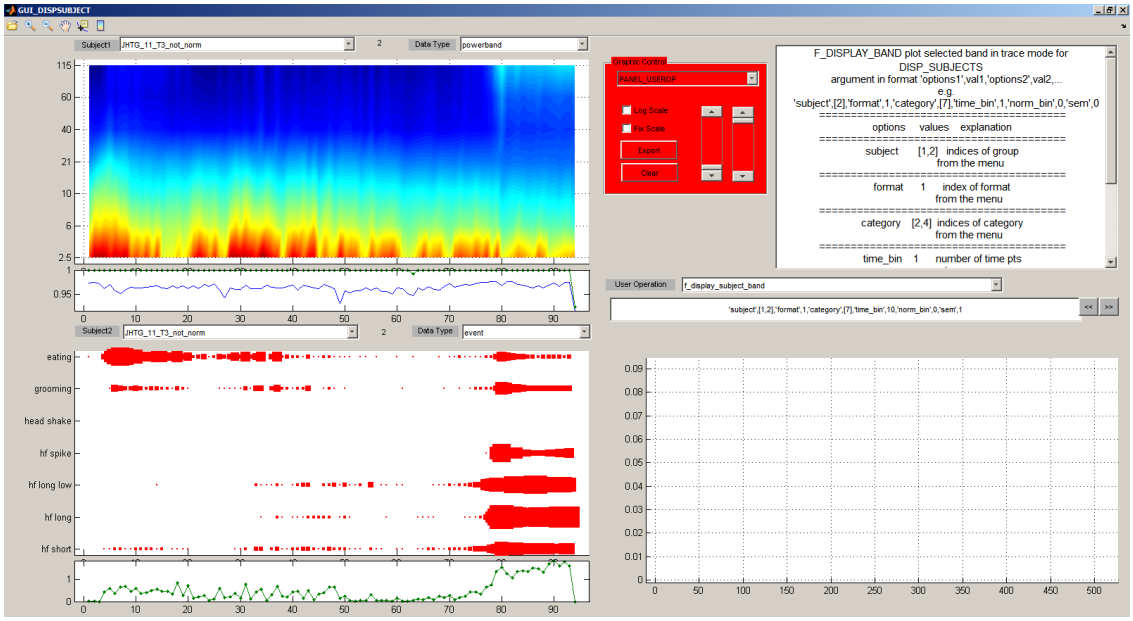
- For events, the green line indicates the baseline event power value

Selecting files by clicking in the file list produces a black box in the lower ‘mean data’ panel. More files can be selected by ‘left-click dragging’ the cursor or by holding ‘shift’ and using ‘arrow’ and ‘page up/down’ keys. The usual ‘ctrl’, ‘shift’ and keyboard and mouse button combinations will also work.

To define a subject, select the appropriate files and click the ‘Add’ button in the Subject panel and enter the subject/animal name. The information about subjects is displayed in the bottom table, where only the fields ‘name’,’offset’, ‘custom_op’ and ‘note’ are editable. When changing the subjects’ name, this will be overwritten on the ‘Subject Data File’ (sdf) unless this name is also changed. Subject names should not contain spaces, but underscores can be used instead. The ‘offset’ is a negative value, which indicates the amount of hours between surgery (or other treatment) and the start of recording. This offset will be taken into account when animals are grouped together to create group-averaged data. ‘Custom’_op is a custom operation, which can be applied to the data (for instance multiplying all data values by 9 in case of the old A3019A transmitters). New data can be appended to the existing subject by repeating the file selection procedure and then clicking ‘Append’.

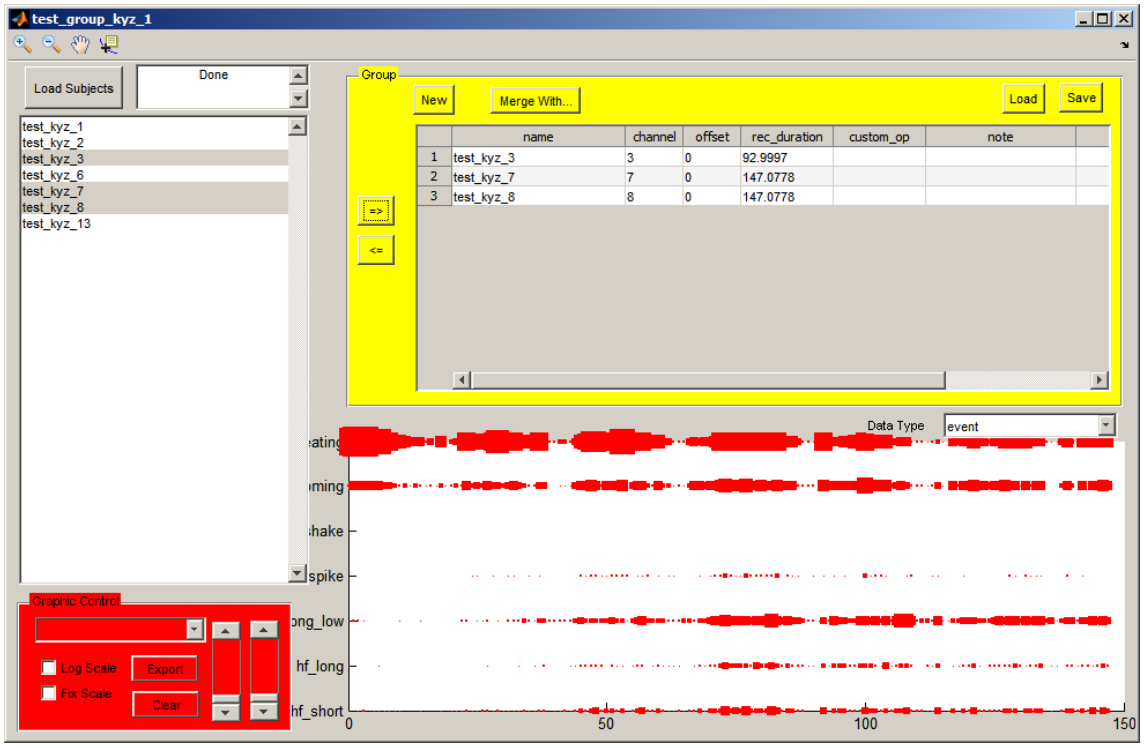
After fully defining the range of one type of data for a subject, ‘Auto fill’ will automatically fill in the other types of data for the same time period. The program will ask for the corresponding root folders containing the appropriate data files. If necessary, change the root folders’ names in ‘change settings’. Beware that, if not saved, all Matlab data will be lost once the window is closed. Therefore, once a subject is created using one type of data it should be saved (‘save’ button) to an ‘sdf’ file at the earliest opportunity. Data can also be appended to existing ‘sdf’ files by clicking ‘Load’ and selecting previously saved subjects/animals. After any change to a subject, the corresponding ‘sdf’ should be saved again.

4. *Display Subject*



Display subject is designed to compare different subjects or different data types within the same subject. Start the process by clicking the ‘open’ icon on the top left corner to load one or more subjects/sdfs. Subjects with the same name (even if the file name is different) will be overwritten with the last one with that name. To avoid confusion and mistakes, either name subjects with distinct and informative names or don’t load subjects of the same name. Select a subject from the ‘Subject1/2’ menu and select the data format from the corresponding menu to display specific data in the panels below. The section in the bottom right corner is for user specific operations only (See section 10). The ‘Graphic Control’ panel can be used to adjust scales for easy viewing or export data in the panels.

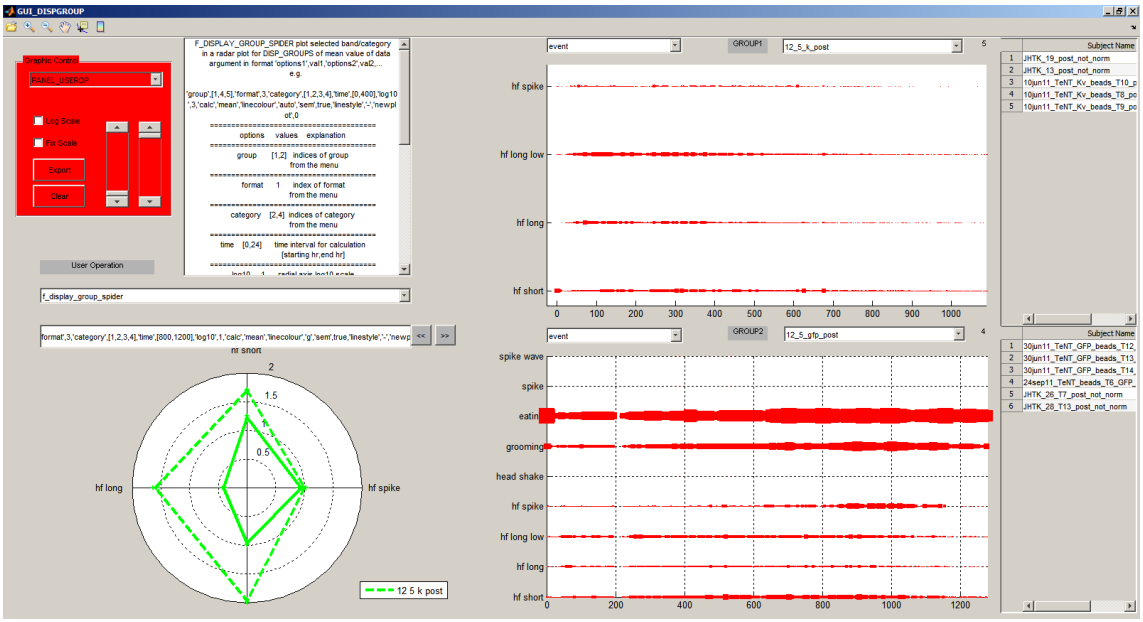
5. *Define Group*



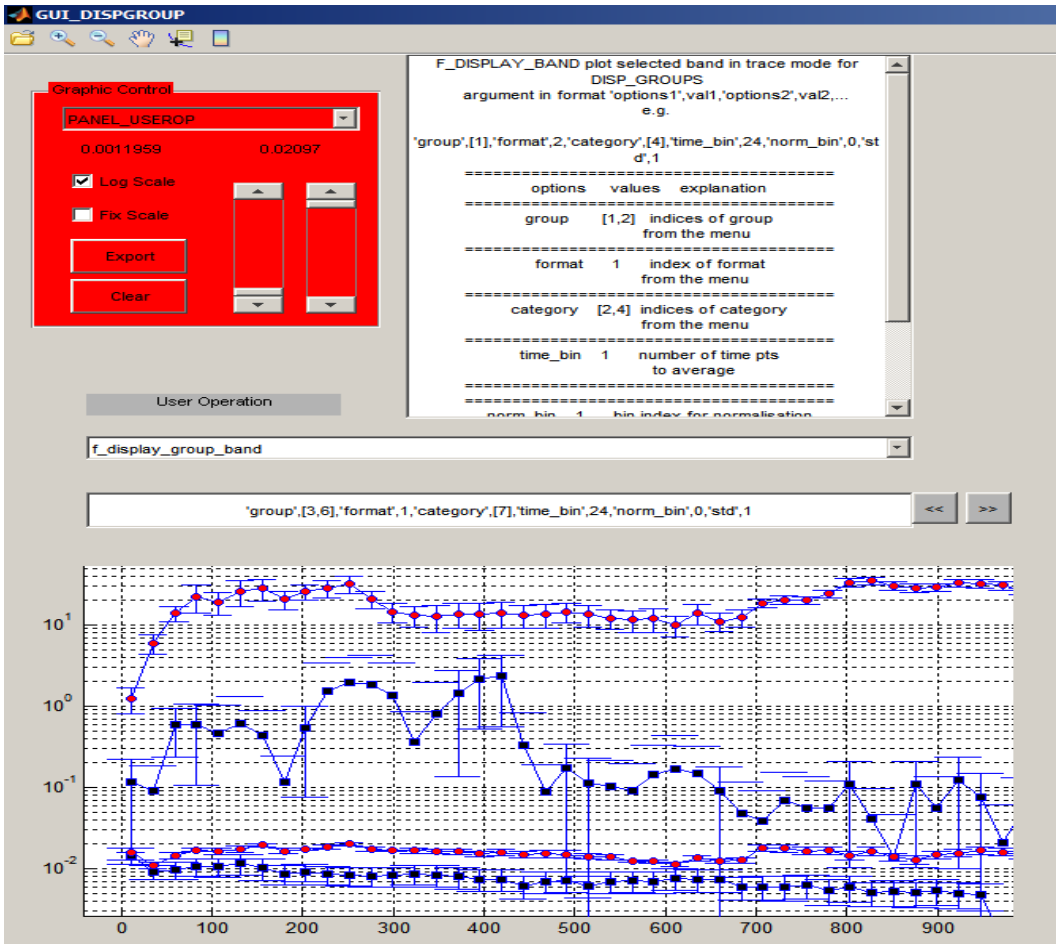
To define a group of subjects, first load a list of subjects by clicking the 'Load Subjects' button. More subjects can be added later on by repeating this procedure. Loaded subjects will be displayed in the list on the left hand side panel. Select a data type and one or more subjects. For multiple subjects, only the last selected subject will be displayed. To create a new group, click on 'New' button in the 'Group' panel. Remember to use underscores rather than spaces when naming groups. Once a group is named it will appear in the window title bar and subjects can be added or removed using the '=>' or '<=' button respectively. Existing groups can be loaded, merged and saved (to Group Data File (gdf) with the corresponding buttons in the 'Group' panel. You can also click on the subject/animal in the table to display them in the axes below. Average group data is only calculated when a group is saved and all subject data is aligned.

6. *Display Group*

Similar to display subject functions. There are three main areas to the user interface. To the left are the graphic control panel (see section 11), information box and user operation area (see section 10). To the right are two panels for group data comparisons. Start the process by clicking the 'open' icon at the top left corner to select a list of groups to compare. Please note that identically named groups will overload each other and cause loss of processed data. Once groups are loaded, they can be selected from the menu at the top left corner of the display panel on the right. The preferred data type (i.e. powerband/metrics/events) is selected from the menu at the top right corner of the panel on the right to display in the panel below the menu. The table right of the panel contains the names of the subjects/animals within the selected group.



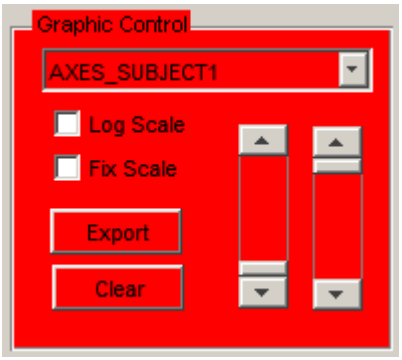
7. *User operations*



A list of user operations will be loaded into a menu at the start of the programme. The functions are found from the folder specified in '/rootpath/userop'. The default location is './USEROP'. After selection of a user operation, a description and instructions to use the function will be displayed in the information panel. The input argument for the function needs to be entered in the text box below the menu. Any error in the input argument will cause an error message. Forward ('>>') and a back ('<<') buttons are allow cycling through previously used input arguments. The result of the user operation is either displayed in the information box or plotted in the axes below. Results can be exported as explained in section 11.

There are currently four built-in user operations for line plot and radar plot of subjects and groups. Their explanations are in appendix 3.

8. *General usage of graphic control panel*



Select a panel from the menu and use the slider to change the upper and lower bound of colour of spectrum type plot or y-axis limit of line type plot. Select the 'Log Scale' option to switch the z-axis (colour) of spectrum type plot or y-axis of line type plot between linear and log10 scales. The 'Fix Scale' option will fix the z-limit or y-limit to the current values even if new data are plotted. As each plotted subject or group will normally auto-adjust to have maximum range, fixing the scale is useful to objectively compare subjects or groups. To do this, first select the panel to fix the scale to, change the scale and fix it. Now, change the panel to display the subject/group to compare to and click 'fix scale' again. Click the 'Export' button to export the data in the plot into ascii format which can be used by other programs (e.g. Excel). The'Clear' button in 'Display Subject' and 'Display Group' clears all plots in the selected axes.

9. *Appendix 1*

Field Name	Valid Input
General Section	
/about	Cannot change
/usage	Single filename
/rootpath/raw_data	Full path to where raw session files are to be saved and loaded
/rootpath/gui_option	Full path to where programme settings are to be saved and loaded
/rootpath/subject_data	Full path to where subject data are to be saved and loaded
/rootpath/group_date	Full path to where group data are to be saved and loaded
/rootpath/userop	Full path to where user operation Matlab functions are stored
/searchformat	Cannot change
/default_analysis_interval	Default amount of time before today when first opened GUI_DEFSUBJECT. Value is auto corrected between 1 day and 365 days. Default value is 7 days.
/default_searchstr	Default string format for file search in GUI_DEFSUBJECT
/default_searchformat	Default data format for define animals. Valid options are listed in /searchformat. Error message will appear if input is invalid.
Powerband Data Section	
/powerband_data/max_channel_no	Cannot change. Default maximum channel number from neuroachiver is 14 in the current model
/powerband_data/signal_filter_type	Valid options are none, bandwidth, pink, brown. Any other input will invoke the error message
/powerband_data/norm_band	Band for normalisation. Default value 0 means no normalisation will take place. Value will be autocorrected to an integer between 0 and maximum number of bands.
/powerband_data/reception_threshold	Threshold value for reception quality to be considered good signal. Input will be autocorrected between 0 and 1.
/powerband_data/band_d	Enter in the format [b1,b2,b3,b4,..,bn], where b_i is the band

ef	boundary values. MUST be entered correctly, there will be no autocorrection for this.
/powerband_data/band_midpoint	Cannot change as it is calculated automatically from /powerband_data/band_def
/powerband_data/signal_filter	Cannot change as it is calculated from /powerband_data/signal_filter_type
/powerband_data/raw_interval	Time interval for the powerband data from neuroarchiver. 4 second is the default value in the current model.
/powerband_data/time_average	Default value 1 hr. It is autocorrected to be greater than 1. Stick with integer values.
/powerband_data/received_level	Default value 0.01, and is autocorrected between 0 and /powerband_data/reception_threshold
/powerband_data/custom_op	String operation to be applied to raw powerband data. Default value *1, i.e. nothing is to be done.
/powerband_data/time_idx	The column index of the time field in powerband text file. DO NOT change it unless you are absolutely sure. Value will be autocorrected to an integer >0.
/powerband_data/splitformat	String format used to read powerband text file. DO NOT change it unless you are absolutely sure.
/powerband_data/readformat	String format used to read powerband text file. DO NOT change it unless you are absolutely sure.
/powerband_data/root_path	Full path to the folder where programme should search for powerband data. Make any changes then press CTRL+ENTER to invoke the dialog for folder tree, otherwise enter the full path manually. This is critical for autofill and search data, avoid making any mistakes.
Metric Data Section	
/metric_data/max_channel_no	Cannot change. Default maximum channel number from neuroachiver is 14 in the current model

/metric_data/band_def	Cannot change. This is automatically calculated using /metric_data/band_id
/metric_data/band_id	Enter metric band name separated by |. Deafult value:E_power|T_power|HF_power|Spikey|Volt_asy|Inter.
/metric_data/band_midpoint	Cannot change. This is automatically calculated using /metric_data/band_id
/metric_data/norm_band	Band for normalisation. Default value 0 means no normalisation will take place. Value will be autocorrected to an integer between 0 and maximum number of bands.
/metric_data/signal_filter_type	Valid options are none, bandwidth, pink, brown. Any other input will invoke the error message
/metric_data/signal_filter	Cannot change as it is calculated from /powerband_data/signal_filter_type
/metric_data/raw_interval	Time interval for the metric data from neuroarchiver. 1 second is the default value in the current model.
/metric_data/time_average	Default value 1 hr. It is autocorrected to be greater than 1. Stick with integer values.
/metric_data/received_level	Default value 80, and is autocorrected between 0 and /metric_data/reception_threshold
/metric_data/reception_threshold	Default value 80, and is autocorrected between 0 and 100
/metric_data/custom_op	String operation to be applied to raw powerband data. Default value *1, i.e. nothing is to be done.
/metric_data/time_idx	The column index of the time field in metric text file. DO NOT change it unless you are absolutely sure. Value will be autocorrected to an integer >0.
/metric_data/channel_id_idx	Not used. For future reference only
/metric_data/event_id_idx	Not used. For future reference only

/metric_data/baseline_idx	Not used. For future reference only
/metric_data/metrics_idx	Not used. For future reference only
/metric_data/splitformat	String format used to read metric data text file. DO NOT change it unless you are absolutely sure.
/metric_data/readformat	String format used to read metric data text file. DO NOT change it unless you are absolutely sure.
/metric_data/root_path	Full path to the folder where programme should search for metric data. Make any changes then press CTRL+ENTER to invoke the dialog for folder tree, otherwise enter the full path manually. This is critical for autofill and search data, avoid making any mistakes.
Event Data Section	
/event_data/max_channel_no	Cannot change. Default maximum channel number from neuroachiver is 14 in the current model
/event_data/raw_interval	Time interval for the metric data from neuroarchiver. 1 second is the default value in the current model. This should be the same as the set of metric data used for generating the event text file from neuroarchiver.
/event_data/time_idx	The column index of the time field in event data text file. DO NOT change it unless you are absolutely sure. Value will be autocorrected to an integer >0. Default value is 2.
/event_data/channel_id_idx	The column index of the channel id field in event data text file. DO NOT change it unless you are absolutely sure. Value will be autocorrected to an integer >0. Default value is 3.
/event_data/event_id_idx	The column index of the event id field in event data text file. DO NOT change it unless you are absolutely sure. Value will be autocorrected to an integer >0. Default value is 4.
/event_data/baseline_idx	The column index of the baseline value field in event data text file. DO NOT change it unless you are absolutely sure. Value will be autocorrected to an integer >0. Default value is 5.
/event_data/metrics_idx	The column indices of the metrics field in event data text file. DO NOT change it unless you are absolutely sure. Value will be autocorrected to integers >0. Default value is

	[6,7,8,9,10,11].
/event_data/time_average	Default value 1 hr. It is autocorrected to be greater than 1. Stick with integer values.
/event_data/splitformat	String format used to read metric data text file. DO NOT change it unless you are absolutely sure.
/event_data/readformat	String format used to read metric data text file. DO NOT change it unless you are absolutely sure.
/event_data/event_id	Enter event type name separated by |. Default value: hf_short|hf_long|hf_long_low|hf_spike|head_shake|grooming|eating|spike|spike_wave. This will affect the calculated results.
/event_data/band_def	Cannot change. This is automatically calculated using /event_data/event_id
/event_data/band_midpoint	Cannot change. This is automatically calculated using /event_data/event_id
/event_data/root_path	Full path to the folder where programme should search for event data. Make any changes then press CTRL+ENTER to invoke the dialog for folder tree, otherwise enter the full path manually. This is critical for autofill and search data, avoid making any mistakes.

10. *Appendix 2*

Guide to the maximum size of various raw data files. Use this to estimate the time period your computer is capable of handling in one go during making definition for subjects/animals. For example, with a computer with 4Gb RAM and 2Gb RAM dedicated to Matlab, it is best not to process more than 1 month of raw data at a given time for defining subjects. The append function can be used to define subjects with longer periods. Remember that for 'analysispowerbands', 14 channels of data are generated each containing 7 power bands plus reception data at 4 second intervals. So for the example above one month worth of data would consume 14 x (7+1+1) x (4 x 900 x 24 x 30) ~ 326.6 million data points of two bytes just for reading the data before Matlab starts to analyse and add data.

Data Type	**1 week**	**1 month**
Power bands	<16MB	<200MB
Metrics	<73MB	<250MB
Events	<1MB	<6MB

11. *Appendix 3*

Function f_display_subject_band.m can be used to plot selected band/bands of a set of subjects using line plots with or without error bars. When there are too many data points for a subject, for example a three months recording will have over 2000 data points for a single subject, one can used *time_bin* option to average data points. There is also options for normalise data to selected time points in the line plot. The input argument for this function is in the format of 'options$_1$',val$_1$,'options$_2$',val$_2$,...,'options$_n$,val$_n$.

For instance, the following argument, will plot the band 7 (category=7) of powerband data (format=1) of subject number 2 and 3 (subject=[2,3]) with no time point average (time_bin=1), no normalisation (norm_bin=0) and no error bars (sem=0). The new plot will replace the existing plot in the panel.

'subject',[2,3],'format',1,'category',[7],'time_bin',1,'norm_bin',0,'sem',0,'newplot',1

The following example will plot category 1, 2 and 4 (category=1,2,4 which in this case is hf_short, hf_long and hf_spike) of the classified event data (format=3) of subject 1 and 10 (subject=[1,10]) with the mean event count over 24hrs (time_bin=24), no normalisation (norm_bin=0) and with error bars ploted (sem=1). This will be plotted together with existing plots in the panel.

'subject',[1,10],'format',3,'category',[1,2,4],'time_bin',24,'norm_bin',0,'sem',1,'newplot',0

The values for appropriate options are listed below

Options	Valid Values	Explanation
subject	Set of integer values >0 and < total number of subjects in the current loaded list	indices of subjects from the menu
format	1 or 2 or 3	1=powerband data; 2=metric data; 3=event data
category	Set of integer values >0 and < number of categories for selected data format	e.g. for powerband data this is the band index.
time_bin	Integer value >0	Number of time points to average
norm_bin	0 or integer value less than the total number of ploted points	Time bin index to normalise to. 0 = no normalisation
sem	0 or 1	0= no error bars plotted 1= plot error bars
newplot	0 or 1	0 = plot with existing plot 1 = plot over existing plot

Function f_display_group_band uses the same arguments as f_display_subject_band with the only exception that option *subject* is replaced with option *group*. The mean value of the plot when time_bin is used is calculated by average each subject member of the group with temporal means before average each subject in the group into the final mean value. The same is applied to the standard deviation of the mean.

Function f_display_subject_spider.m can be used to plot selected band/bands of a set of subjects using spider/radar plots with or without error bars. Because the plot has angular axis of categories rather than time, it is necessary to specify the time interval for which the data will be averaged and plotted. This is done with the option *time.* There is also options for plot data in that time interval in averaged or summed mode. This is particularly useful for event data where one may wish to visualise the data in term of total events or mean event rate. The radial axis of values can be plotted in linear fashion or a modified log10 based version. The modified log10 based version converts linear values to plot values using the formula, $y=\log_{10}(x+10^{-logscale})+logscale$. For example, if logscale=3, then a value 0 will equal to 0 and a value of 1 will equal to 3.0004 and 10 will equal to 4 and 100 will equal to 5, etc. The input argument for this function is in the format of $'options_1',val_1,'options_2',val_2,...,'options_n,val_n$.

The values for appropriate options are listed below

Options	Valid Values	Explanation
subject	Set of integer values >0 and < total number of subjects in the current loaded list	indices of subjects from the menu
format	1 or 2 or 3	1=powerband data 2=metric data 3=event data
category	Set of integer values >0 and < number of categories for selected data format	e.g. for powerband data this is the band index.
time	Set of two integer values in $[n_1,n_2]$	n1 is the start time and n2 is the end time for the interval from which mean/sum is calculated
calc	'mean' or 'sum'	Mean=average value between time interval is calculated Sum=the total value between time interval is calculated
log10	Integer value n>=0	0=linear radial axis scale, >0 the radial axis uses pseudo log10 based scale calculated using $y=\log_{10}(x+10^{-n})+n$
sem	0 or 1	0=no error bar plotted 1=error bar plotted

newplot	0 or 1	0=plot with existing plot 1=erase existing plot and plot in the panel
linecolor	'b','r','k','g','y','c','m','auto' or $[n_1,n_2,n_3]$ with $0<=n_i<=1$	Specifies plot line colour. 'auto' will plot with automatically cycled colour. 'b'=blue; 'r' = red; 'k'=black; 'g'=green; 'y'=yellow; 'c'=cyan; 'm'=magenta. [n1,n2,n3] specify exact rgb value for the line colour.
linestyle	'-', '—', '.', '-.'	Specifies plot line style. '-' = solid line; '—' = dash line; '.' = dot line; '-.' = dash dot line
linewidth	Integer value >=1	Specifies line width

The following example will plot the mean value data (calc='mean') of band 1,4 and 7 (category=[1,4,7]) between 0 to 48th hour (time=[0,48]) of powerband data (format=1) for subject number 2 and 3 (subject=[2,3]) using linear axial scale (log10=0) with no error bars (sem=0). The new plot will replace the existing plot in the panel using solid (linestyle='-') automatic line colour (linecolour='auto') of width 3 (linewidth=3).

'subject',[2,3],'format',1,'category',[1,4,7],'time',[0,48],'log10',0,'calc','mean','sem',0,'newplot',1,'linecolour','auto','linestyle','-','linewidth',3

The following example will plot category 1, 2 and 4 (category=1,2,4 which in this case is hf_short, hf_long and hf_spike) of the classified event data (format=3) of subject 1 and 10 (subject=[1,10]) with the total event count (calc='sum') over 160th to 380th hour (time=[160,380]) with error bars ploted (sem=1). This will be plotted together with existing plots in the panel (newplot=0) using dash (linestyle='—') blue (linecolour='b') line of width 3 (linewidth=3) with an pseudo log10 scale (log10=1).

'subject',[1,10],'format',3,'category',[1,2,3,4],'time',[160,380],'log10',1,'calc','sum','newplot',0,'linecolour','b','linestyle','--','linewidth',3

Function f_display_group_spider uses the same arguments as f_display_subject_spider with the only exception that option subject is replaced with option group. The mean value of the plot when time_bin is used is calculated by average each subject member of the group with temporal means before average each subject in the group into the final mean value. The same is applied to the standard deviation of the mean.