Manual for REST transformation processing

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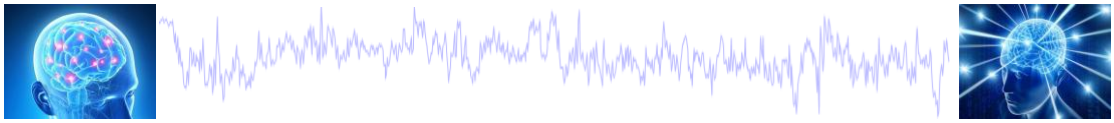
Notice:

- This GUI will be automatically installed when you run the main function **REST.m**.
- Before you perform the REST transformation processing of your EEG data, you first need to clear any imported datasets.
- The electrode information (number and order) used to calculate the Leadfield matrix must be matched with the data (i.e. Nos. of channels in data and leadfield matrix should be equal).
- When you perform the REST transformation processing, please follow the order listed in **Userguide.pdf**; if not, the GUI will report the error, e.g., 'No EEG data has been imported, please import data !!!', 'Wrong Leadfield has been imported, please import the right Leadfield !!!', etc.
- This GUI only supports the data with the format (.cnt, .mat, and .vhdr), for the ***.cnt** and ***.vhdr** data, the corresponding electrode information should be included, but for the ***.mat** data, only the data structure should be imported. The imported data should be named as 'data' in Matlab workspace, and for the ***.mat** data, the input structure must be (nchann×point).
- **The Lead_field file (Leld_field matrix and electrodes location files) in this toolbox just used for TEST !!! Please recalculate the corresponding Lead_field matrix of your data.**
- In addition, the Matlab version is able to run on Linux/Windows, except the function "Calculate leadfield" (the file "**Leadfield.exe**" is unable to run on Linux (ONLY on windows)). Therefore, the recommended operating system is "Windows 7/8/10 64bit".

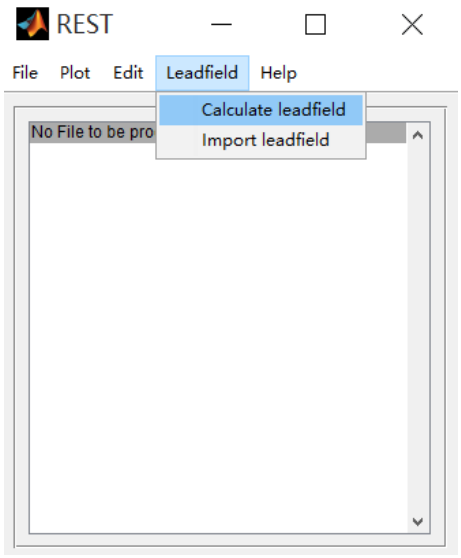


1. Leadfield calculation

For a new electrode system, you need to create a new Leadfield matrix. This step is conducted by the **LeadField.exe**.

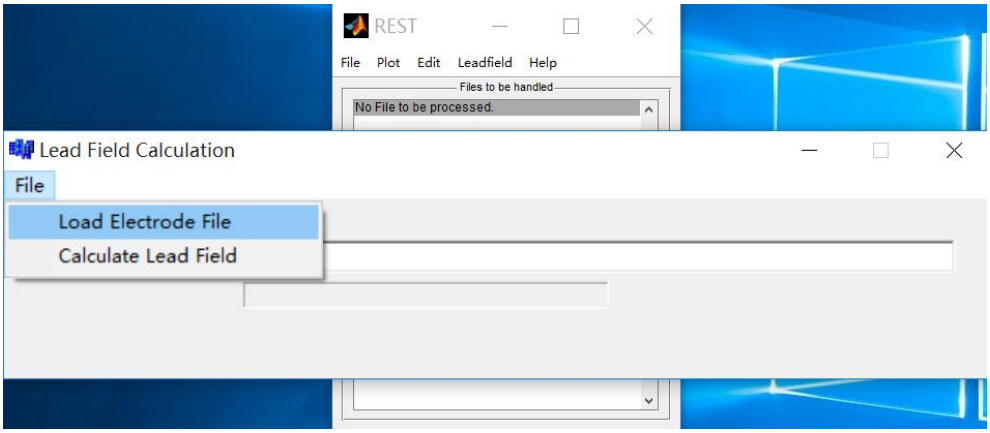
It calculates the Leadfield matrix from the 3000 cortical dipoles and the newly given electrode array (e.g., ele_129.txt) for the canonical concentric-three-spheres head model. The radii of the three concentri spheres are 0.87 (inner radius of the skull), 0.92 (outer radius of the skull) and 1.0 (radius of the head), while the conductivities are 1.0 (brain and scalp) and 0.0125 (skull). The electrode array should be saved as *.txt ASCII files with their Caretesian (x, y, z) coordinates in three columns. The detailed operation is as follows:

1). Run REST.m (Type '**REST**' in Command Window) --> Leadfield --> Calculate leadfield



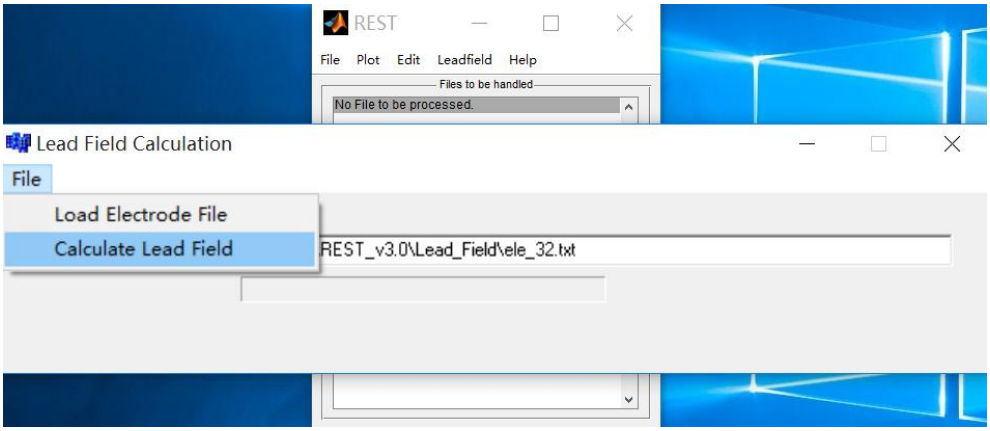
2). File --> Load Electrode File

The electrode file should be in the *. txt format; and the first column represents the x position of electrode, the second column represents the y position of electrode, the third column represents the z position of electrode, (e.g., ele_129.txt).



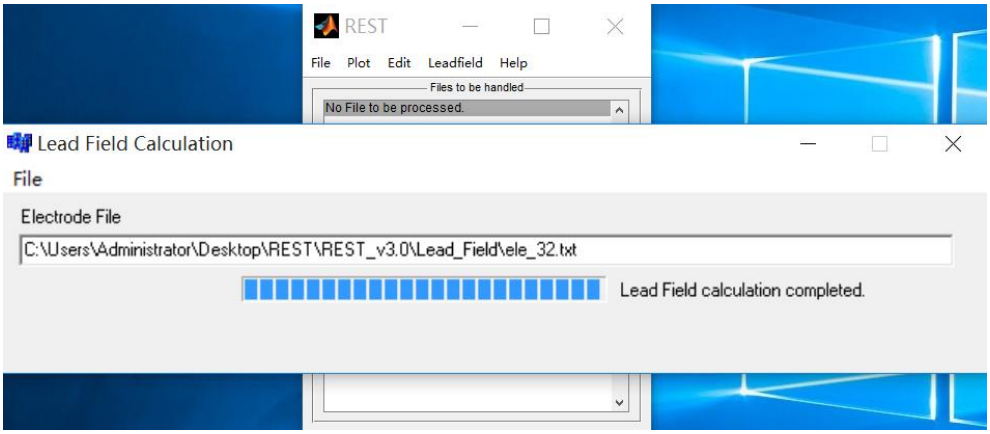
3). File --> Calculate Lead Field

After the electrode file has been successfully loaded, it may take a few minutes to calculate the corresponding Leadfield matrix, this depends on the size of the matrix and the computer used.



4). Leadfield calculation completed.

Upon completion of the Leadfield matrix calculation, the Leadfield matrix will be saved as “Lead_Field.dat” in the same directory as the **electrode file** (e.g. Lead_Field.dat in the file).

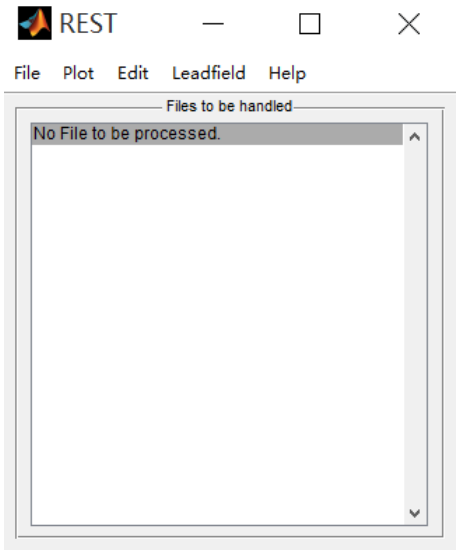


In case you have the leadfield matrix with *.dat format, you can move it to this directory and re-name it as 'Lead_Field.dat'.

2. REST transformation

After we have successfully calculated the corresponding Leadfield matrix for the EEG data, the following procedure would be the REST transformation processing, which is conducted based on **REST.m.**

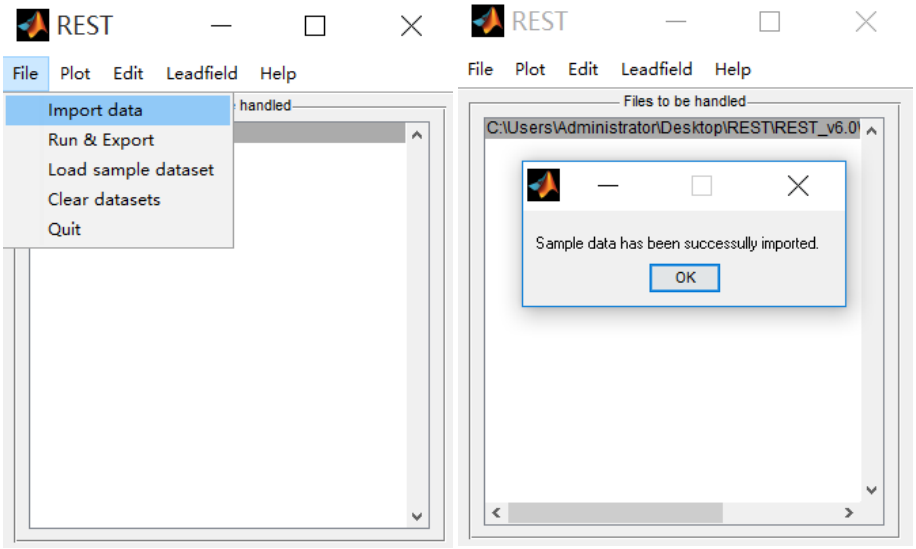
Run **REST.m** (Type 'REST' in Command Window), here is the main interface of this GUI.



1). File --> Import data (.cnt, .mat, and etc.)

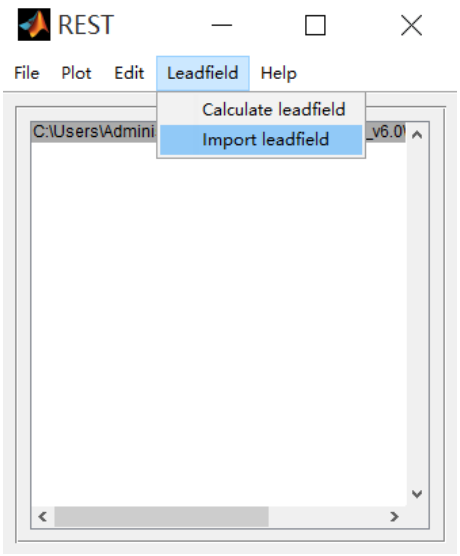
The imported data should be in the *.cnt, *.mat, and etc. format. For the GUI

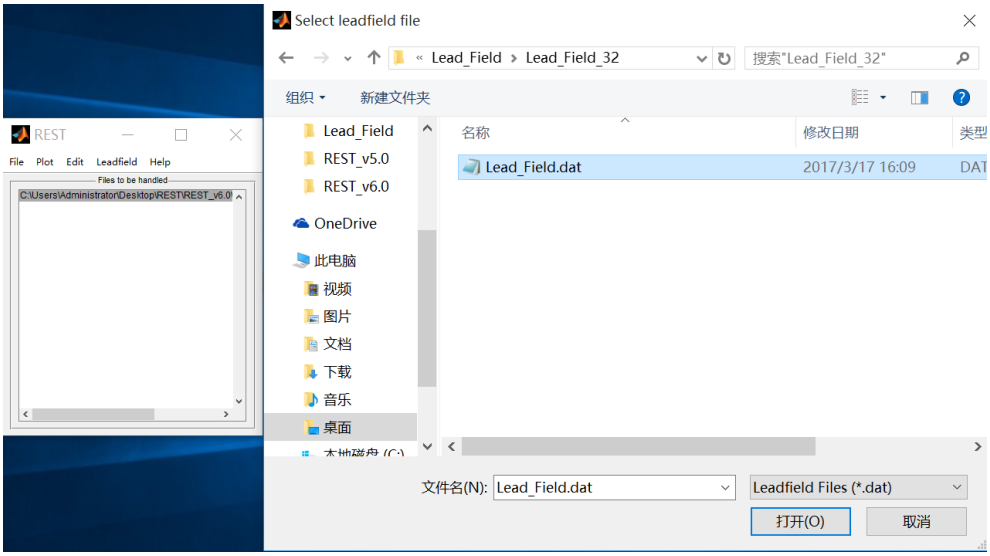
test, we provide the data with the *.mat, and *.vhdr format.



2). Leadfield --> Import leadfield

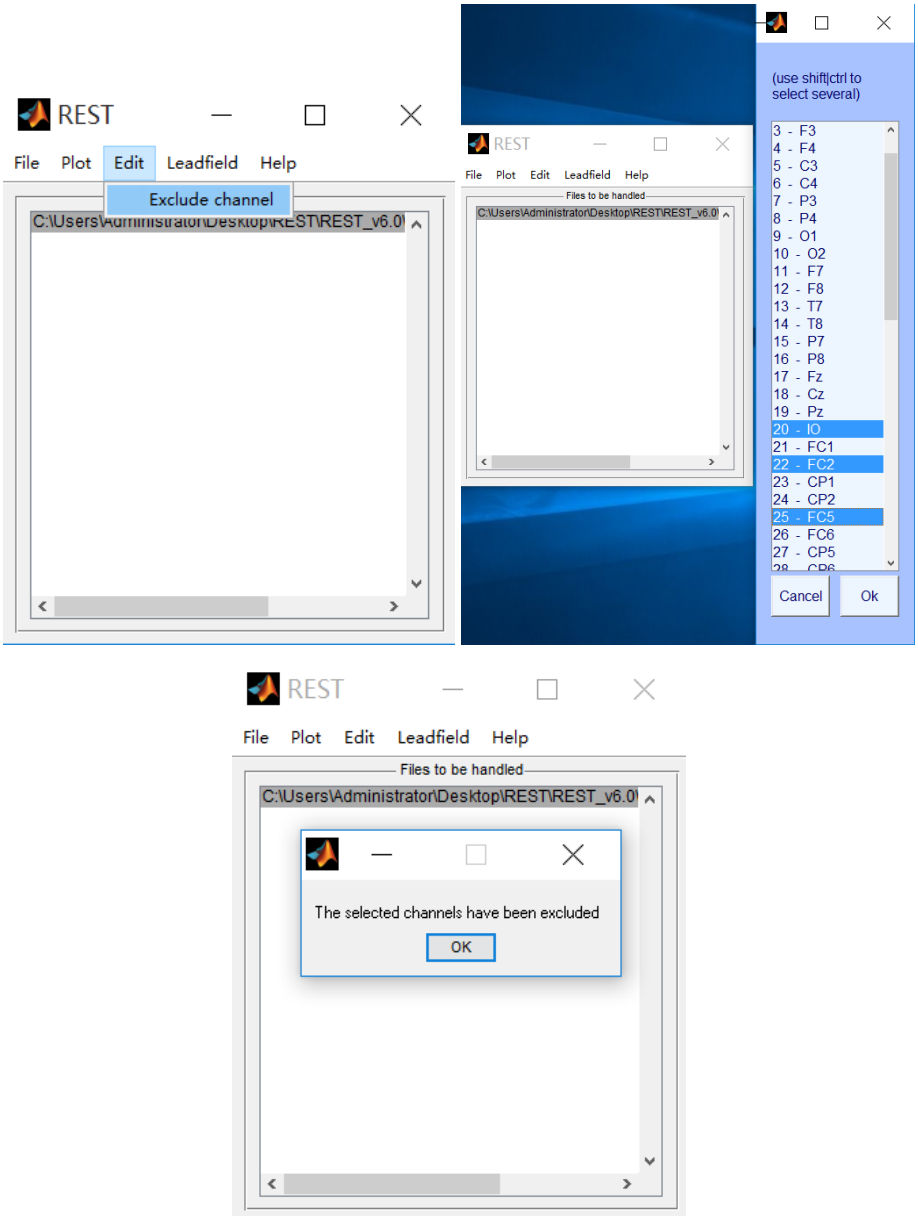
After the EEG data has been loaded, you just need to use this option to import the corresponding Leadfield matrix (e.g., Lead_Field.dat). Notice that the excluded channels (e.g., EKG, ECG, and bad channels, etc.) should not be contained in the imported Leadfield matrix.





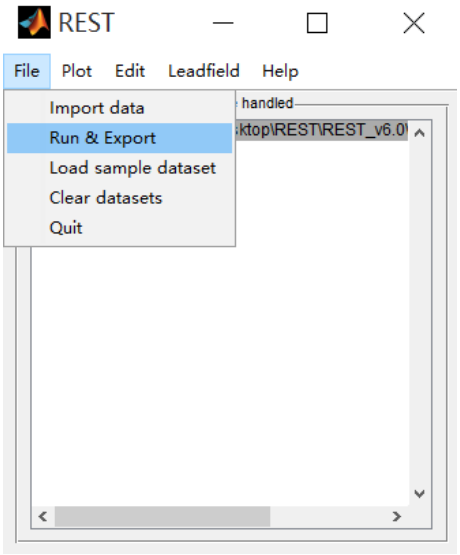
3). Edit --> Exclude channel

After the Leadfield matrix has been successfully imported, you can use this option to exclude the useless channels (e.g., EKG, ECG, and bad channels, etc.), and these channels will be removed from the subsequent REST transformation processing.



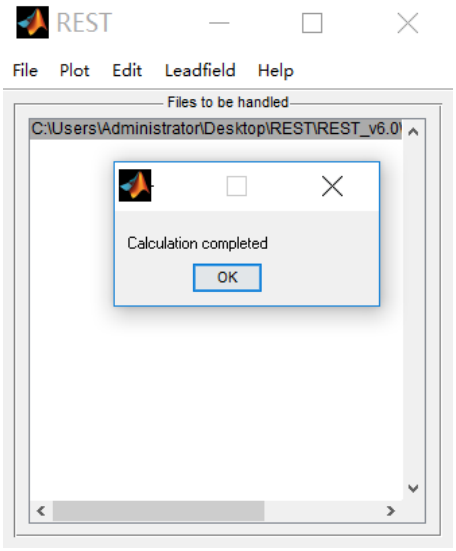
4). File --> Run & Export

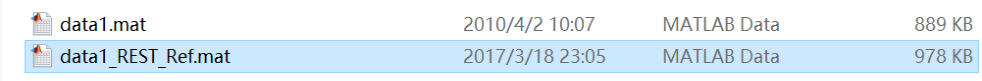
After the excluded channels have been removed from the EEG data, use this option to perform the corresponding REST transformation processing.



5). Calculation completed.

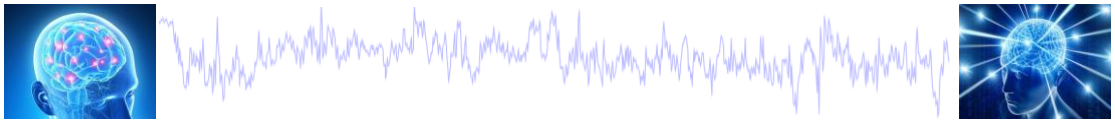
After the REST transformation processing has been successfully completed, the Re-reference EEG data will be saved in the current directory with the *_REST_Ref postfix containing the re-referenced data with the same name as the original data.

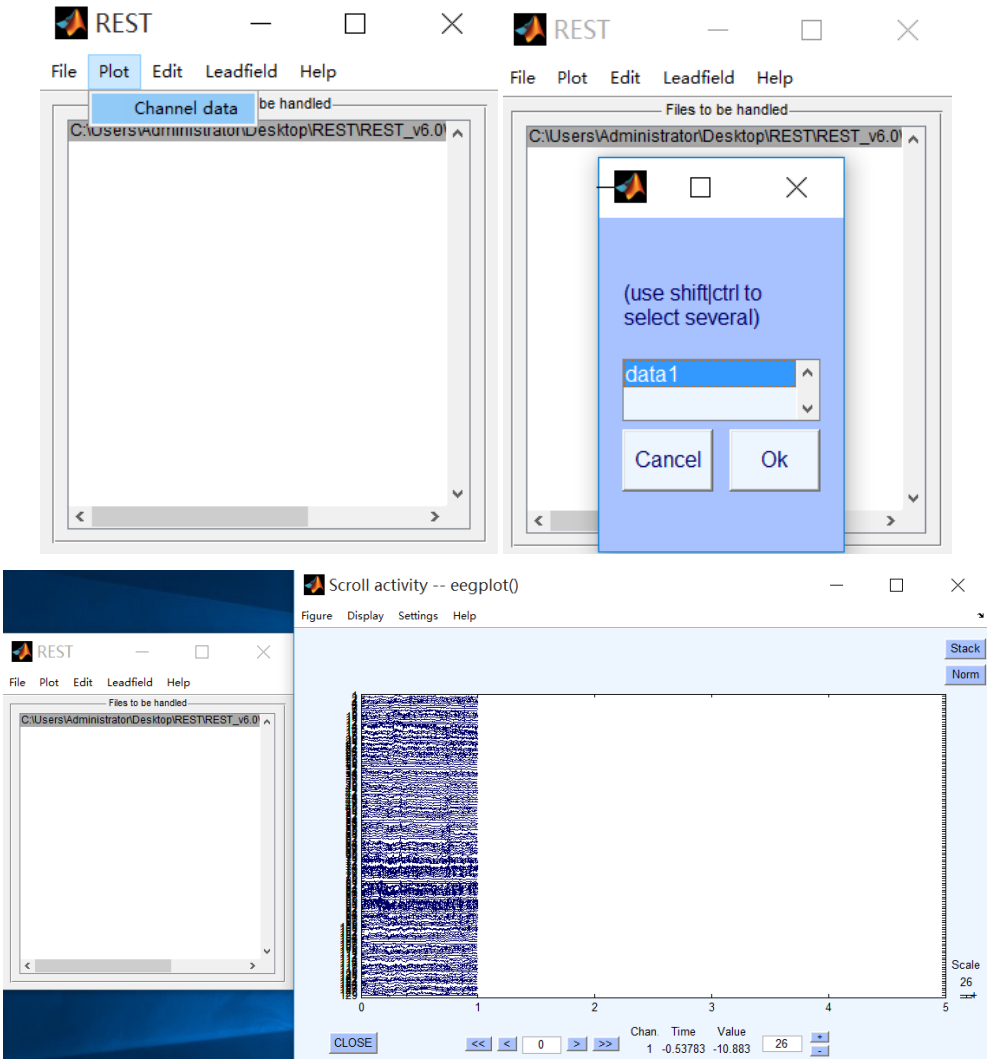




6). Plot --> Channel data (optional)

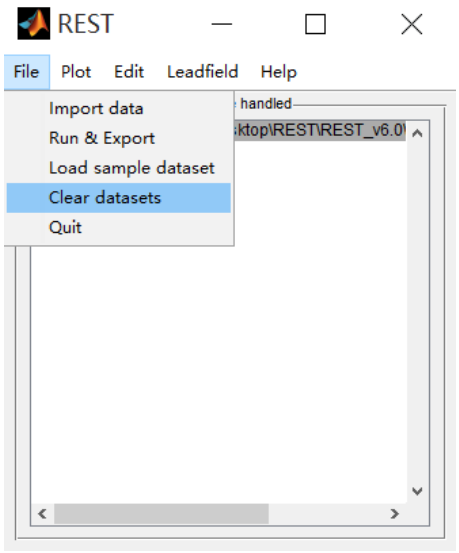
If you want to plot the EEG data, then you can use this option. Here, we only intend to plot the original EEG data rather than the re-REST EEG data.





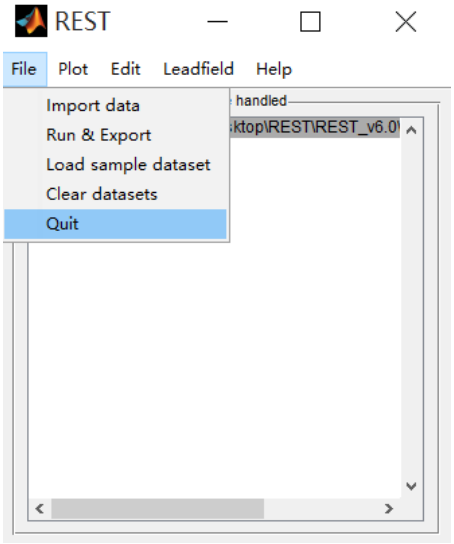
7). File --> Clear datasets (optional)

If you want to clear the Matlab workspace, you can use this option to clear the imported data and the variations in the Matlab workspace.



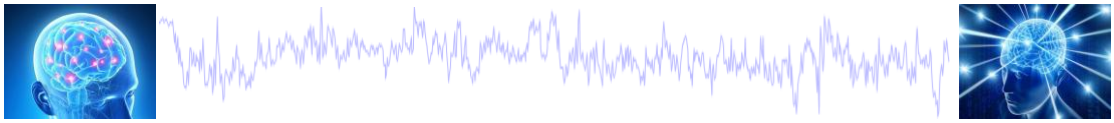
8). File --> Quit

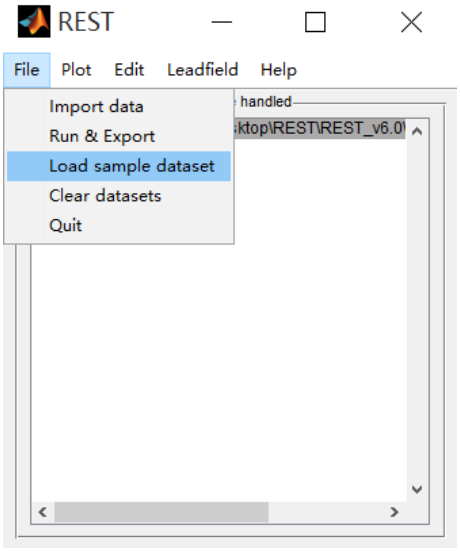
After you finish the REST transformation processing, use this option to exit the GUI.



9). File --> Load sample dataset (optional)

If you want to practice to use this REST GUI, use this option to load the sample dataset, and then follow the instructions above to perform the REST transformation processing. Here, we provide BP data (named as sample.vhdr) in the current directory named as 'sample_data'; the channel number is 64, srate is 500, time point is 500.

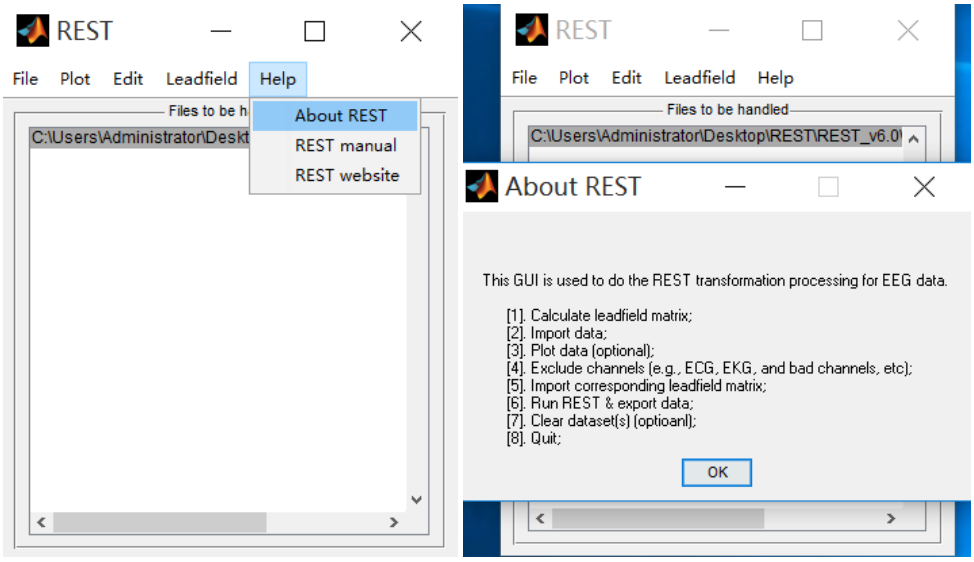




3. Help

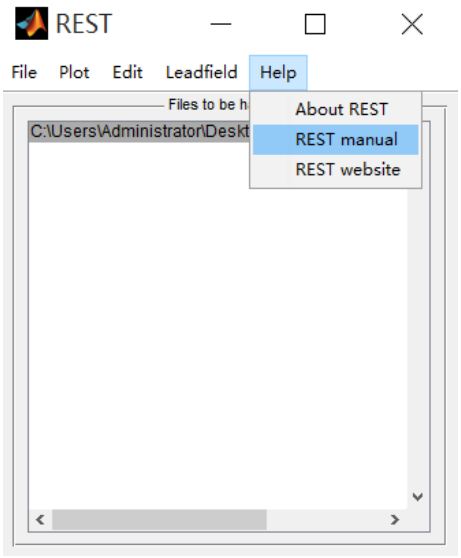
1). Help --> About REST

The detailed procedures for REST transformation processing can be obtained from this option.



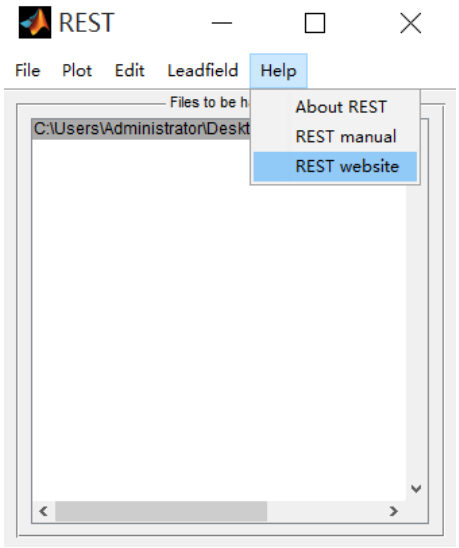
2). Help --> REST manual

If you have any question about this GUI, you can use this option to find the manual for this GUI.



3). Help --> REST website

The recent version of this GUI can be downloaded from the website of REST (e.g., 'http://www.neuro.uestc.edu.cn/rest/'), you just need to use this option to find and download the recent version of this GUI.




Web Browser - REST(Reference Electrode Standardization Technique)
REST(Reference Electrode Standardization Technique)
Location: http://www.neuro.uestc.edu.cn/rest
ReST
Reference Electrode Standardization Technique
Key Laboratory for NeuroInformation of Ministry of Education,China
New version of the Rest software has been released (Oct. 27, 2013)!
Home
About REST
Why REST
Free Software
Who are using REST
Independent Comments on REST
Previous Guidelines for EEG/ERPs reference
About REST
What is REST?
REST (Reference Electrode Standardization Technique) is a re-reference technique, a software method for translating multichannel spontaneous EEG or event-related potentials with reference at any a physical point on brain/body surface or the post-processed data referenced at average or linked ears etc to a new dataset with reference at Infinity where the potential is zero/constant. REST appeared first in 2001(Yao, 2001), the first free download software was released in 2010,and followed a few updating version including EEGlab version.REST is now acknowledged more and more in EEG/ERPs community around the world, more than 50 stuides have actually adopted REST to get zero reference as the foundation of their following analyses.
Figure 1.Simulated EEG recordings with reference at infinity (zero)

Web Browser - Download REST
REST(Reference Electrode Standardization Technique)
Download REST
Location: http://www.neuro.uestc.edu.cn/REST/Down.html
Download REST
Download Rest Software(for free): EXE Version (Updated Sep.22,2015) Matlab Version (V1.0) EEGLAB Plugin Version (V1.0) BP analyzer Plugin
Download User Manual of REST: English Version Chinese Version
Download Talks document by Yao: Scalp EEG/ERP with Zero Reference (Updated Sept. 15,2013) 2016零参考与认知脑电（中国认知科学学会第二届认知及转化医学大会报告）
Download Demonstration of REST: Demonstration of REST (Chinese)
Caution:REST is a toolbox for humain EEG study only with no guarantee of suitability for any specific purpose.
REST should not under any situations be used for clinic.