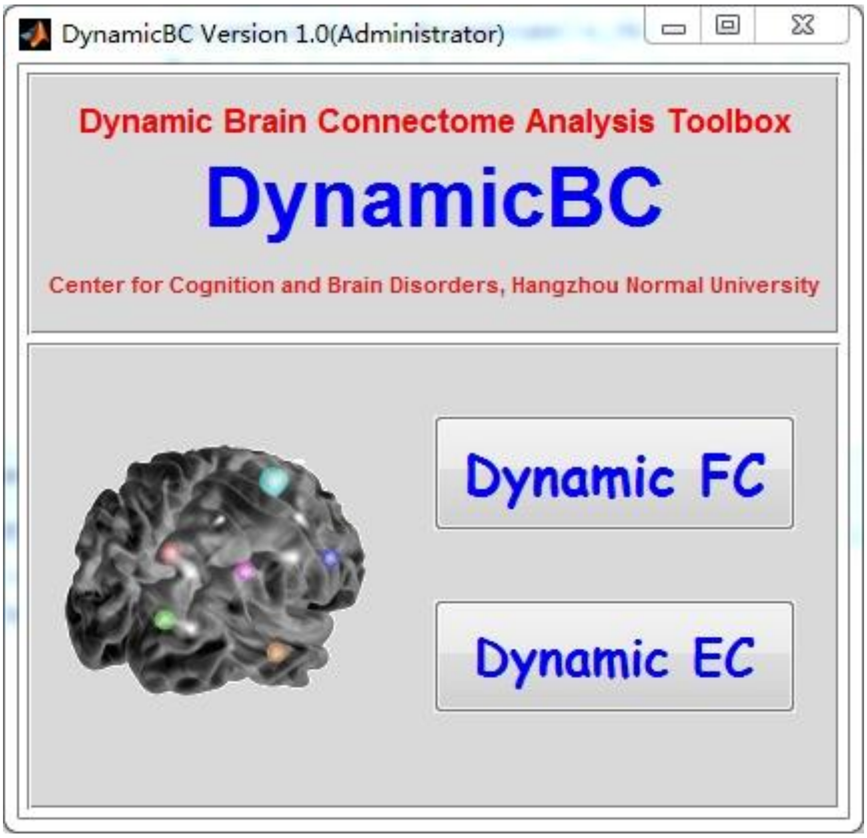
Dynamic Brain Connectome Analysis Toolbox Manual



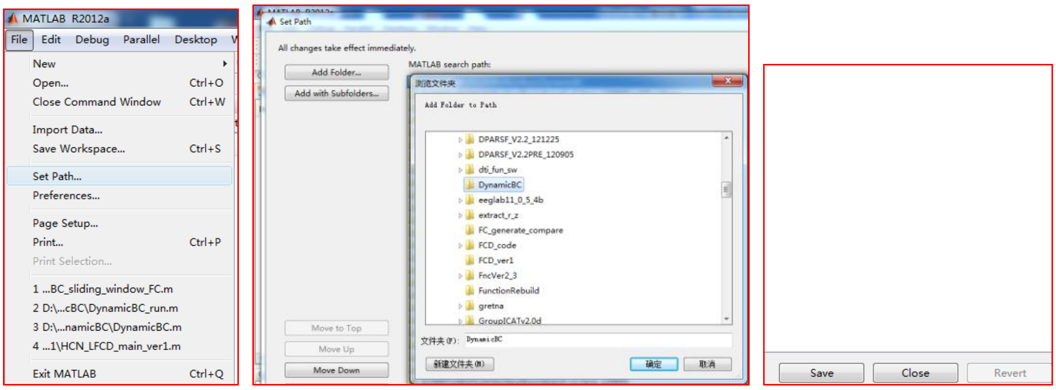
Created by Center for Cognition and Brain Disorder, Hangzhou Normal University.

Users would ask questions and give comments by email (dynamicbrainconn@gmail.com) and online forum (http://www.restfmri.net/forum/).

Content

1 Set Up

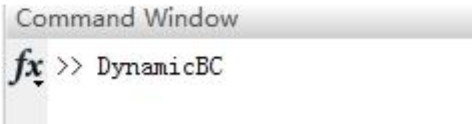
Download the software from www.restfmri.net/, unzip and add path in MATLAB.



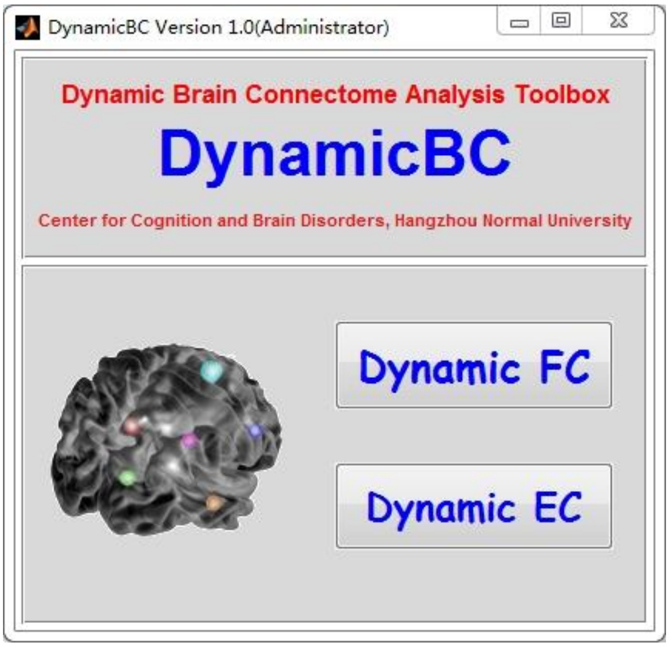
Matlab: '***File***' -> '***Set Path***' -> '***Add folder***' -> select the folder 'DynamicBC' -> '***save***' -> '***close***'
Then the DynamicBC toolbox has been set up.

Open the toolbox

Command Window: type ***DynamicBC*** and Enter



Then the Main Window of the Toolbox will appear:



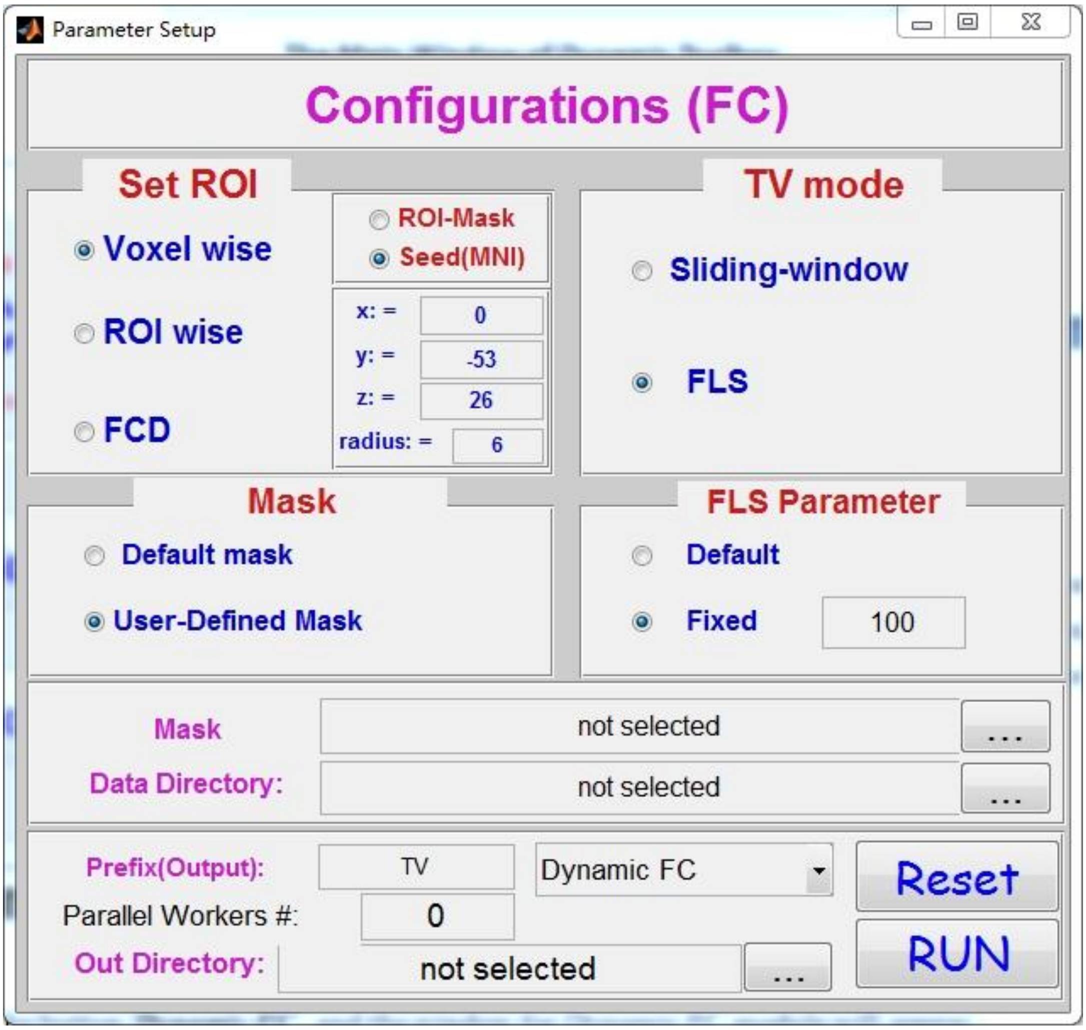
The Main Window of Dynamic Toolbox

There are two buttons on the main window: '***Dynamic FC***' & '***Dynamic EC***'. These two buttons are linked to the different connectivity module of the toolbox, which '***Dynamic FC***' is for the

dynamic functional connectivity (FC) analysis, while '***Dynamic EC***' is for the dynamic effective connectivity (EC) (Granger Causality analysis used for computing EC in this toolbox).

2 Dynamic FC

Click the button '***Dynamic FC***', and the window for Dynamic FC module will appear.



The window for the Dynamic FC module

This window is for the parameter setup of the Dynamic FC module.

There are three modules of the Dynamic FC: '***Voxel wise***', '***ROI wise***' and '***FCD***', and there are two types of the time-varying mode: 'Sliding-window' and 'FLS'. 'FLS' is short for Flexible Least Squares.

2.1 'Voxel wise' module:

The voxel wise (seed-to-voxel) analysis calculated the bivariate FC and/or EC

between seed brain region and every voxel in the whole brain.

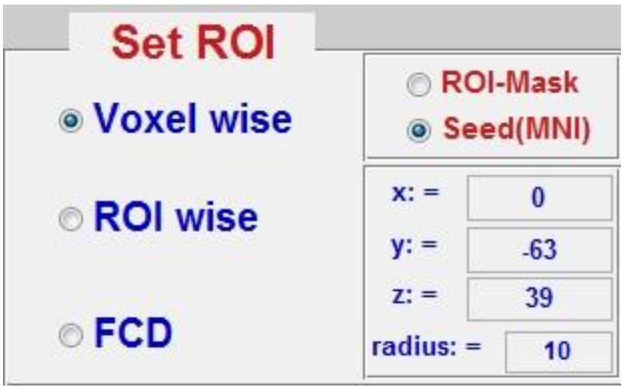
2.1.1 Seed(MNI)

Setting: MNI center: 0 -63 39, radius 10 mm, TV mode: FLS, Default mask, FLS Parameter: Fixed 80 (or Default 100)

Seed information input: Input the MNI coordinate in the box '***x:*** = ' '***y:*** = ' & '***z:*** = '

Input the Radius of the mask ball in the box '***radius:*** = '

Here we set the centre of the ball in the Precuneus: **0 -63 39 (MNI)**, and the radius **10mm**:



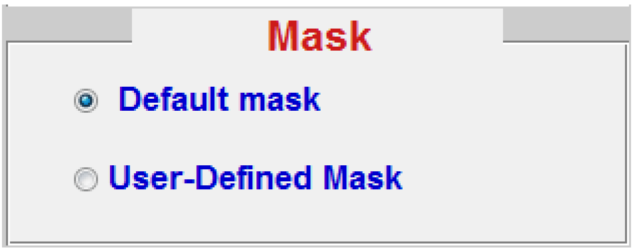
Set up the Seed centre and the radius.

Time-Varying (TV) mode selection: Since the setup of the 'Sliding-window' and 'FLS' in all three modules of the Dynamic FC is the same. Here we use the 'FLS' method here and we will use the 'Sliding-window' method later:

Time-varying mode selection

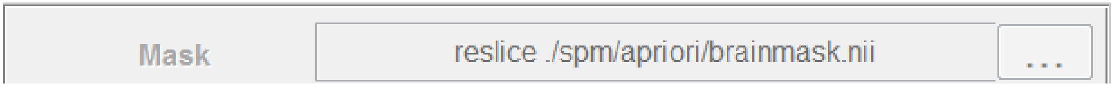
Mask selection: two kinds of mask could be selected in the toolbox, the '***Default mask***' & the '***User-Defined Mask***'. This selection is suit for the 'Voxel wise' module and the 'FCD' module.

Here we select the '***Default Mask***' for the analysis, and later we will use the '***User-Defined Mask***'.



The mask selection window

If we select the '***Default Mask***', the mask selection will be gray. The toolbox will reslice the brainmask in the SPM toolbox (./spm/apriori/brainmask.nii) into the data space.



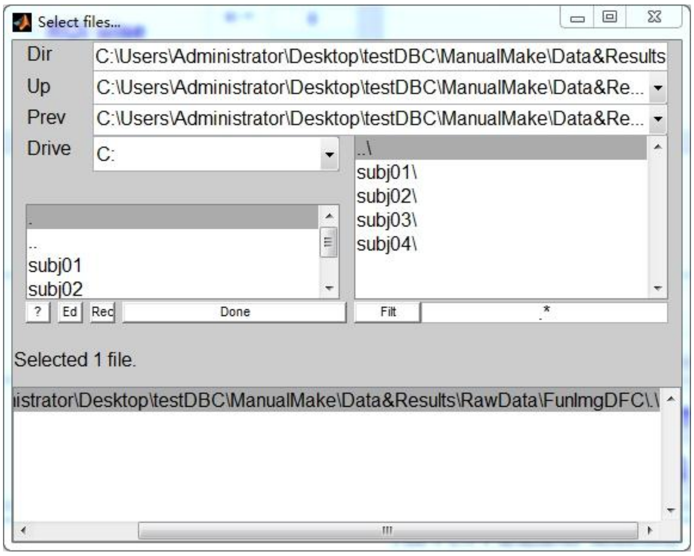
the Mask selection

<u>FLS mode selection</u>: The Default value is 100, while a Fixed value could change with your data or hypothesis. Here we use the Fixed value 80.

The FLS Parameter selection

<u>Data Selection</u>: Click the button '**...**' and select the data folder, which contained the subfolders for each subject.

Data selection window 1.

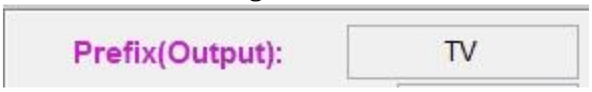


Data selection window 2.

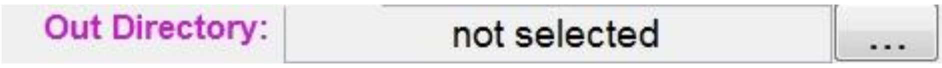
<u>Output Setup Parameter:</u>

Prefix: the default prefix is '***TV***', and we can change it. Here we use the default value

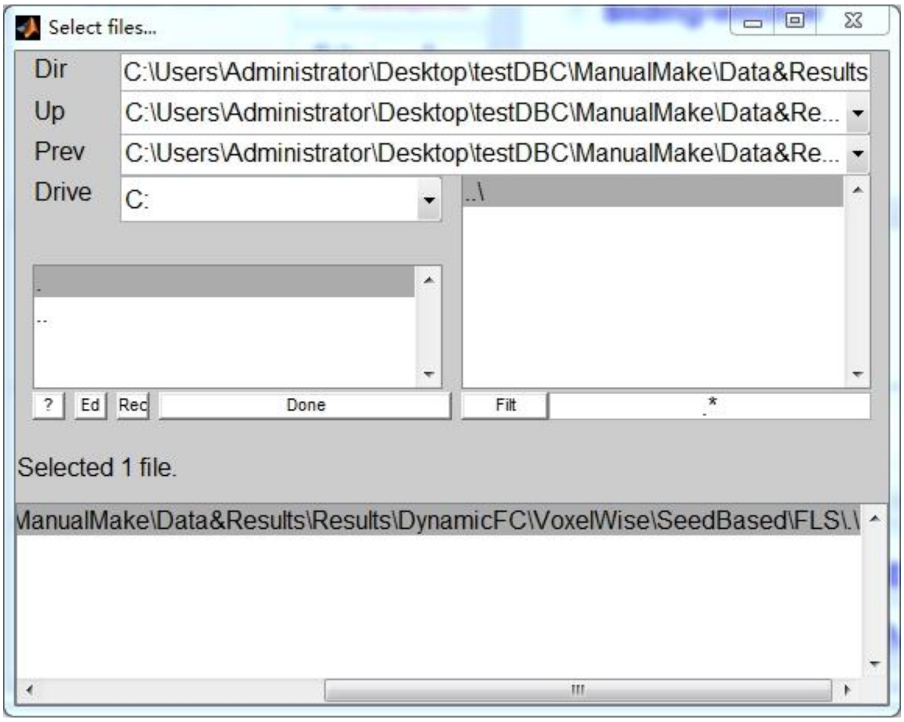
of the setting up, and later we will change it.



Output Directory selection: click the '...' and select the output directory,

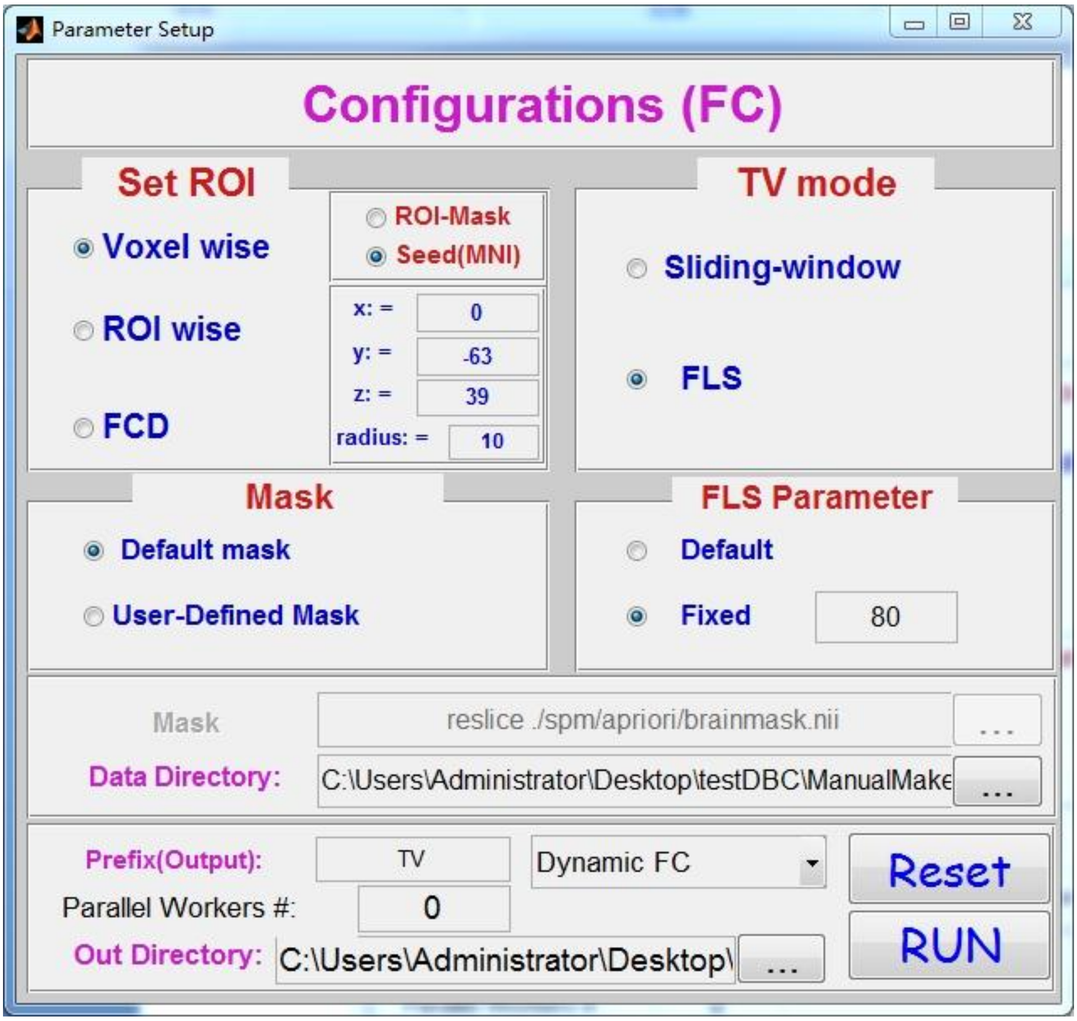


Output directory selection window 1



Output directory selection window 2

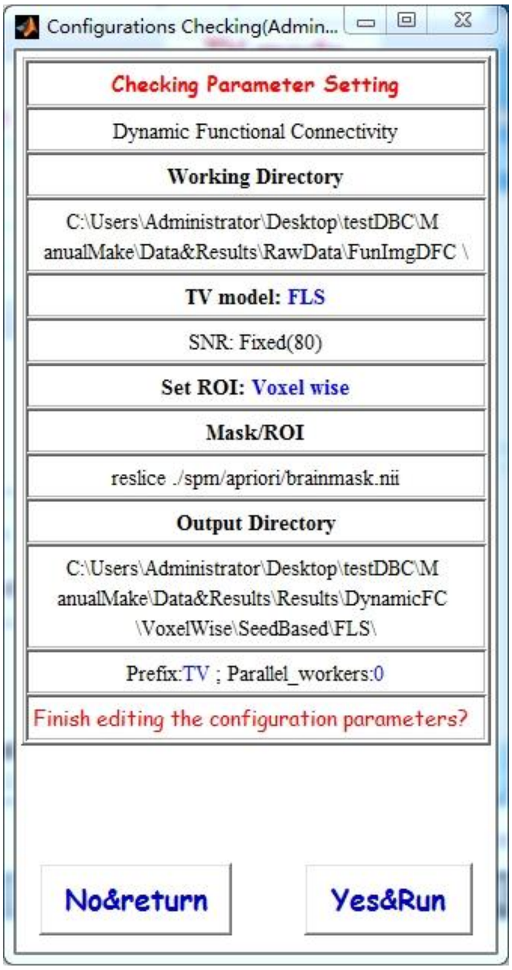
After all parameter selection, the window for the Dynamic FC module has been changed.

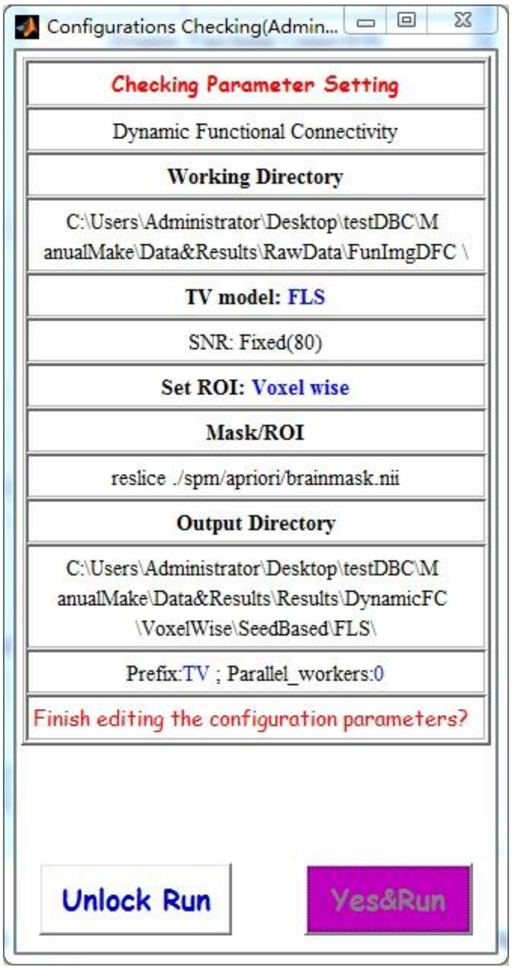


The changed window for the Dynamic FC module

Then:
Click '***RUN***' and we will get the third window for the parameter check and run.
Click '***Reset***', the selected parameter will disappear and return the default setting.

<u>Click '*RUN*'</u>:





The parameter check&run window.   The Running state

The parameter check window will show some setting parameter before.

After checking, if there are some mistake, click '***No&return***', and return to reset the parameter. If it is correct, then click '***Yes&Run***', and the toolbox will compute the dynamic FC.

<u>The running state</u>: when running, the parameter check window will lock the '***Yes&Run***' button and the command window will appear the current state of the toolbox:

```
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Generate Human brain mask from SPM default mask...
Brain mask: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\Results\DynamicFC\VoxelWise\SeedBased\FLS\brain_ma
Default value 0/NaN is not in the mask/label!
Default value>0 is inside the mask!
There are 104388 voxels inside the mask
Running subject    1 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
```

The command window running state 1.

```
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Generate Human brain mask from SPM default mask...
Brain mask: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\Results\DynamicFC\VoxelWise\SeedBased\FLS\brain_m
Default value 0/NaN is not in the mask/label!
Default value>0 is inside the mask!
There are 104388 voxels inside the mask
Running subject    1 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
Running subject    2 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj02
```

The command window running state 2

```
Dynamic Functional Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Generate Human brain mask from SPM default mask...
Brain mask: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\Results\DynamicFC\VoxelWise\SeedBased\FLS\brain_
Default value 0/NaN is not in the mask/label!
Default value>0 is inside the mask!
There are 104388 voxels inside the mask
Running subject    1 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
Running subject    2 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj02
Running subject    3 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj03
Running subject    4 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj04
====Finish ALL!^_^====
```

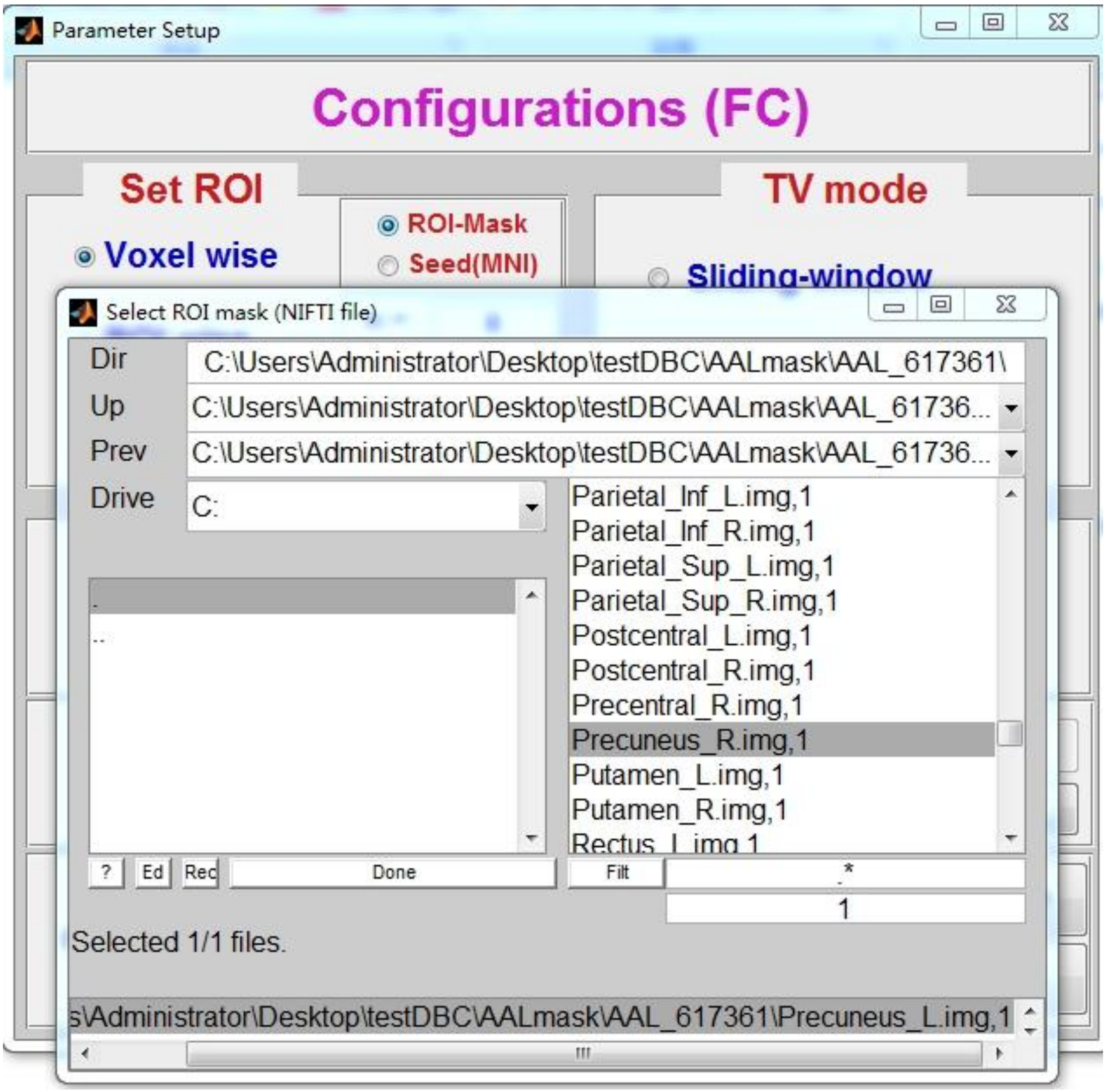
The Finish state in the command window

When the computation finished, the parameter check&run window will disappear, and the command window will print '**====Finish DynamicBC!^_^====**'.

2.1.2 ROI-Mask

Setting: ROI: Precuneus_L, TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Mask: gray mask, Prefix: roi_TV

Select the '***ROI-Mask***' module, and the ROI selection window will appear. Here we select the Precuneus_L from AAL template. *Note: the information of the ROI will be not shown in the parameter check&run window.*



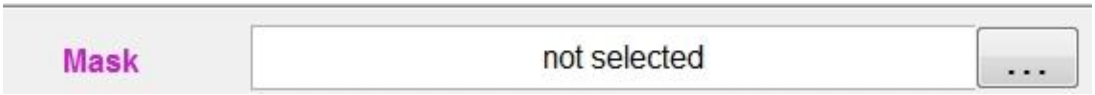
Selection of the ROI-Mask

Time-Varying (TV) mode selection: here we select the 'sliding-window' mode for the current analysis. The '***Window Size***' is the length of time window. Here we use 50 time points.' ***Overlap***' means the how much time points were overlapped between the one window and the next. Here we use the 0.6, which means that if the first start time point is 1, the second window starts from 21 (floor(1+(1-0.6)*50)).

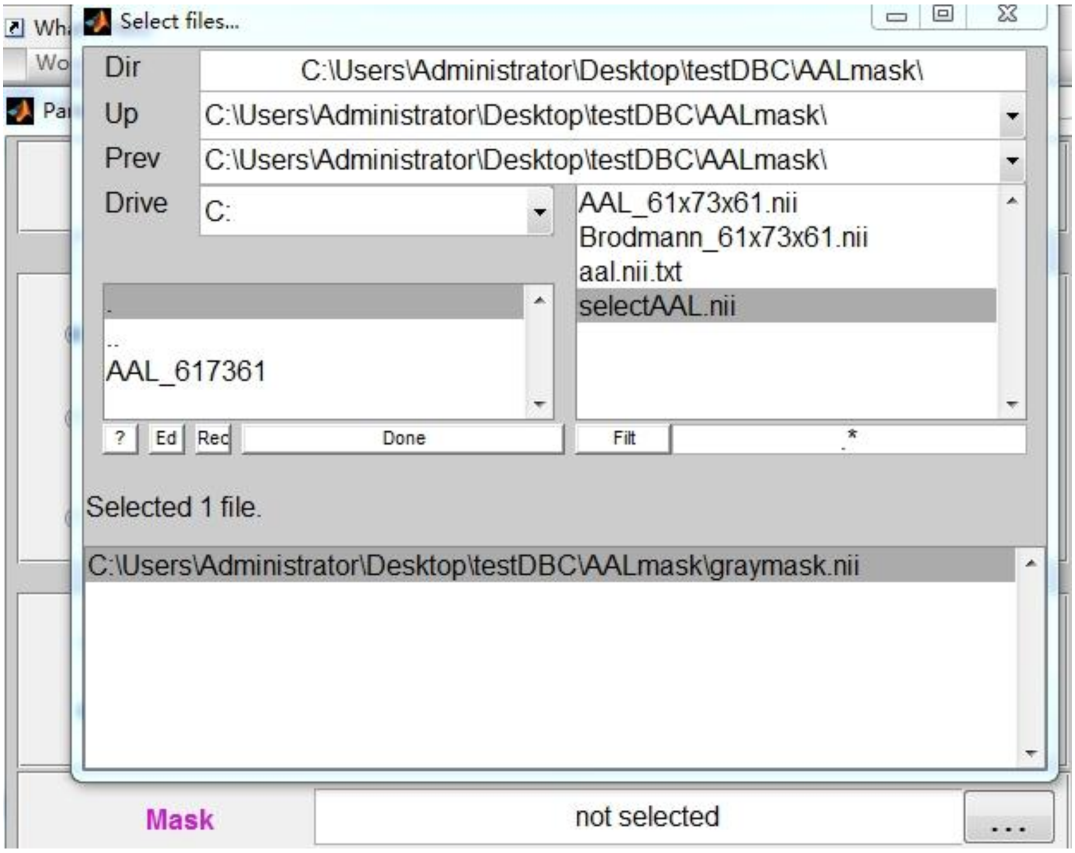
The parameter for Sliding-window

<u>Mask selection:</u> here we select the '***User-defined Mask***', then click the button '**...**'. Here we use the pre-defined mask.

Mask selection window 1

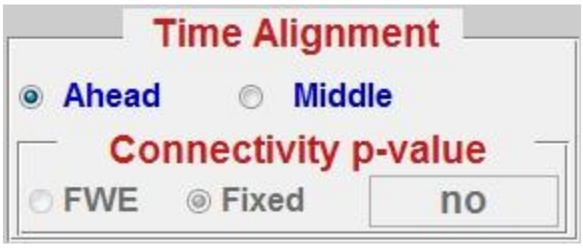


Mask selection window 2



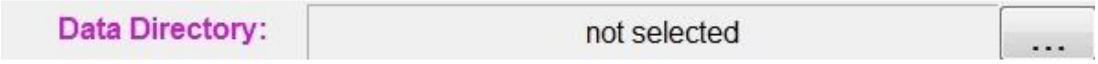
Mask selection window 3

<u>Time Alignment:</u> '*Ahead*' & '*Middle*'.

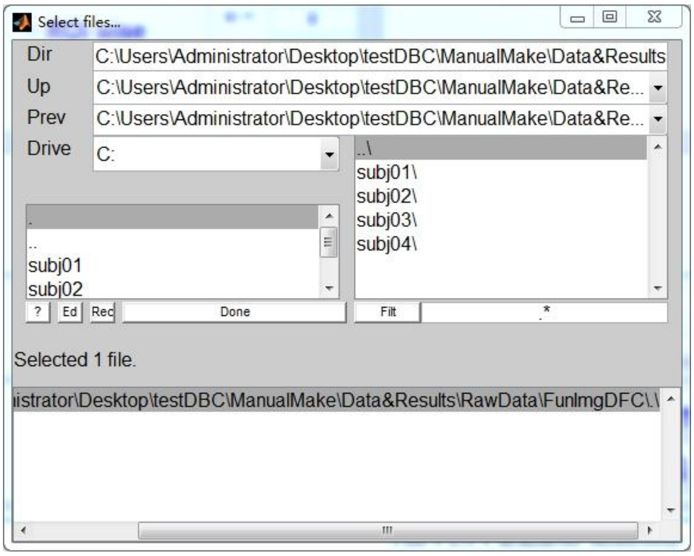


time alignment selection window

<u>Data Selection</u>: Click the button '**...**' and select the data folder, which contained the subfolders for subjects.



Data selection window 1.

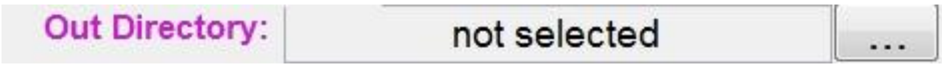


Data selection window 2.

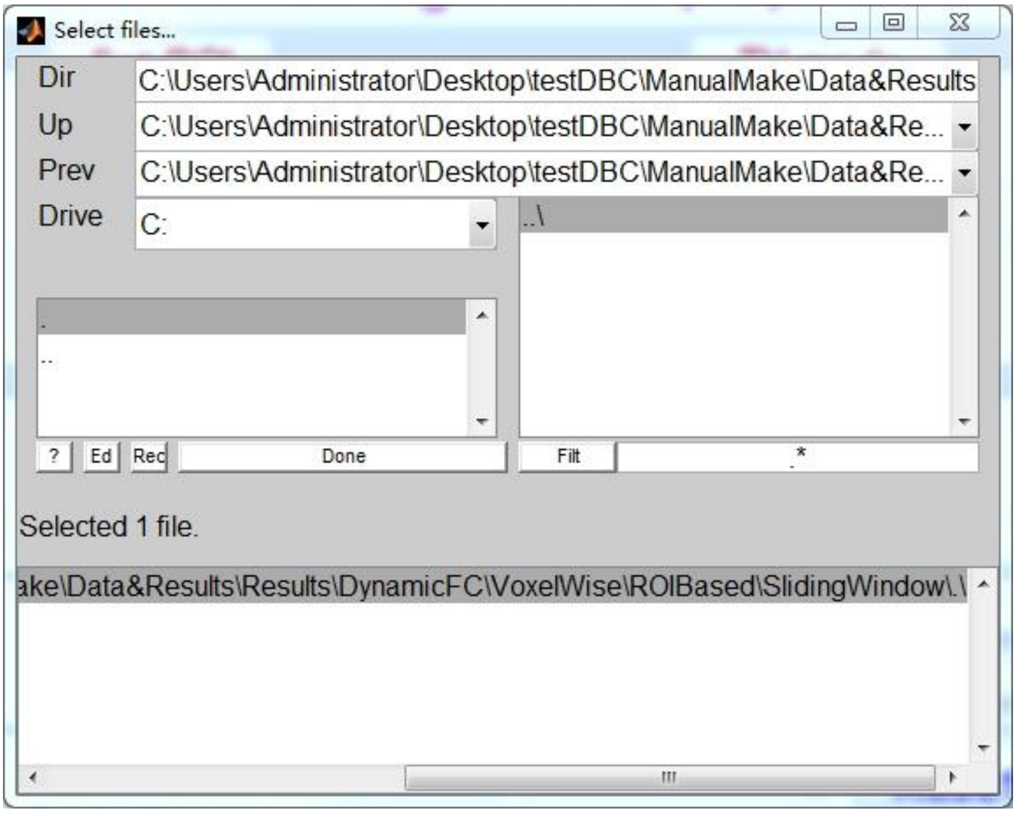
<u>Output Setup Parameter:</u>

Prefix: the default prefix is '***TV***', and we change it to be '***roi_TV***'.

Output Directory selection: click the '...' and select the output directory,

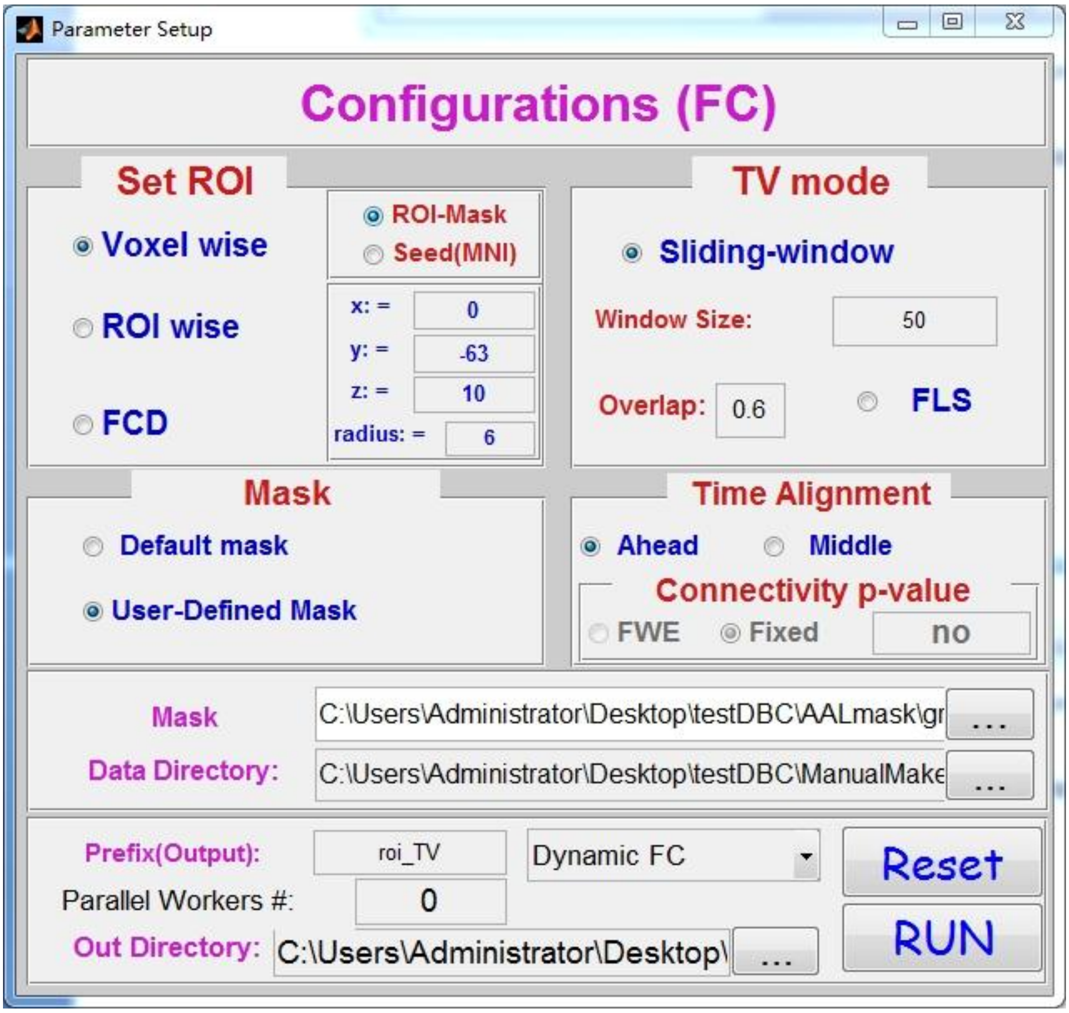


Output directory selection window 1



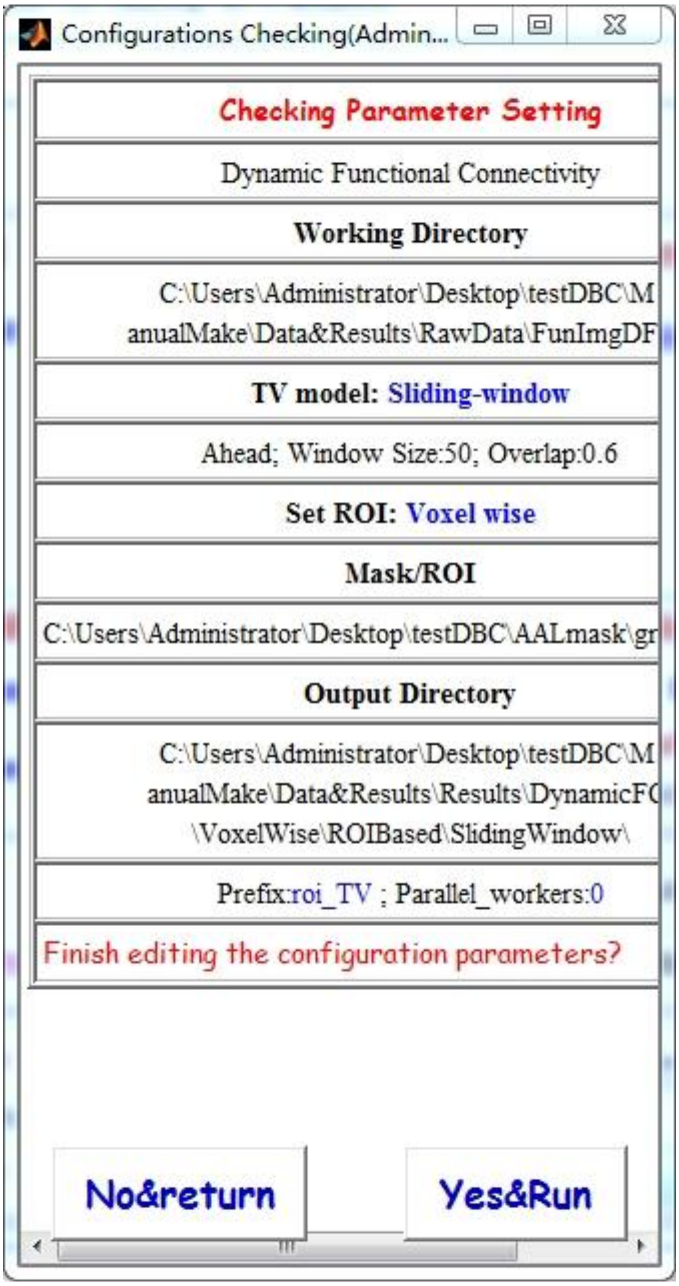
Output directory selection window 2

After all parameter selection, the window for the Dynamic FC module has been changed.



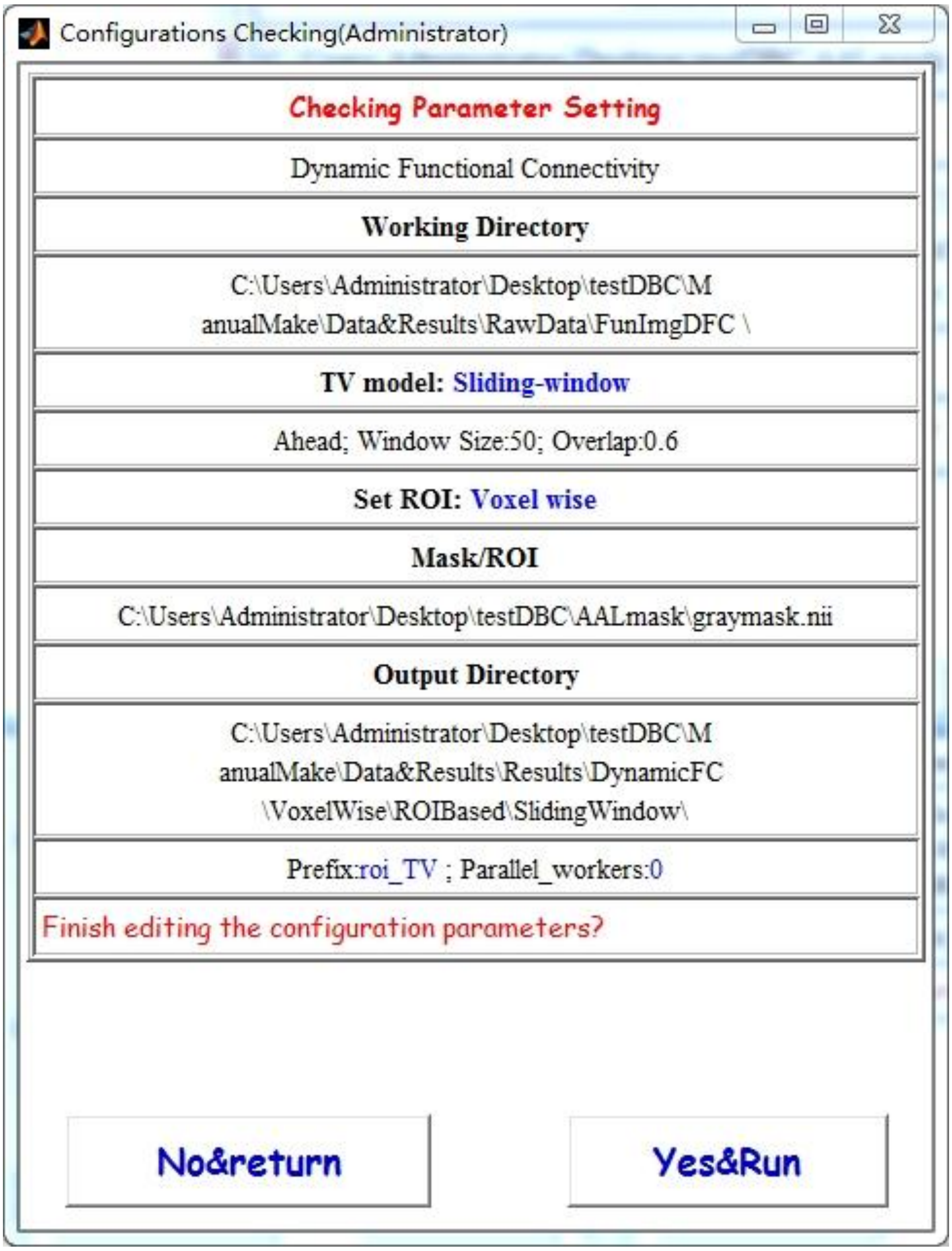
The changed window for the Dynamic FC module

Then:
Click '***RUN***'



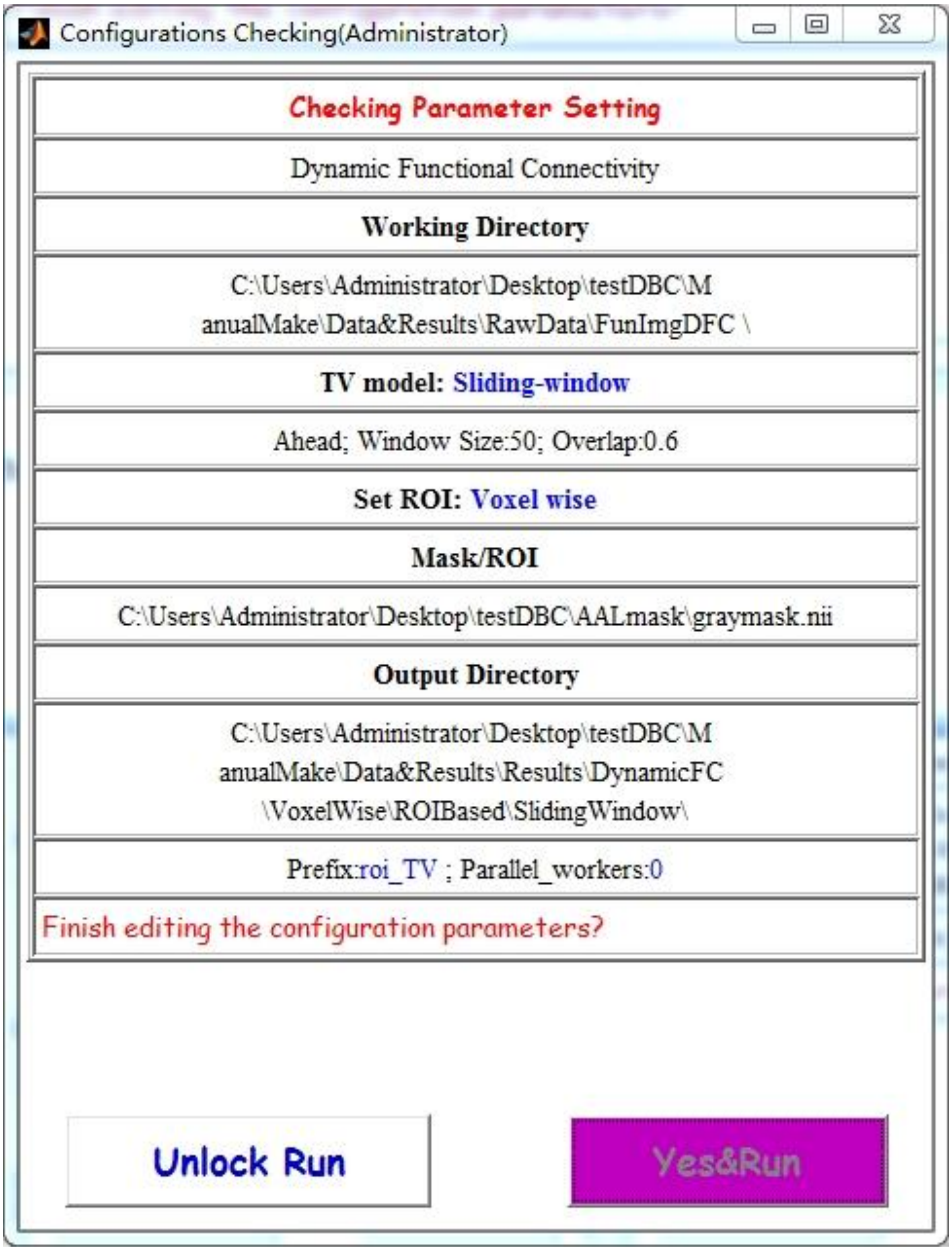
The parameter check&run window

you can pull the right edge to see the whole setting infomation



The parameter check&run window

After check, Click '***Yes&Run***'



<u>The running state</u>: when running, the parameter check window will lock the '***Yes&Run***' button and the command window will appear the current state of the toolbox:

```
Dynamic Functional Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Default value 0/NaN is not in the mask/label!
Default value>0 is inside the mask!
There are 54837 voxels inside the mask
Running subject    1 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
Running subject    2 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj02
Running subject    3 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj03
>>
```

The command window running state

```
>> DynamicBC
Dynamic Functional Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Default value 0/NaN is not in the mask/label!
Default value>0 is inside the mask!
There are 54837 voxels inside the mask
Running subject    1 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
Running subject    2 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj02
Running subject    3 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj03
Running subject    4 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj04
====Finish ALL!^_^====
```

The Finish state in the command window

When the computation finished, the parameter check&run window will disappear, and the command window will print '**====Finish ALL!^_^====**'.

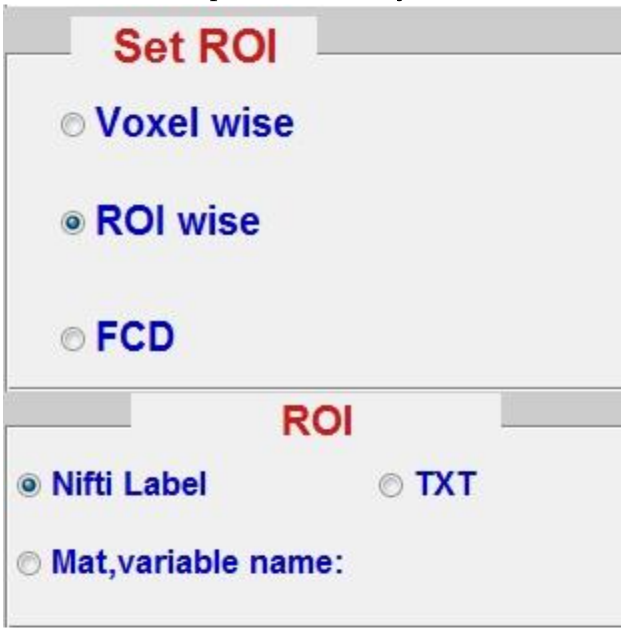
2.2 'ROI wise' module:

ROI-to-ROI (ROI-wise) analysis computed the bivariate FC/EC between each pair of ROIs, resulting brain connectivity matrix (network) allows users to further perform graph theoretical analysis.

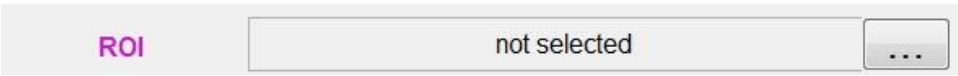
2.2.1 Nifti Label

Setting: ROI template: AAL template, TV mode: FLS, FLS Parameter: Fixed 100, Prefix: TV

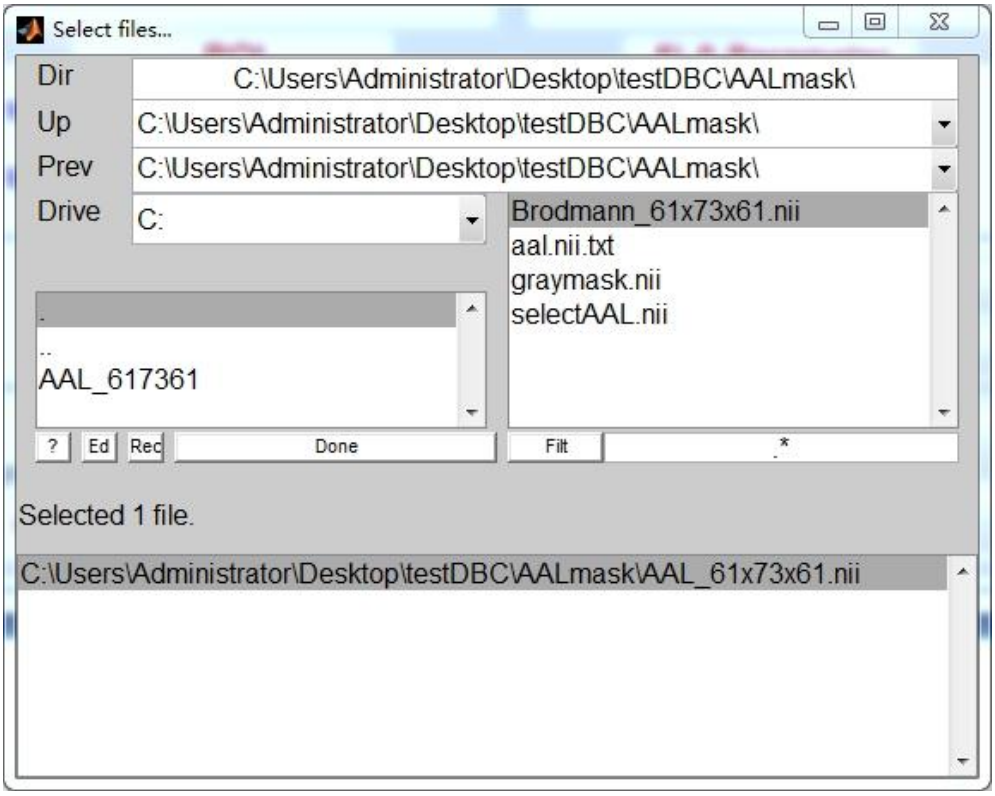
Model selection: select '***Nifti Label***', then click the '**...**' in the ROI selection window, and select the ROI-template. This ROI-template should be a multi-valued Nifti images in the data space, such as AAL template offered by REST software.



Module selection

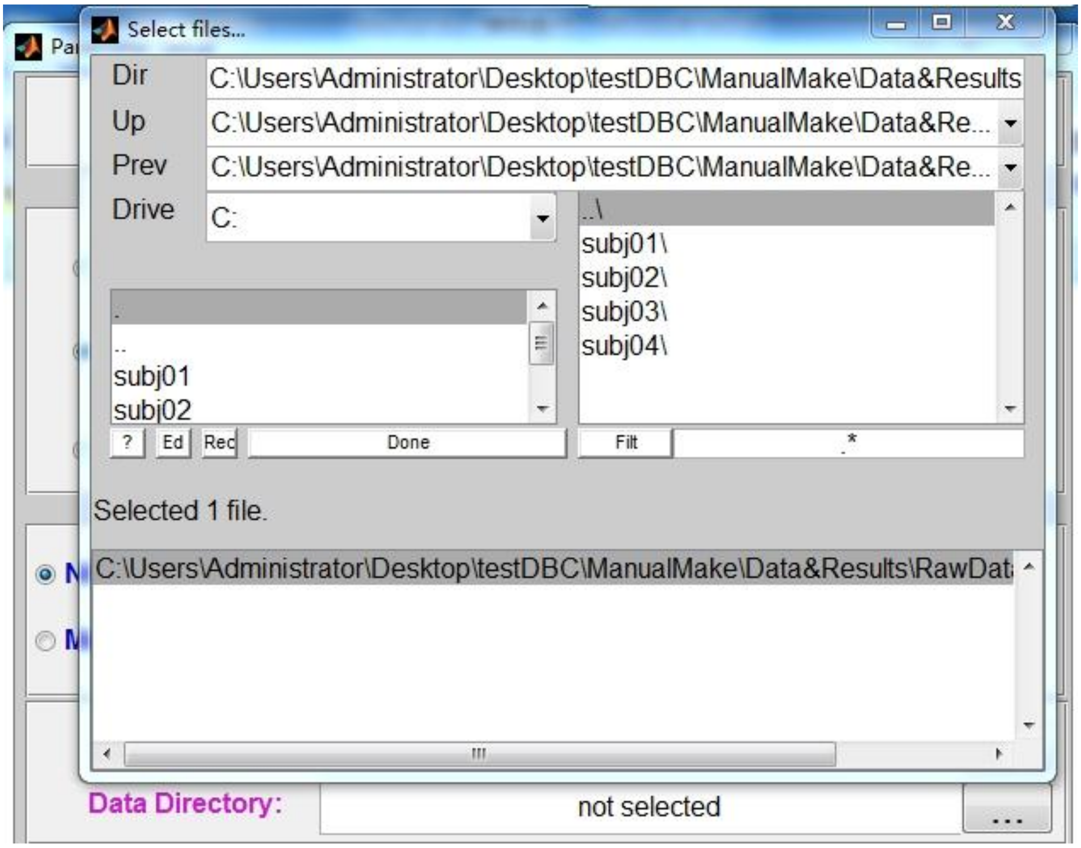


ROI selection window 1



ROI selection window 2

<u>Data Selection</u>: Data selection is like the former selection.



Data selection window

Here we select the '***FLS***' for the TV mode. The setting is the same as the former.

The output setting is like the former setting.
Then Click '***RUN***', check, and click '***Yes&Run***'

The running state:

```
Dynamic Effective Connectivity---setting
Dynamic Functional Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Default value 0/NaN is not in the mask/label!
Running subject     1 (all     4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
Warning: Directory already exists.
> In DynamicBC_run at 250
  In DynamicBC>wgr_run_check at 1105
>>
```

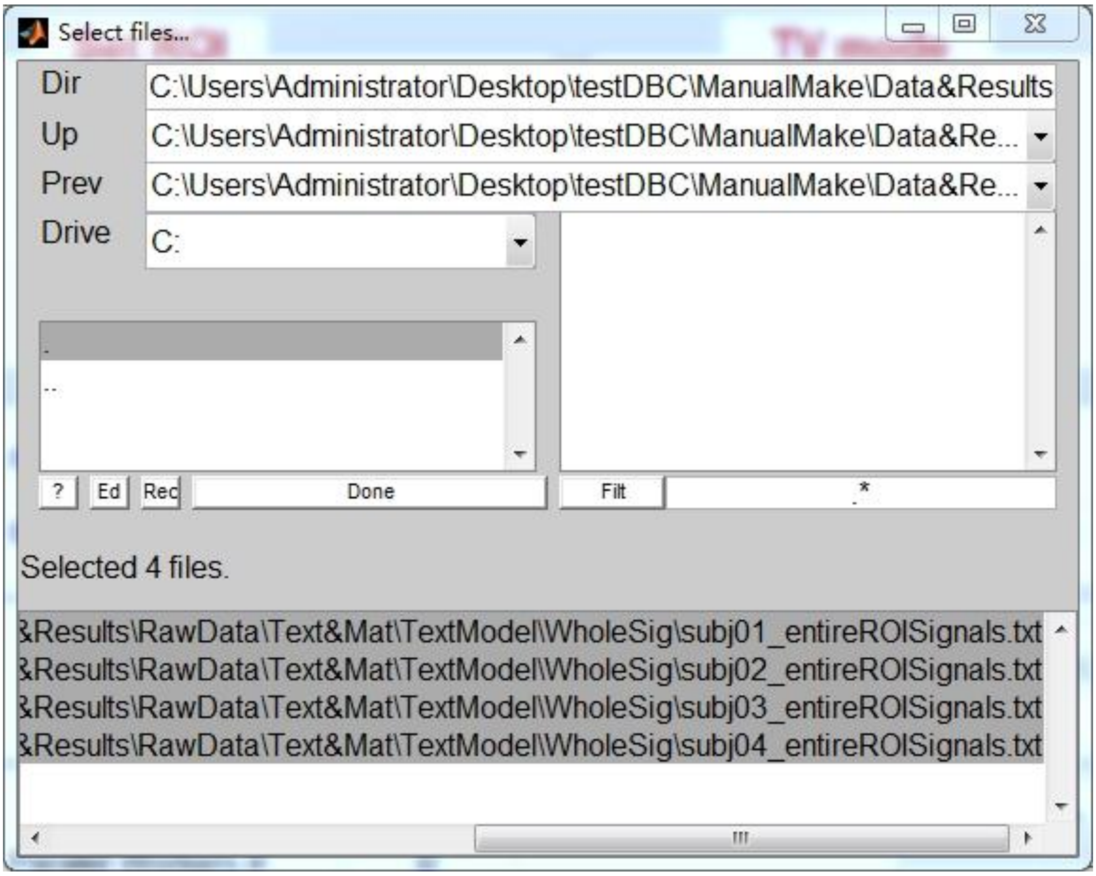
```
Running subject     4 (all     4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj04
Warning: Directory already exists.
> In DynamicBC_run at 250
  In DynamicBC>wgr_run_check at 1105
??? Warning: Struct field assignment overwrites a value with class "cell".
 See MATLAB 7.0.4 Release Notes, Assigning Nonstructure Variables As Structures Displays Warning for details.
> In DynamicBC_fls_FC at 59
  In DynamicBC_run at 267
  In DynamicBC>wgr_run_check at 1105
====Finish ALL!^_^====
```

The finish state in the command window

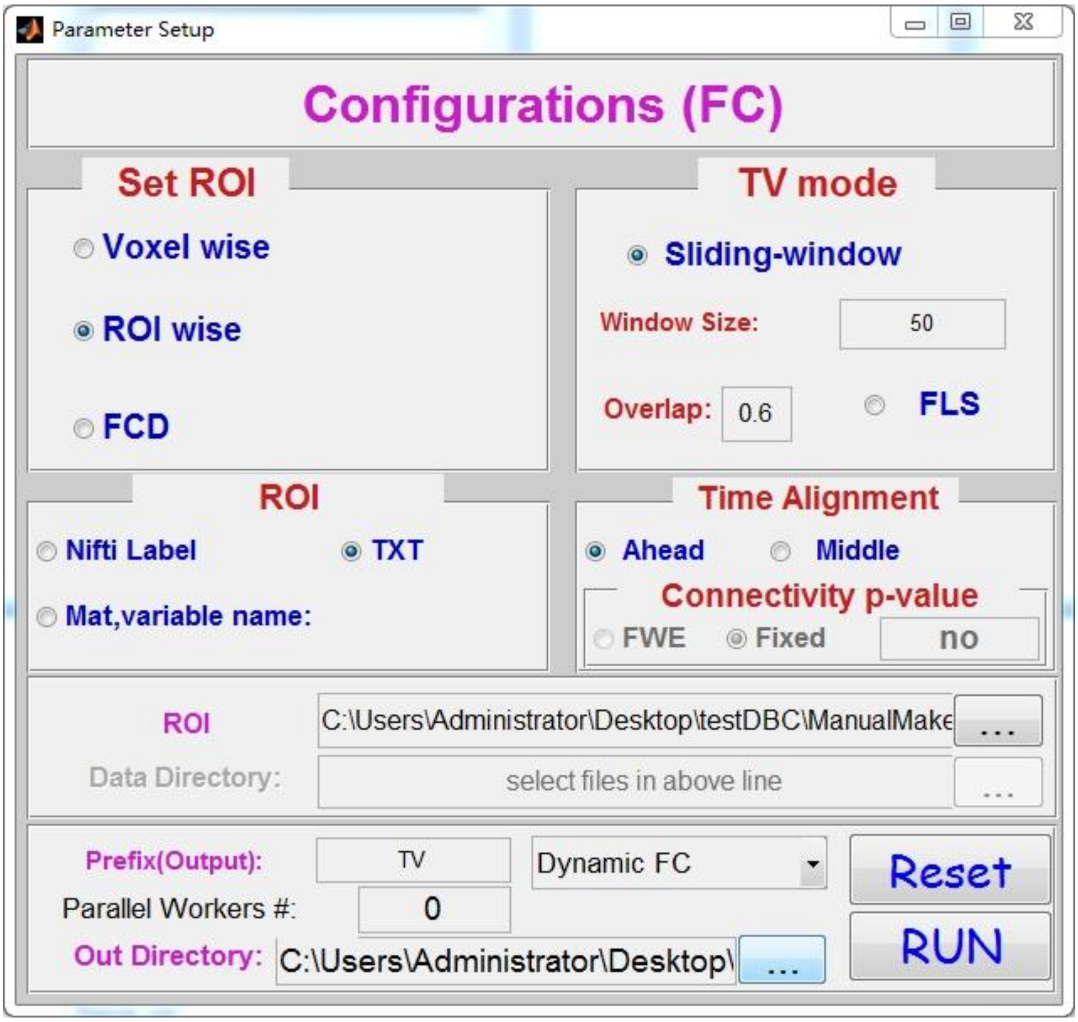
2.2.2 TXT

Settting: 116(ROIs) * 240(timepoints), TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Prefix: TV

Model selection: select '***TXT***', then click the '**...**' in the ROI selection window, then select the TXT, each txt file contains N (roi number) * M (time points) matrix.
Here we need not select the Data Directory.



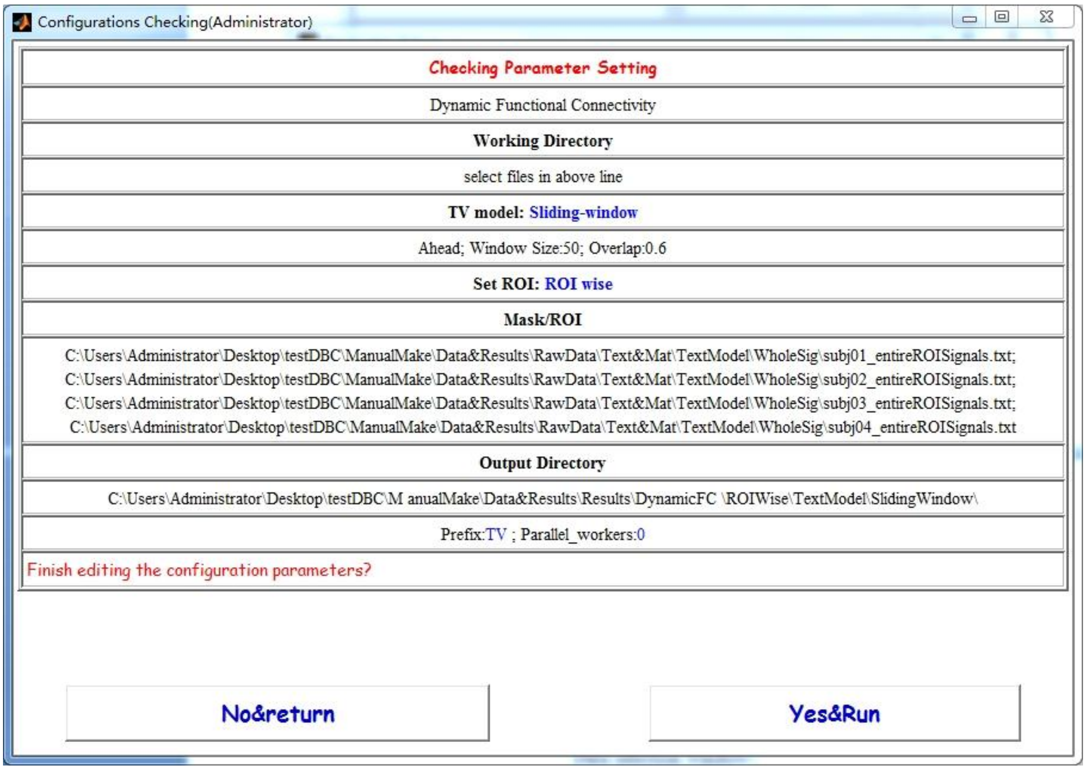
Here we select the '***sliding-window***' for the TV mode. The setting is the same as the former one.



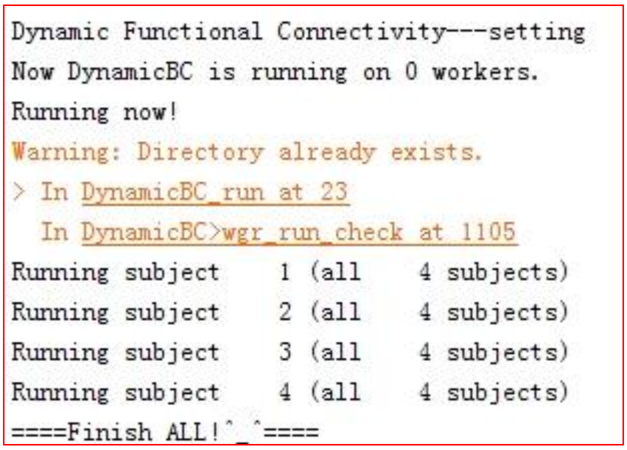
The changed window for the Dynamic FC module

Then

Click '***RUN***', check, and click '***Yes&Run***'.



The running state:



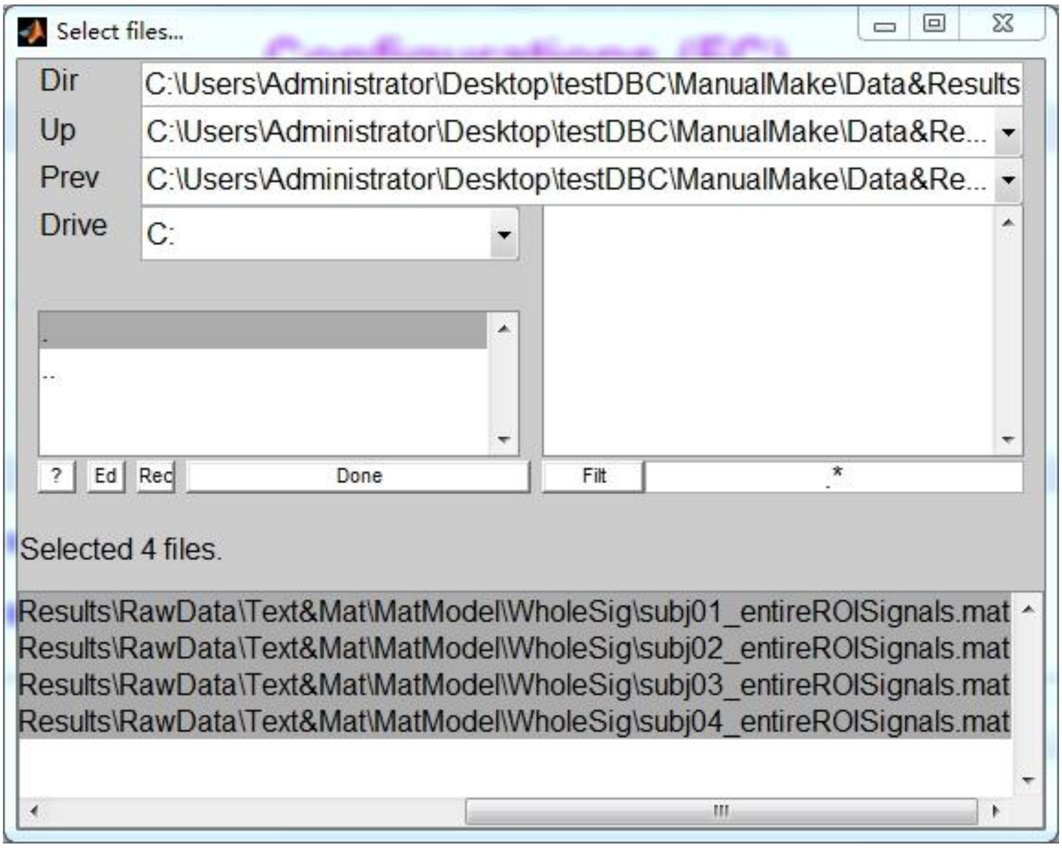
2.2.3 Mat

Setting: 116(ROIs) * 240(timepoints), TV mode: FLS, FLS Parameter: Fixed 100, Prefix: TV

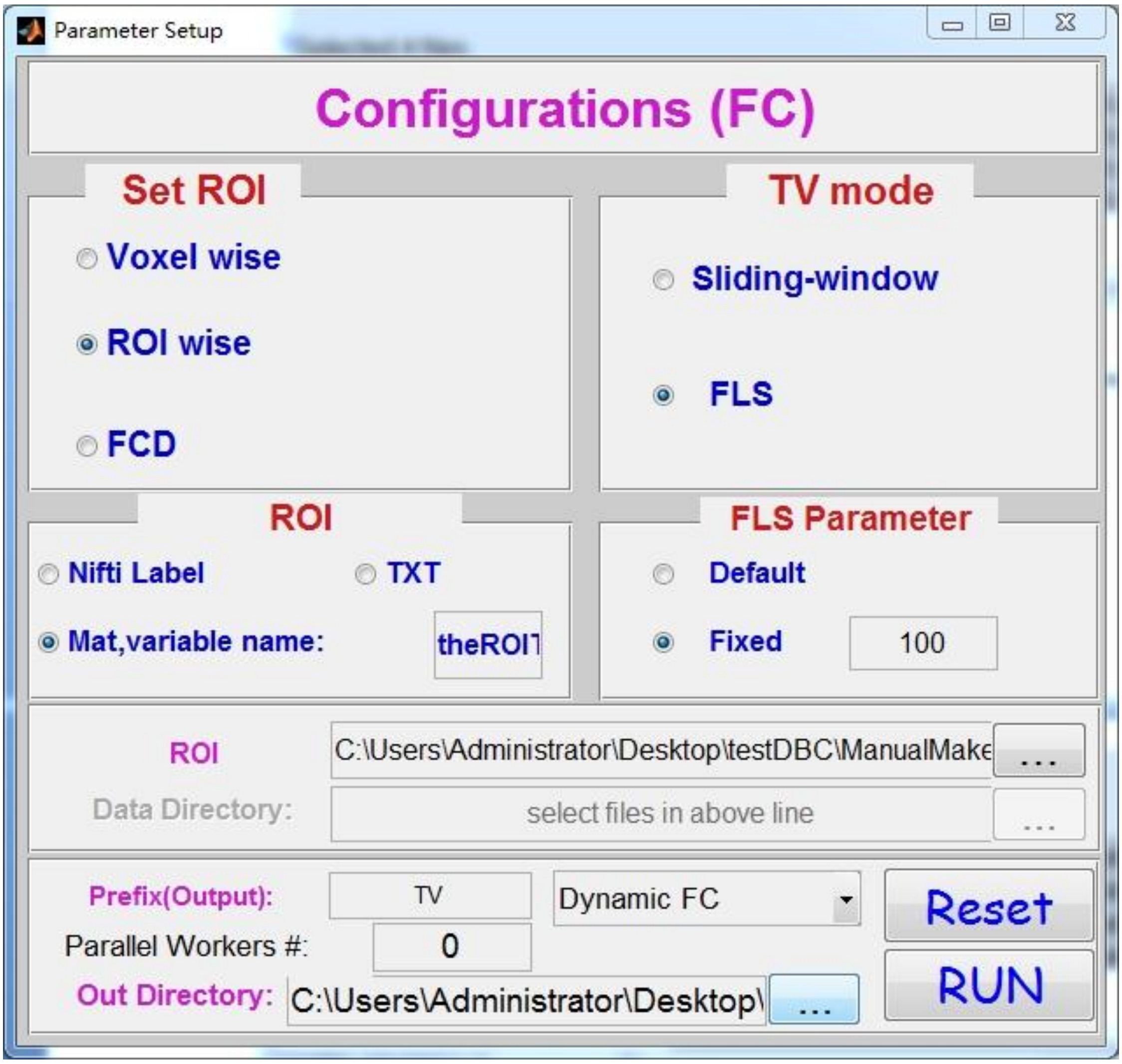
Model selection: select '***Mat***', then input the variable name for the signal saved mat. Here we select the REST generated mat of signal, the name of variable is '***theROITimeCoursesTotal***'

then click the '**...**' in the ROI selection window, then select the mat, each mat file contains N (roi number) * M (time points) matrix.

Here we need not select the Data Directory.



Here we select the '***FLS***' for the TV mode. The setting is the same as the former one.



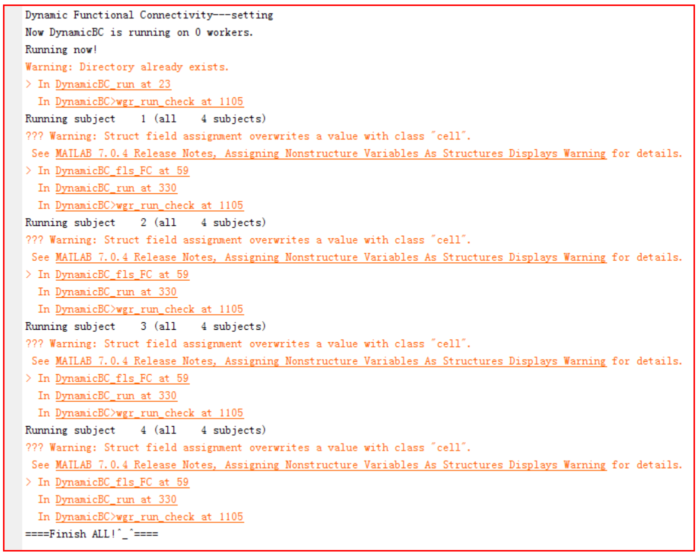
The changed window for the Dynamic FC module

Then

Click '***RUN***', check, and click '***Yes&Run***'.

The running state:

```
Dynamic Functional Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Running subject     1 (all     4 subjects)
```



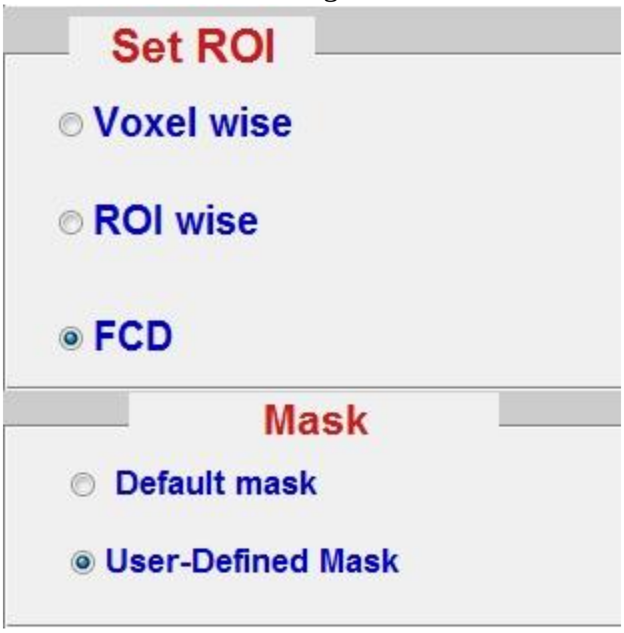
```
Dynamic Functional Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Running subject    1 (all    4 subjects)
??? Warning: Struct field assignment overwrites a value with class "cell".
 See MATLAB 7.0.4 Release Notes, Assigning Nonstructure Variables As Structures Displays Warning for details.
> In DynamicBC_fls_FC at 59
  In DynamicBC_run at 330
  In DynamicBC>wgr_run_check at 1105
Running subject    2 (all    4 subjects)
??? Warning: Struct field assignment overwrites a value with class "cell".
 See MATLAB 7.0.4 Release Notes, Assigning Nonstructure Variables As Structures Displays Warning for details.
> In DynamicBC_fls_FC at 59
  In DynamicBC_run at 330
  In DynamicBC>wgr_run_check at 1105
Running subject    3 (all    4 subjects)
??? Warning: Struct field assignment overwrites a value with class "cell".
 See MATLAB 7.0.4 Release Notes, Assigning Nonstructure Variables As Structures Displays Warning for details.
> In DynamicBC_fls_FC at 59
  In DynamicBC_run at 330
  In DynamicBC>wgr_run_check at 1105
Running subject    4 (all    4 subjects)
??? Warning: Struct field assignment overwrites a value with class "cell".
 See MATLAB 7.0.4 Release Notes, Assigning Nonstructure Variables As Structures Displays Warning for details.
> In DynamicBC_fls_FC at 59
  In DynamicBC_run at 330
  In DynamicBC>wgr_run_check at 1105
====Finish ALL!^_^====
```

2.3 'FCD' module:

Voxel-to-voxel computed the bivariate FC between every pair of voxels without using a priori seed/ROI to mapping whole-brain connectome. And then, the toolbox provides the connectivity degree (functional CD) that counts total number of connections of a given voxel, while the connectivity strength (functional CS) that sums of weights of all the connections of a given voxel.

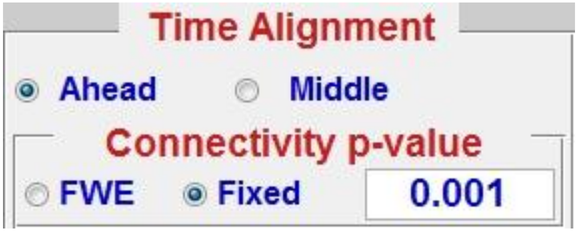
Setting: Mask: gray mask, TV mode: Sliding-window, Window Size: 50, Overlap: 0.6, Prefix: TV, pvalue: fixed 0.001

Here we select the '***User-Defined Mask***' for mask selection, which the mask is the same as the former setting.

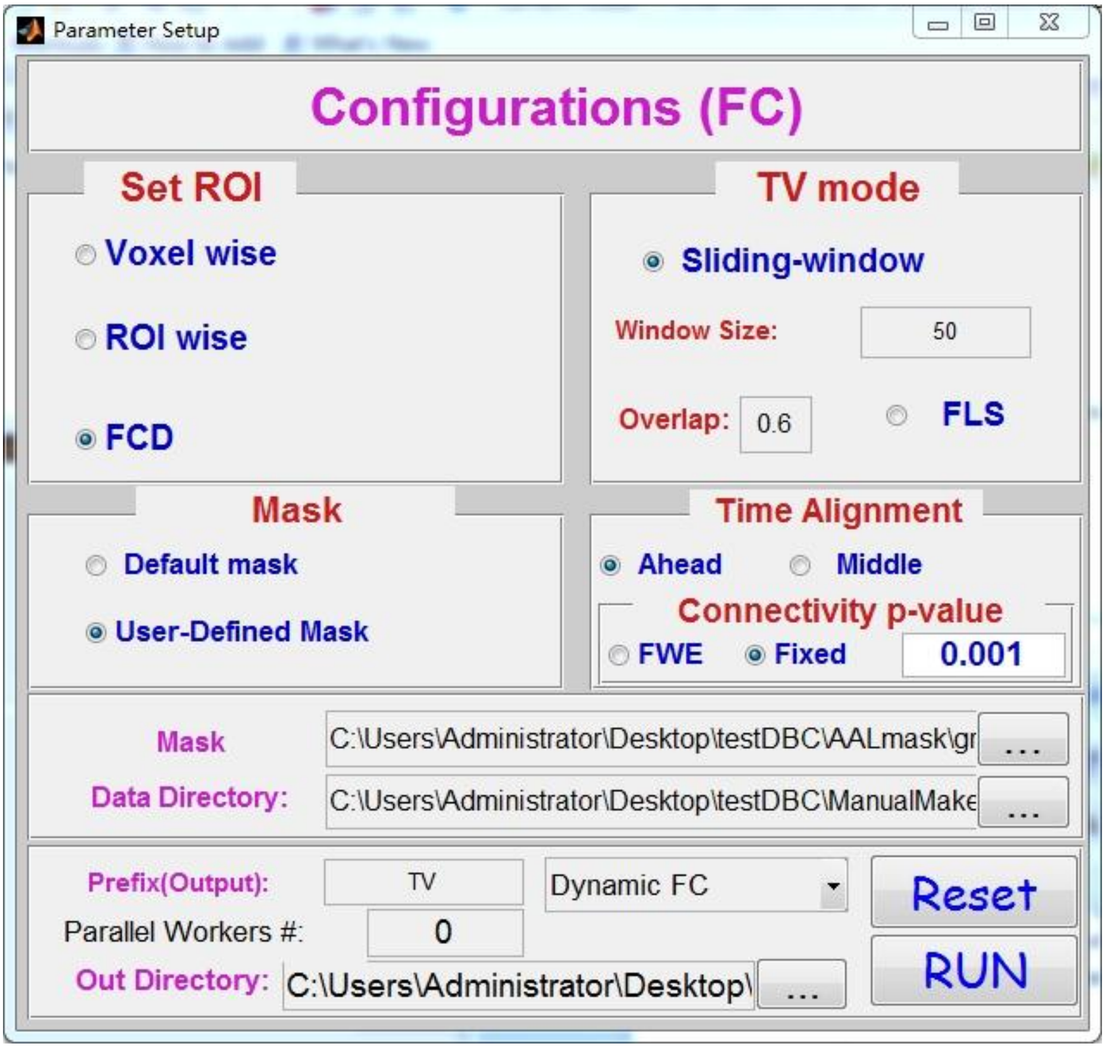


The TV mode is '***Sliding-window***', '***Window Size***' is 50, '***Overlap***' is 0.6
The '***Data Directory***' selection is the same as the former selection, select the folder with subfolders which represent the subjects.

New module for FCD
The FCD need to set the threshold for the cut-off of Functional connectivity.
The toolbox have two kinds of p value: Uncorrected P value ('***Fixed***') and FWE corrected P value ('***FWE***'). Select one of these two kinds of Pvalue. Here we use the Fixed p <0.001.



Also we select the '***Sliding-window***' TV mode for the FCD analysis. The FCD using '***FLS***' mode is not suit for the large mask. If the mask contains less than 1500 voxel, then the '***FLS***' mode could be used.



Then Click '***RUN***', check, and click '***Yes&Run***'

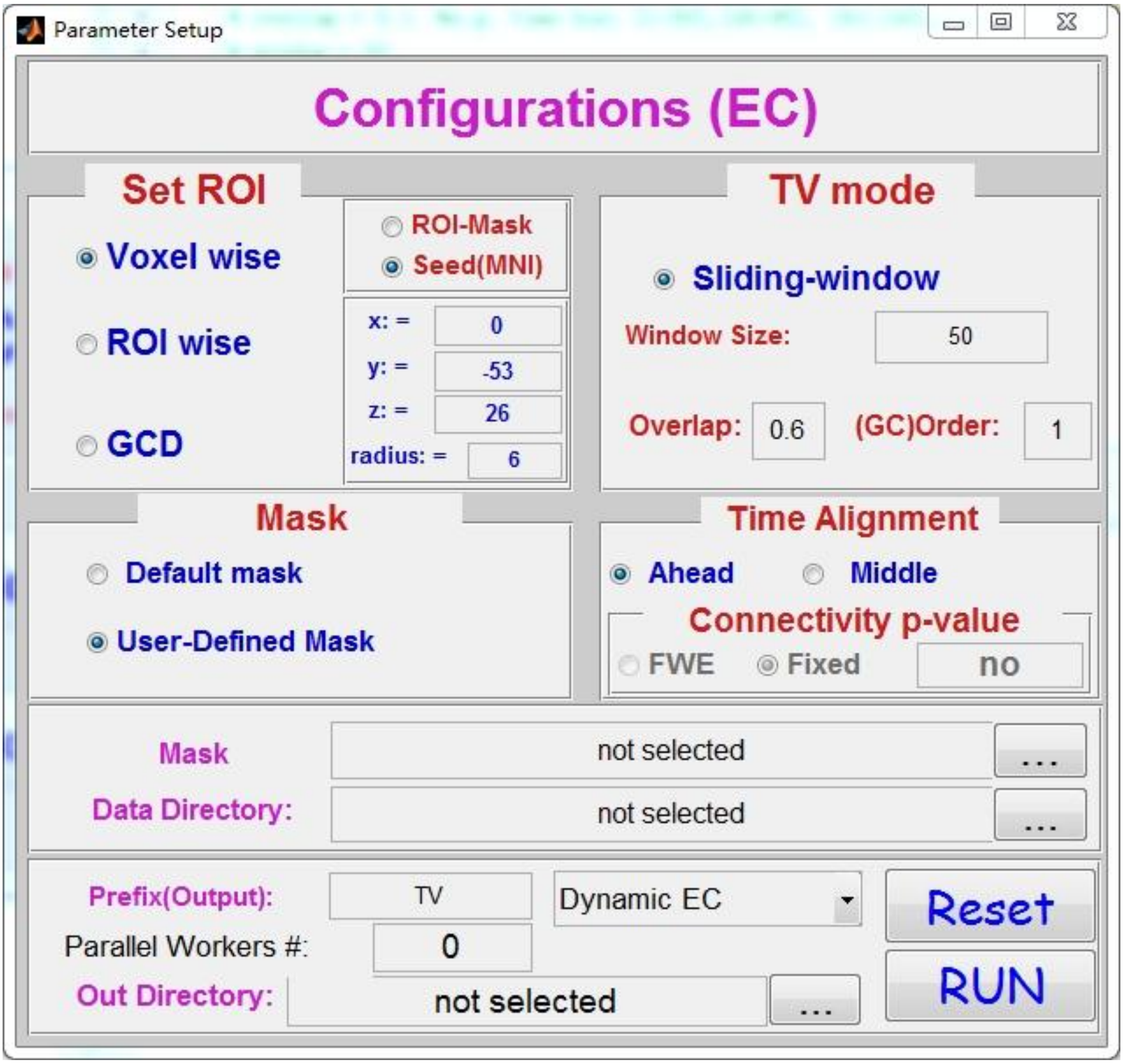
The running state:

```
Dynamic Functional Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Default value 0/NaN is not in the mask/label!
Default value>0 is inside the mask!
There are 54837 voxels inside the mask
Running subject    1 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
```

```
Dynamic Functional Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Default value 0/NaN is not in the mask/label!
Default value>0 is inside the mask!
There are 54837 voxels inside the mask
Running subject     1 (all     4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
Running subject     2 (all     4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj02
Running subject     3 (all     4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj03
Running subject     4 (all     4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj04
====Finish ALL!^ ^====
```

3 Dynamic EC

Click the button '***Dynamic EC***', and the window for Dynamic EC module will appear.



The window for the Dynamic EC module

This window is for the parameter setup of the Dynamic EC module.
There are three modules of the Dynamic EC: '***Voxel wise***', '***ROI wise***' and 'G***CD***'. Unlike the Dynamic FC, there is only one kind of the TV mode: 'Sliding-window' for the Dynamic analysis.

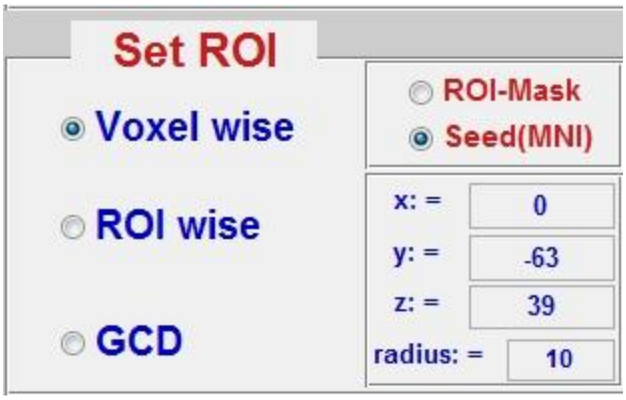
3.1 'Voxel wise' module:

3.1.1 Seed(MNI)

Setting: MNI center: 0 -63 39, radius 10 mm, TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Mask: gray mask, Prefix: TV

Seed information input: Input the MNI coordinate in the box '***x:*** = ' '***y:*** = ' & '***z:*** = '

Input the Radius of the mask ball in the box '***radius:* =** '
Here we set the centre of the ball in the Precuneus: **0 -63 39 (MNI)**, and the radius **10mm**, like the FC module.



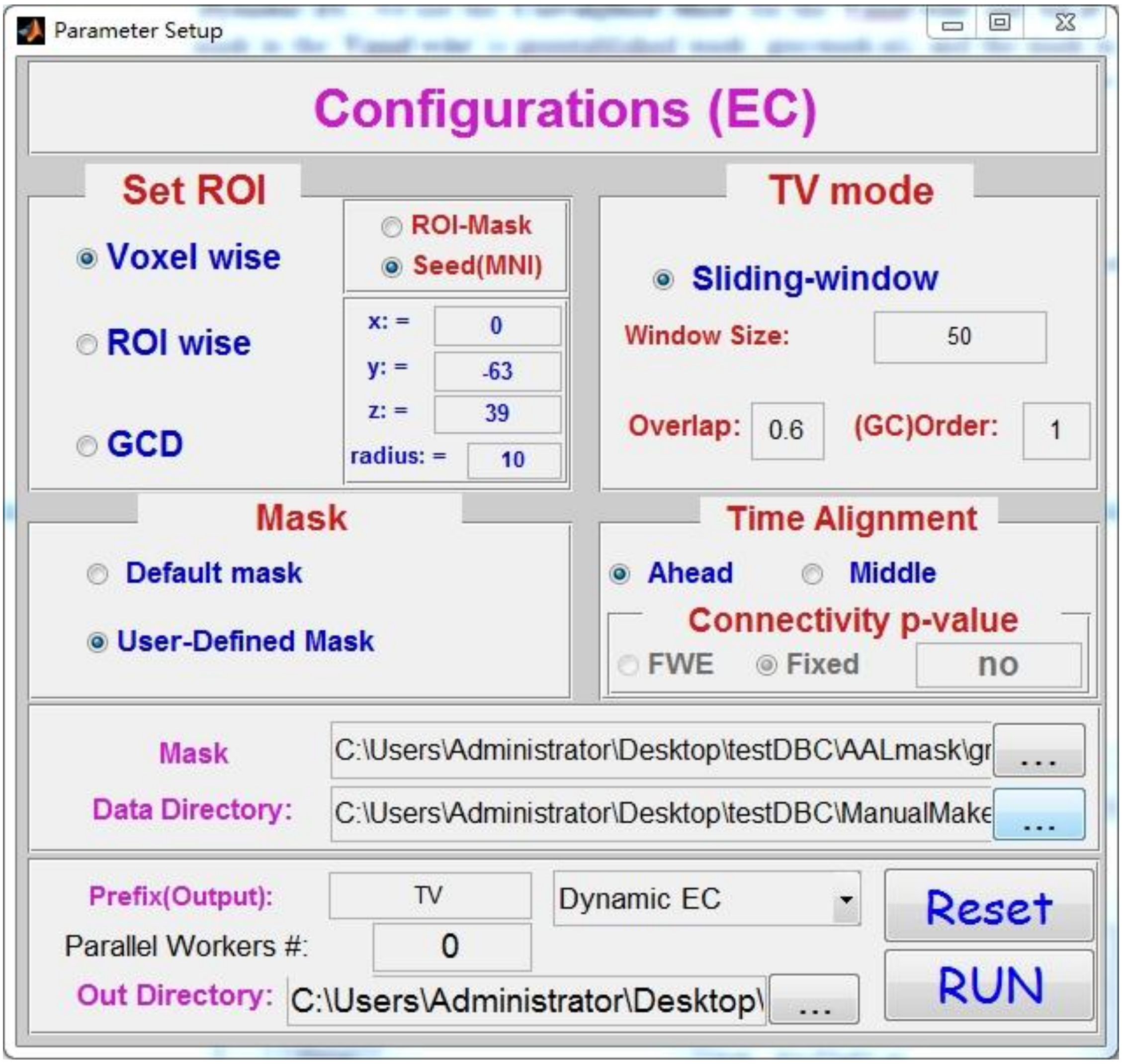
Set up the Seed centre and the radius.

Since the Dynamic EC module only have the 'Sliding-window' TV mode, the later TV mode setting will be the same and will not be discussed. Here we set the value like the Dynamic FC module: '***Window Size***': 50, '***Overlap***': 0.6. '***GC order***' :1.
Note: For Resting-State fMRI Data, we advise that the GC order to be 1, while the other kinds of data, such as EEG/MEG data, the order always should be changed.

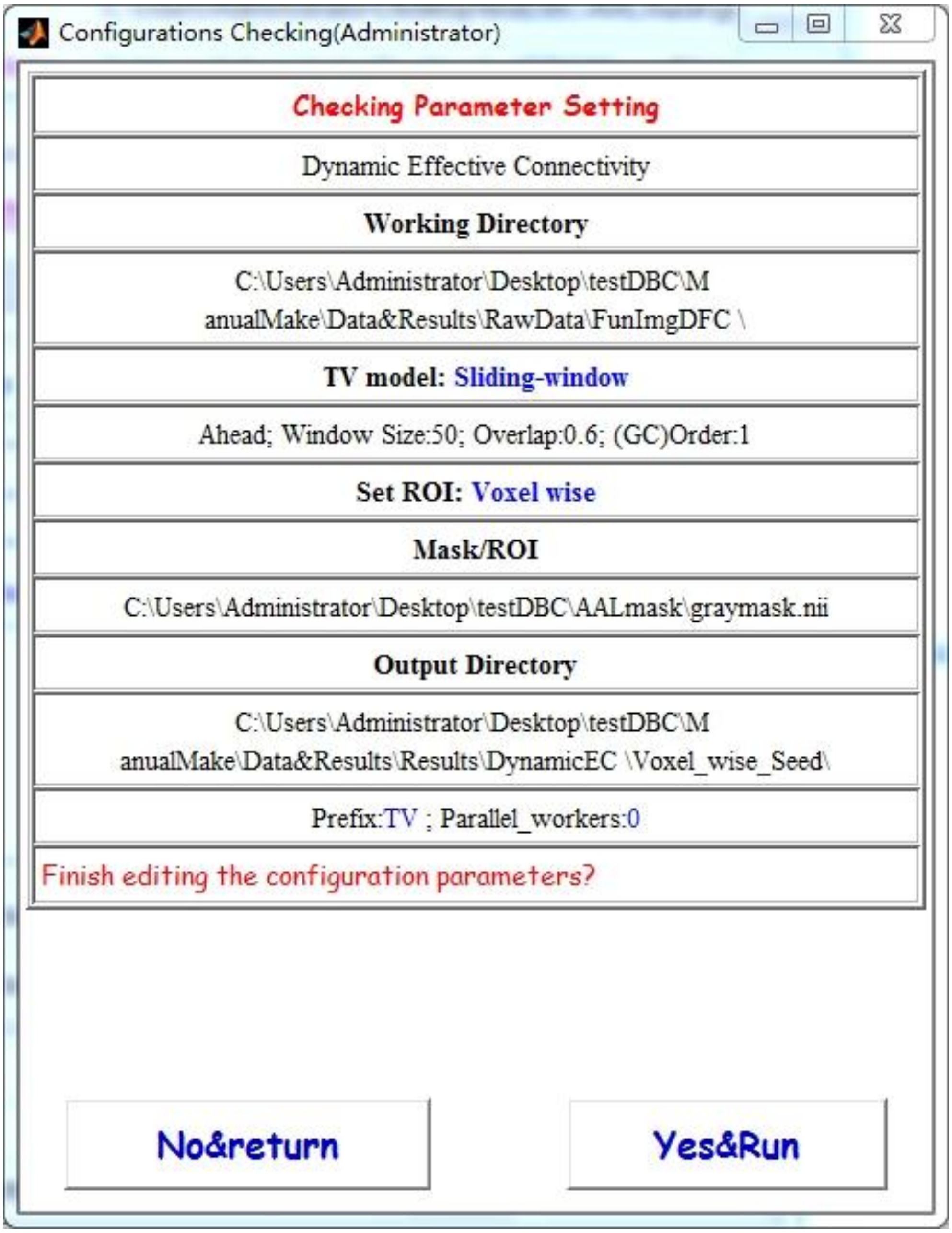
Mask selection: the selection of Mask in '***Dynamic EC***' module is the same as the '***Dynamic FC***'. We will not discuss the selection of the mask. In the whole test of '***Dynamic EC***', we use the '***User-defined Mask***' for the '***Voxel wise***' and '***GCD***'. The mask in the '***Voxel wise***' is preestablished mask: graymask.nii, and the mask in the '***GCD***' is Cingulum_Ant_R region from AAL template for the consider of time consuming and computer memory.

Also, the Data selection is the same as the former '***Dynamic FC***' module.

Therefore, we will give the final parameter selection window in later module demonstration.



The changed window for the Dynamic EC module (Seed(MNI))



Then Click '***RUN***', check, and click '***Yes&Run***'

The running state:

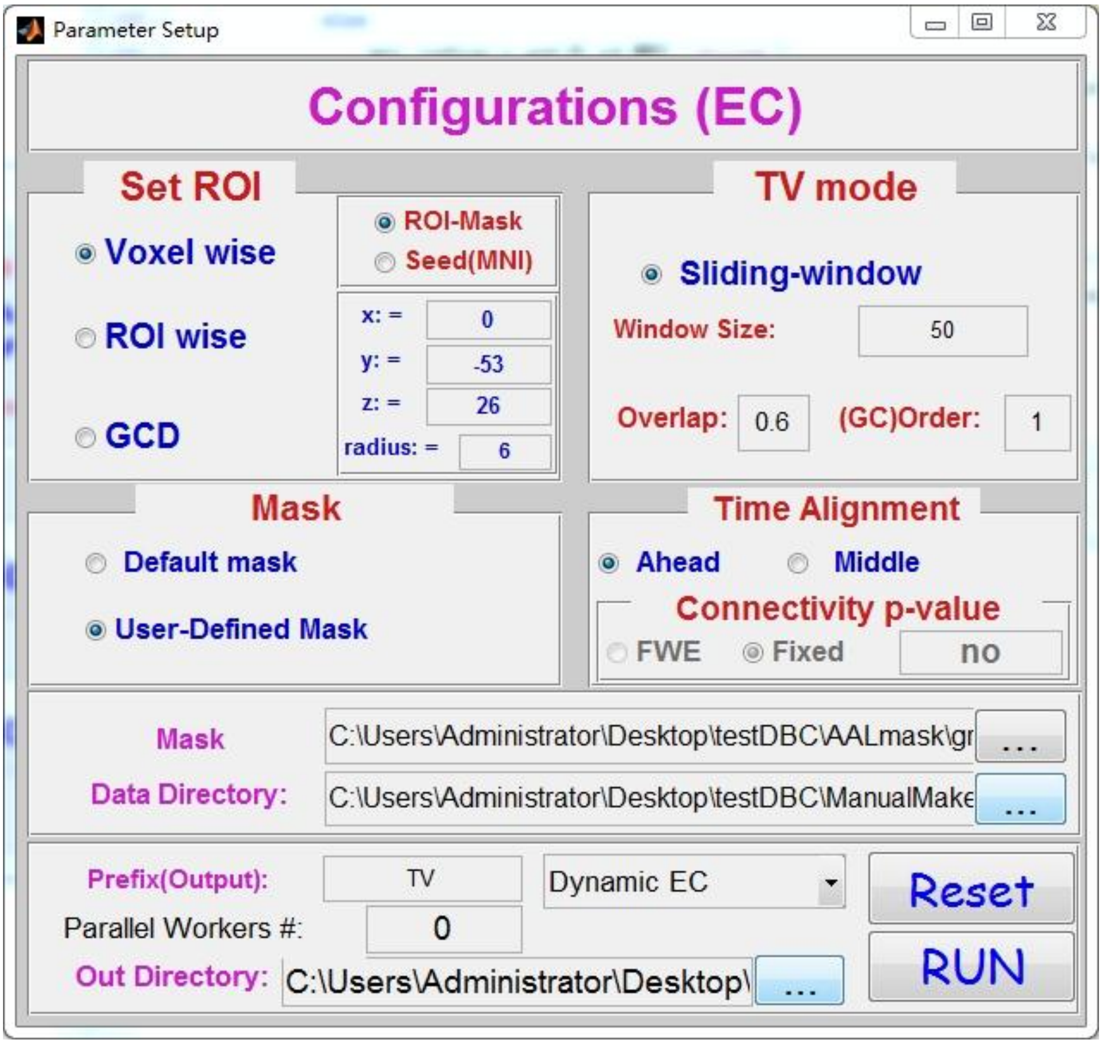
```
Dynamic Effective Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Default value 0/NaN is not in the mask/label!
Default value>0 is inside the mask!
There are 54837 voxels inside the mask
Running subject     1 (all     4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
```

```
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Default value 0/NaN is not in the mask/label!
Default value>0 is inside the mask!
There are 54837 voxels inside the mask
Running subject    1 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
Running subject    2 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj02
Running subject    3 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj03
Running subject    4 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj04
====Finish ALL!^_^====
```

3.1.2 ROI-Mask

Setting: ROI: Precuneus_L, TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Mask: gray mask, Prefix: TV

Like the '***ROI-Mask***' in the '***Dynamic FC***' module, select the '***ROI-Mask***' and the ROI selection window will appear. Also, we select the Precuneus_L from AAL template.



The changed window for the Dynamic EC module (ROI)

Then Click '***RUN***', check, and click '***Yes&Run***'

The running state:

```
Dynamic Effective Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Default value 0/NaN is not in the mask/label!
Default value>0 is inside the mask!
There are 54837 voxels inside the mask
Running subject    1 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
Running subject    2 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj02
Running subject    3 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj03
Running subject    4 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj04
====Finish ALL!^_^====
```

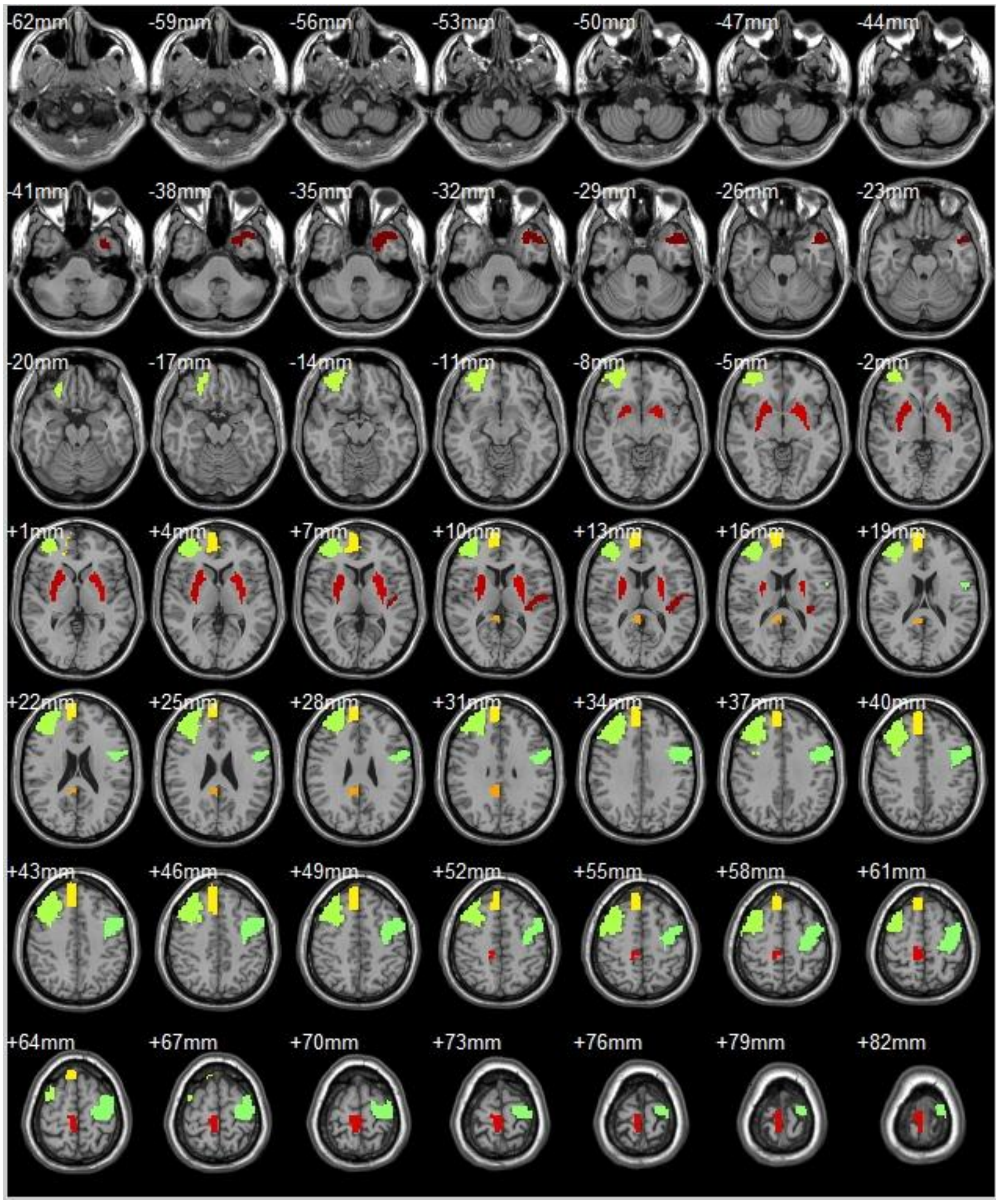
3.2 'ROI wise' module

3.2.1 Nifti Label

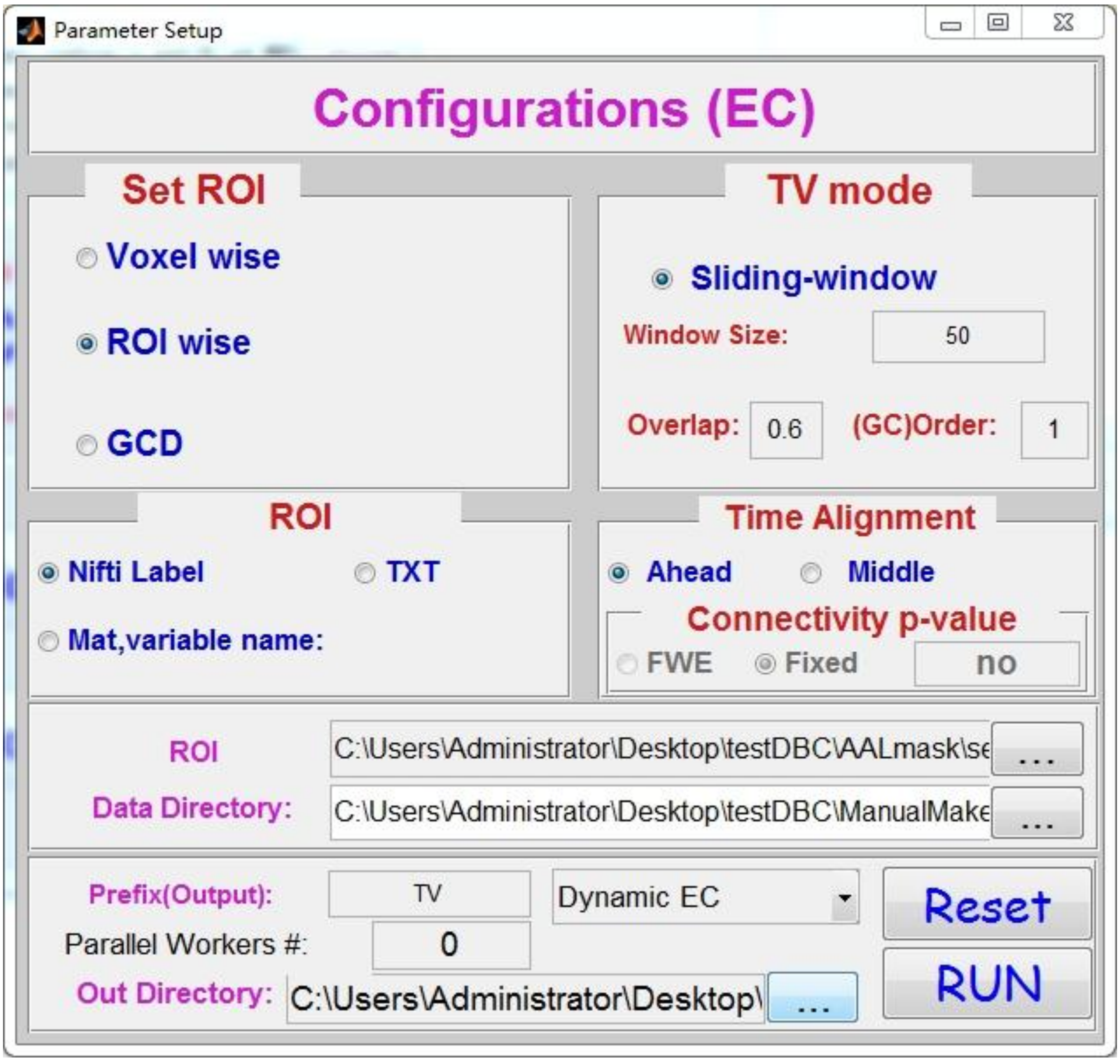
Setting: template: random select 10 AAL regions, TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Mask: gray mask, Prefix: TV

Like the ' ***Nifti Label*** ' in the '***Dynamic FC***' module, we randomly select 10 AAL Regions into a multi-value template. Here we use this template for analysis.

The other settings are the same as the former setting.



The random select AAL regions combined template.



The changed window for the Dynamic EC module (ROI wise Nifti label)

Then Click '***RUN***', check, and click '***Yes&Run***'

The running state:

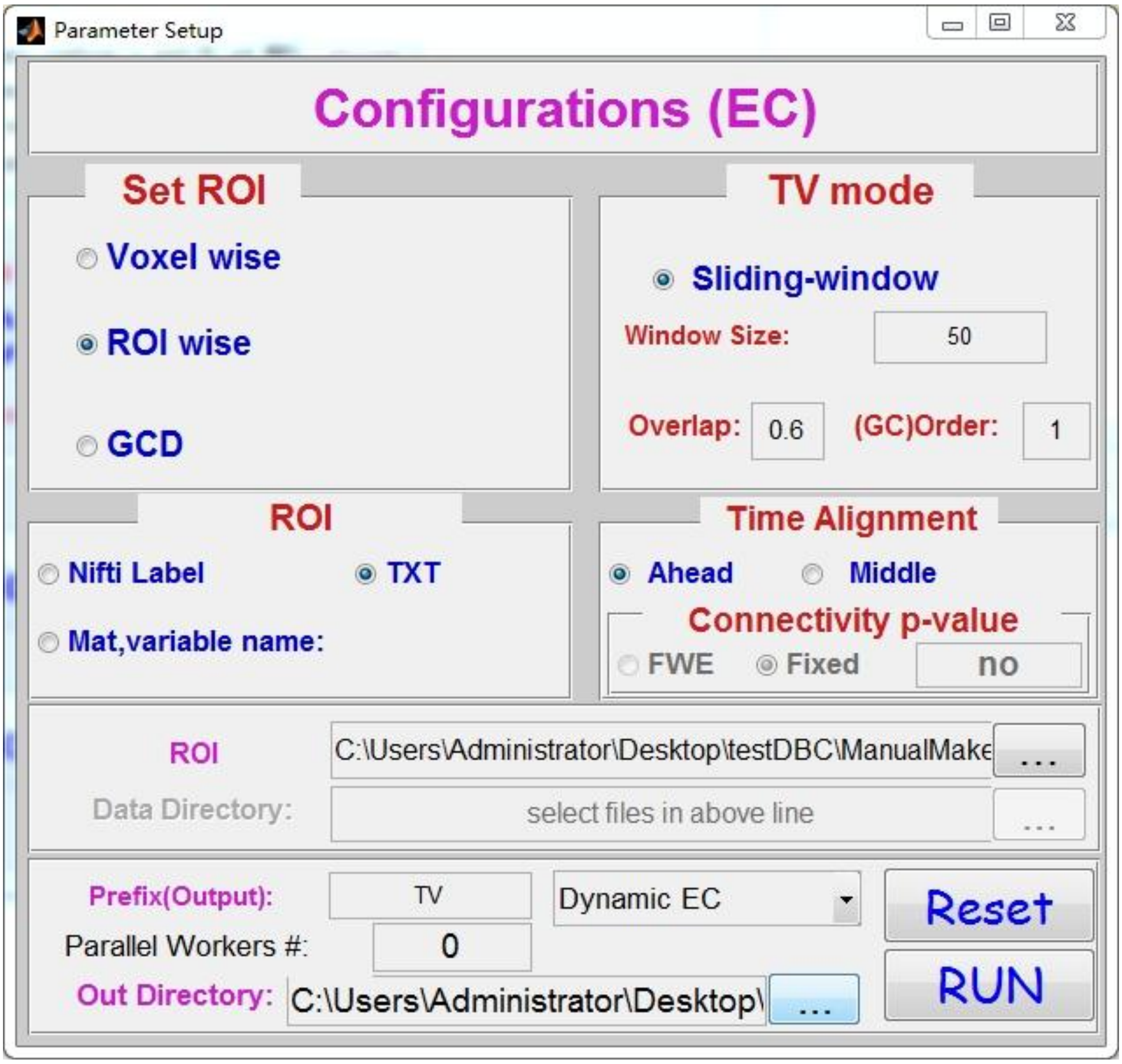
```
Dynamic Effective Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Default value 0/NaN is not in the mask/label!
Running subject    1 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
```

```
Dynamic Effective Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Default value 0/NaN is not in the mask/label!
Running subject    1 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
Running subject    2 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj02
Running subject    3 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj03
Running subject    4 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj04
====Finish ALL!^_^====
```

3.2.2 TXT

Settting: 116(ROIs) * 240(timepoints), TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Prefix: TV

The settings are similar to the '***TXT***' in the '***Dynamic FC***' module, each TXT file contains N (roi number) * M (time points) matrix.



The changed window for the Dynamic EC module (ROI wise TXT)

Then Click '***RUN***', check, and click '***Yes&Run***'

The running state:

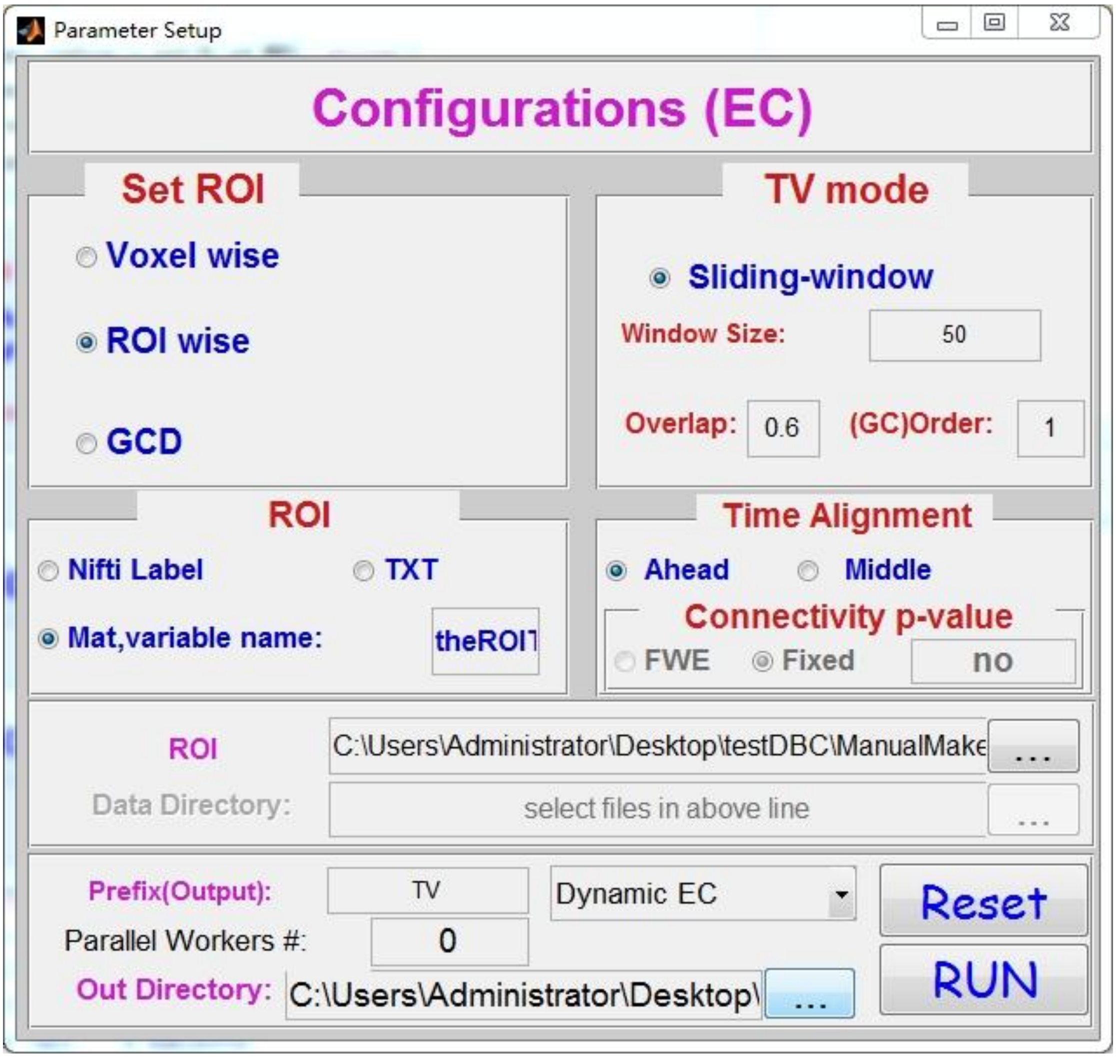
```
Dynamic Effective Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Running subject     1 (all     4 subjects)
Running subject     2 (all     4 subjects)
Running subject     3 (all     4 subjects)
Running subject     4 (all     4 subjects)
====Finish ALL!^_^====
```

3.2.3 Mat

Setting: 116(ROIs) * 240(timepoints), TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Prefix: TV

The settings are similar to the '***Mat***' in the '***Dynamic FC***' module, each mat file contains N (roi number) * M (time points) matrix. Like the former setting, we need to point out the matrix variable name. Here we also used the REST generated mat file. The name of variable is '***theROITimeCoursesTotal***'.

The other settings are similar to former one.



The changed window for the Dynamic EC module (ROI wise Mat)

Then Click '***RUN***', check, and click '***Yes&Run***'

The running state:

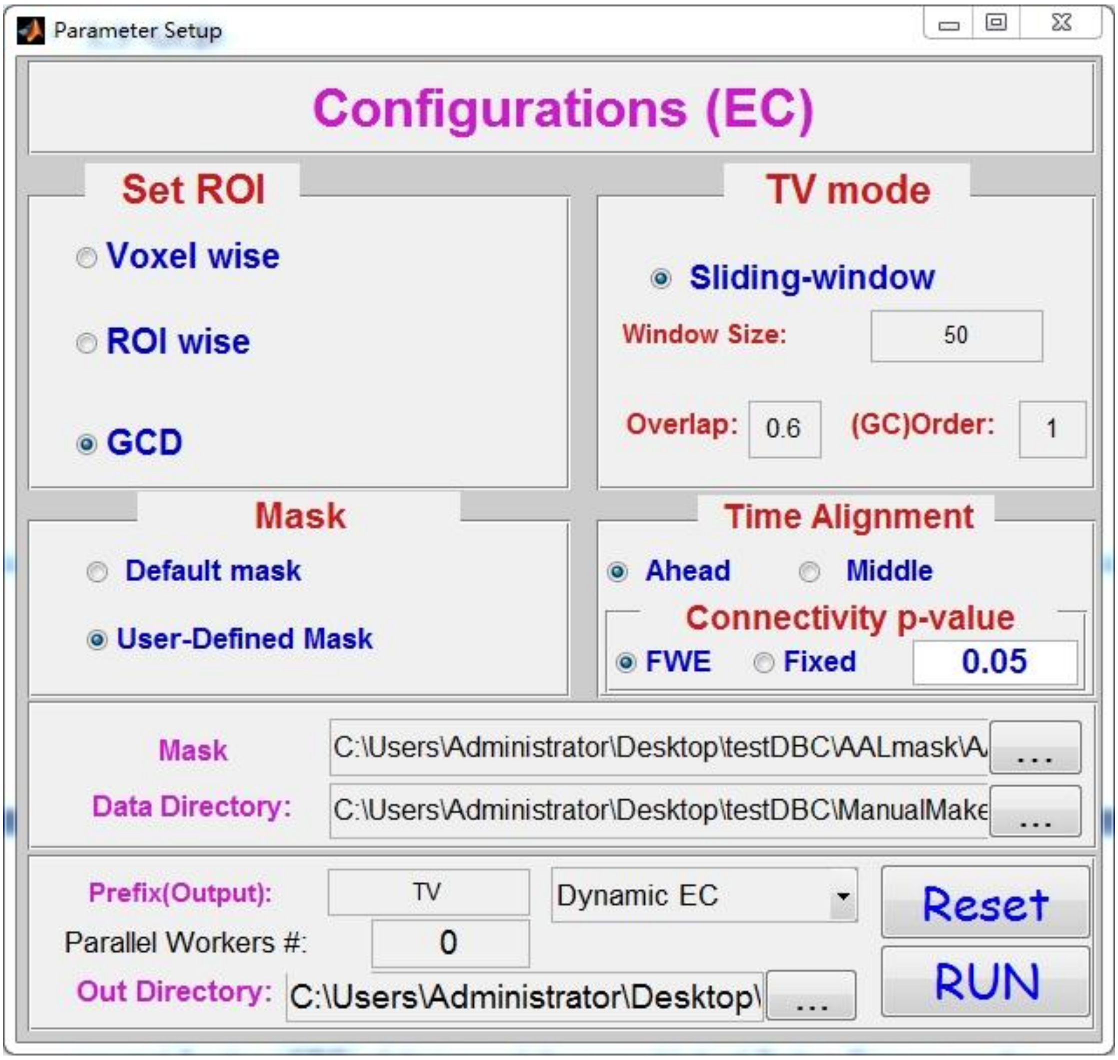
```
Dynamic Effective Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Running subject    1 (all    4 subjects)
Running subject    2 (all    4 subjects)
Running subject    3 (all    4 subjects)
Running subject    4 (all    4 subjects)
====Finish ALL!^_^====
```

3.3 GCD

Voxel-to-voxel computed the bivariate Granger causality between every pair of voxels to mapping whole-brain effective connectome. The toolbox provides the Granger causality density that counts total number of incoming and outgoing connectivity of a given voxel.

Setting: Mask: Cingulum_Ant_L from AAL template, TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Prefix: TV, pvalue: p<0.05 FWE corrected

As described before, here we select the 'Cingulum_Ant_L' in AAL template for the '***User-Defined Mask***' selection. The other setting is similar to the '***FCD***' in '***Dynamic FC***' module. The difference between '***GCD***' and '***FCD***' settings is that we use the '***FWE***' mode for the p value selection. Here we use the FWE corrected p<0.05 (p<0.05 FWE corrected).



The changed window for the Dynamic EC module (ROI wise Mat)

Then Click '***RUN***', check, and click '***Yes&Run***'

The running state:

```
Dynamic Effective Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Default value 0/NaN is not in the mask/label!
Default value>0 is inside the mask!
There are   426 voxels inside the mask
Running subject     1 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
```

```
Dynamic Effective Connectivity---setting
Now DynamicBC is running on 0 workers.
Running now!
Warning: Directory already exists.
> In DynamicBC_run at 23
  In DynamicBC>wgr_run_check at 1105
Default mode: fMRI(reading from NIFII image), if not? choose "Set ROI/ ROI wise"
Default value 0/NaN is not in the mask/label!
Default value>0 is inside the mask!
There are   426 voxels inside the mask
Running subject    1 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj01
Running subject    2 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj02
Running subject    3 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj03
Running subject    4 (all    4 subjects)
Only one file in: C:\Users\Administrator\Desktop\testDBC\ManualMake\Data&Results\RawData\FunImgDFC\subj04
====Finish ALL!^_^====
```

4 Result

4.1 Dynamic FC

4.1.1 Dynamic FC: Voxel wise: Seed(MNI)

Setting: MNI center: 0 -63 39, radius 10 mm, TV mode: FLS, Default mask, FLS Parameter: Fixed 80, Prefix: TV

Result Folder:

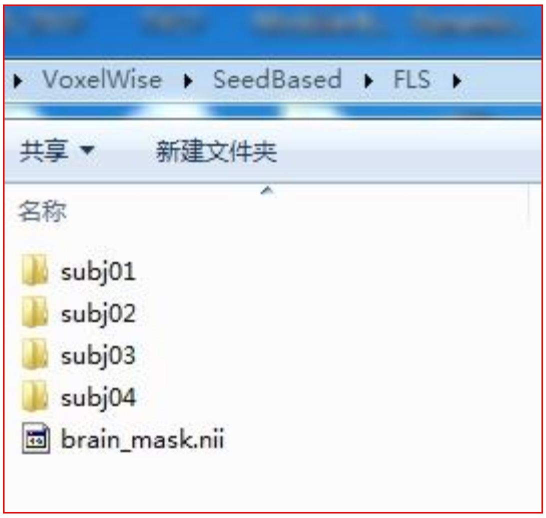
The result folder contains 2 items, the one is functional maps and the other is the variance map across functional map of each subject.

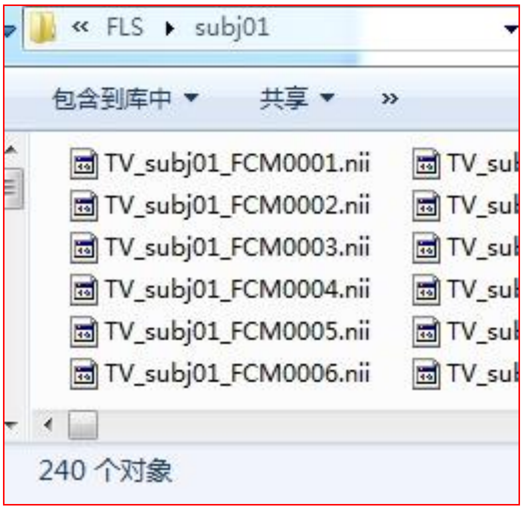
In the functional maps folders, there are n items, n subfolders file. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis, and the result folder contains 4 subfolders file.

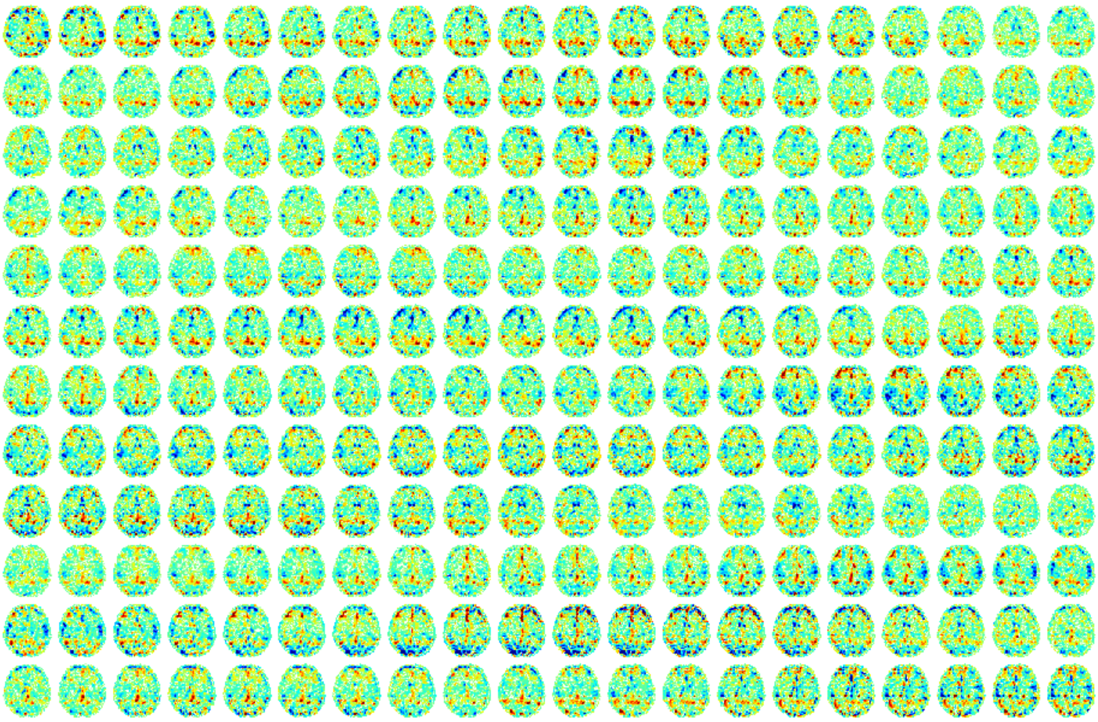
Each subject contains N Nifti_1 files. In our demonstration, the signal length is 240. Then in our result subfolder, it containes 240 items.

The rule of the output filename: ***<Prefix>_<subject name>_FCM####.nii.***

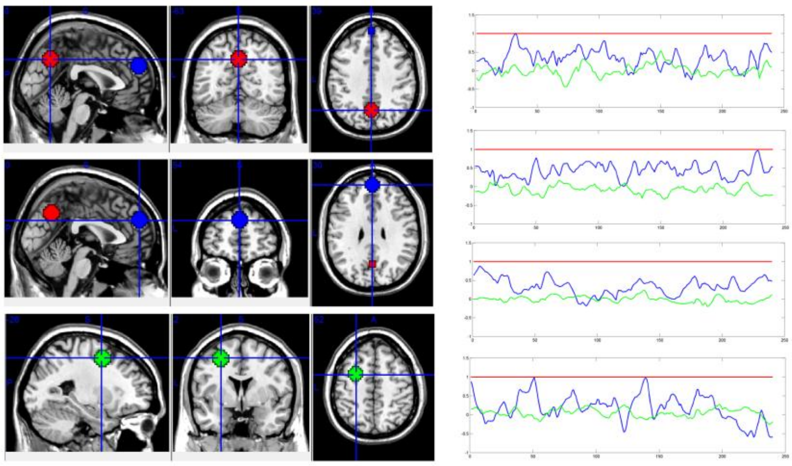
Therefore, the output filename of our demonstration is like this: TV_subj0#_FCM0001.nii ~ TV_subj0#_FCM0240.nii.







ROI: seed(red), DMPFC(blue)&FEF(green)



In the ***variance map folders***, there are n items, n subfolders file. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis, and the result folder contains 4 subfolders file. Each subject contains one file.
The rule of the output filename: ***<Prefix>_<subject name>_FCM_variance.nii.***
Therefore, the output filename of our demonstration is like this: TV_subj0#_FCM_variance.nii.

4.1.2 Dynamic FC: Voxel wise: ROI-mask

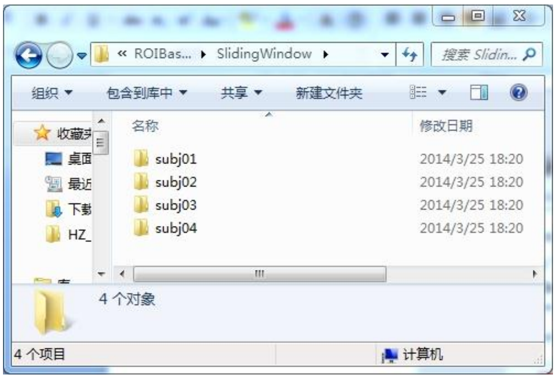
Setting: ROI: Precuneus_L, TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Mask: gray mask, Prefix: roi_TV
Result Folder:

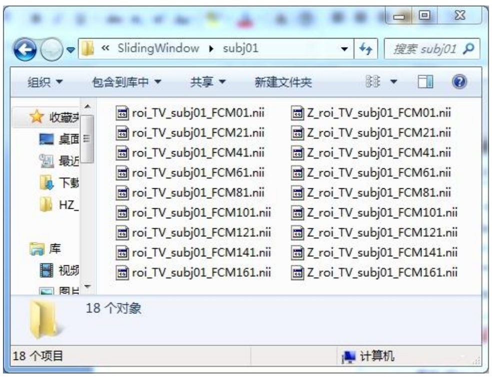
The result folder contains 3 items, the one is functional maps (r-value) and corresponding z-value maps, and the third one is the variance map across functional map of each subject.

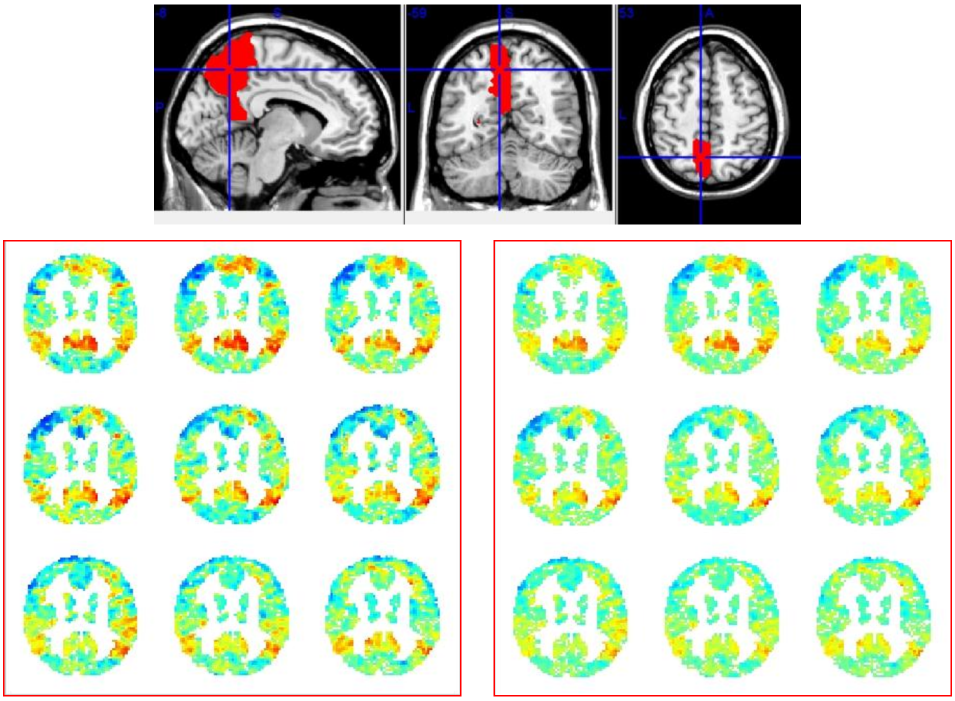
The functional maps (r-value) folder named *seed_CORR_FCmap*, which contains n subfolders. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis, and the result folder contains 4 subfolders. Each subject contains (N-Winlen)/(Winlen*(1-Overlap)) Rmaps and (N-Winlen)/(Winlen*(1-Overlap)) Zmaps. In our demonstration, the signal length is 240. Then in our result subfolder, it containes 9 Rmap and 9 Zmap.
The rule of the output filename: ***<Prefix>_<subject name>_FCM??.nii*** Therefore, the output filename of our demonstration is like this:
roi_TV_subj0#_FCM21.nii ~ TV_subj0#_FCM161.nii

The functional maps (Z-value) folder named *seed_Z_FCmap*, which contains n subject subfolders. The rule of the output filename: ***Z_<Prefix>_<subject name>_FCM??.nii***

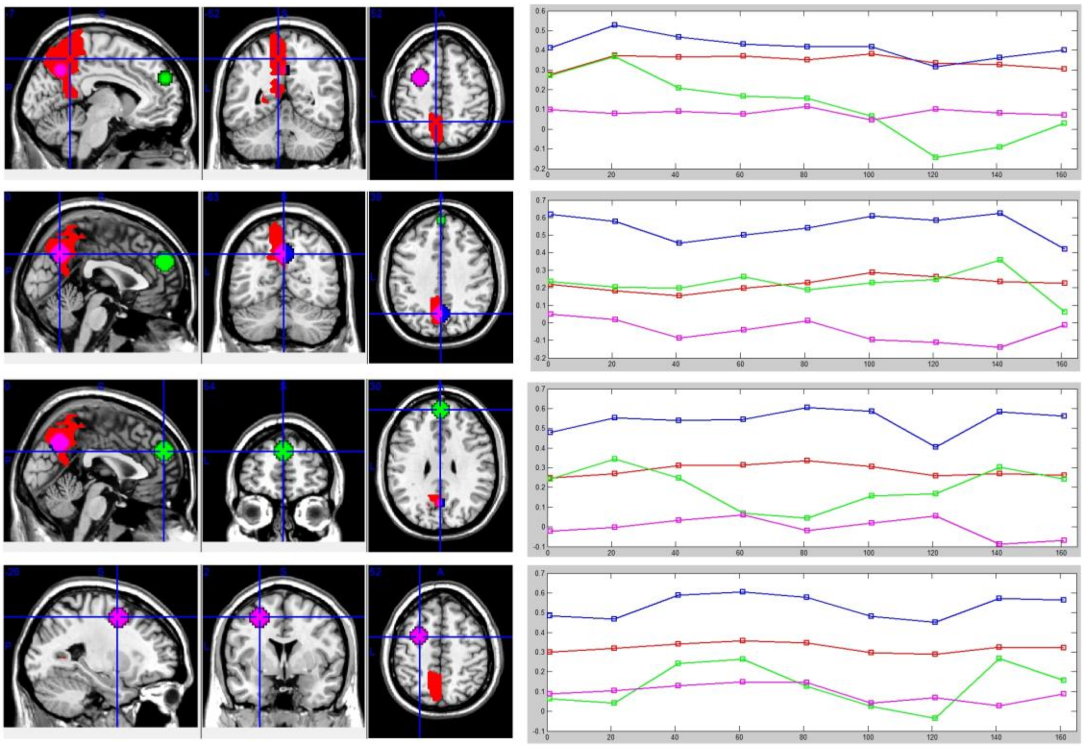
In the ***variance map folders*** named *FC_SW_Variance*, there are n subject item. Each subject contains two files: ***<Prefix>_<subject name>_FCM_variance.nii, and Z_<Prefix>_<subject name>_FCM_variance.nii***







ROI: Precuneus_L(red), PCC/PCUN(blue), DMPFC(greed), FEF(violet)



4.1.3 Dynamic FC: ROI wise: Nifti Label

Setting: ROI template: AAL template, TV mode: FLS, FLS Parameter: Fixed 100, Prefix: TV

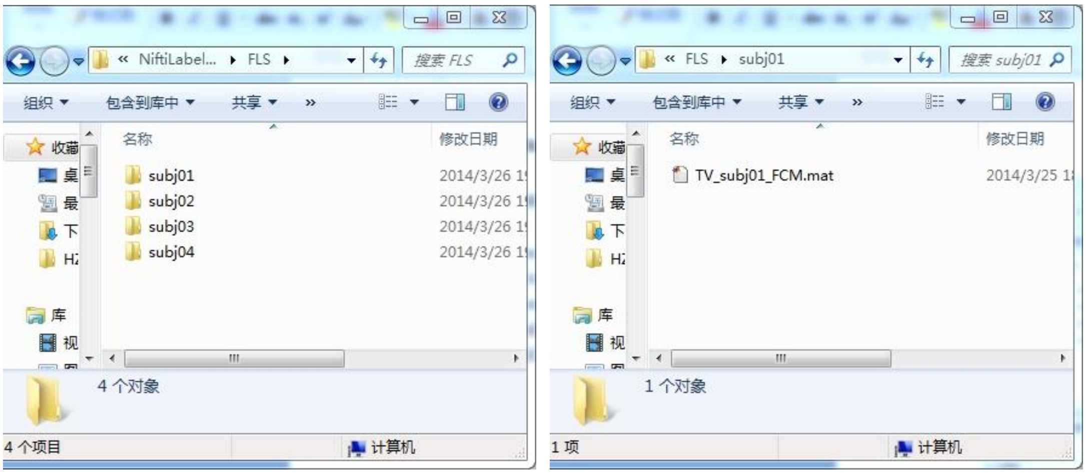
Result Folder:

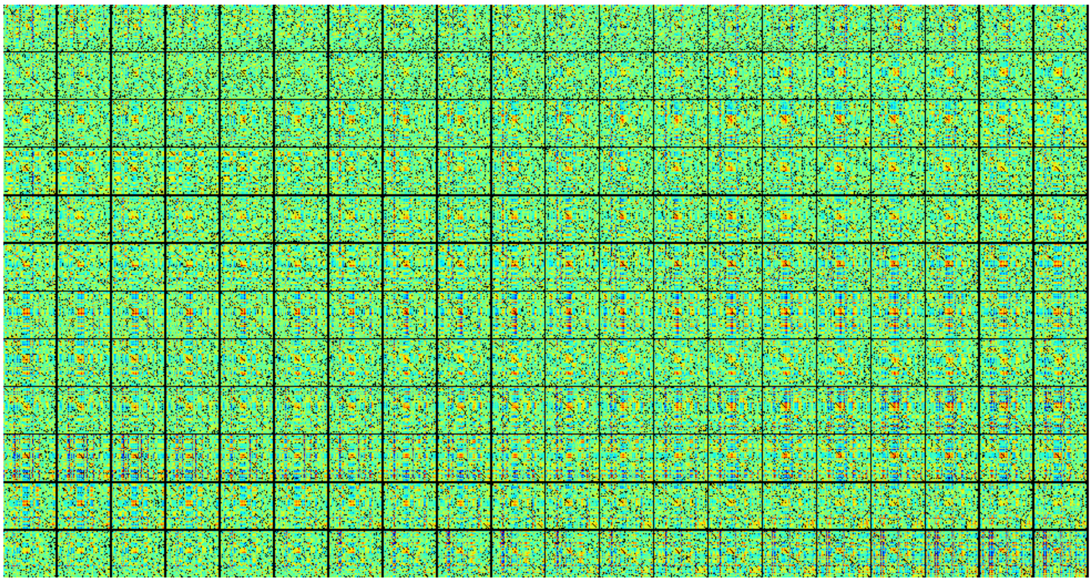
The result folder contains n items, n subfolders. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis, and the result folder contains 4 subfolders.

Each subfolder contains a MAT file, which kept the dynamic FC matrix in a struct.

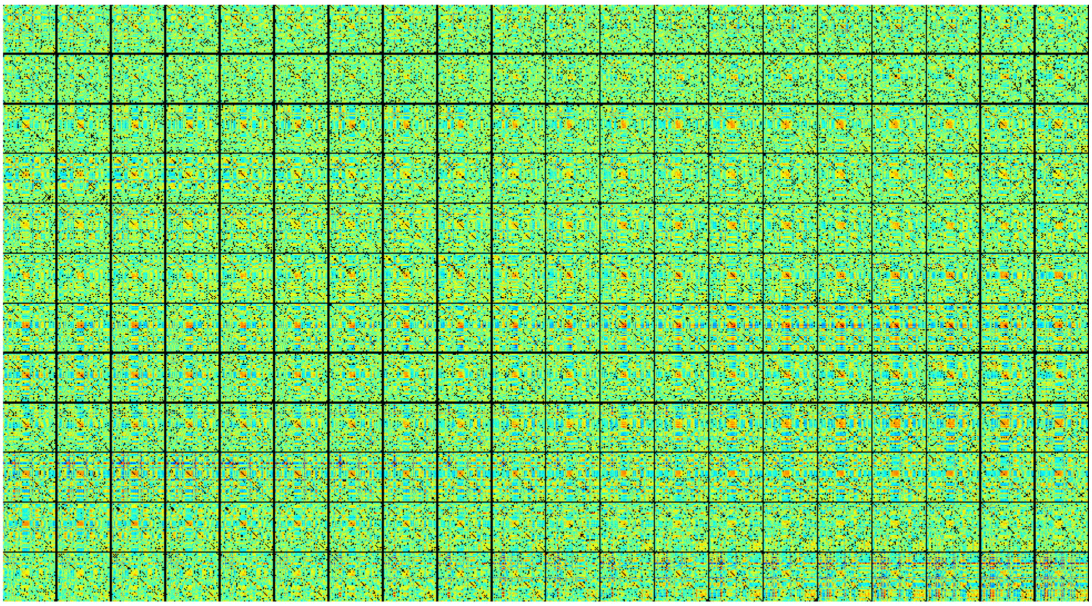
Output name : ***<Prefix>_<subject name>_FCM.mat.***

There is a structure variable of FCM. FCM.Matrix is 1xn cell, which contain functional connectivity matrices. The FCM.variance is a variance matrix across all functional connectivity matrices of each subject.



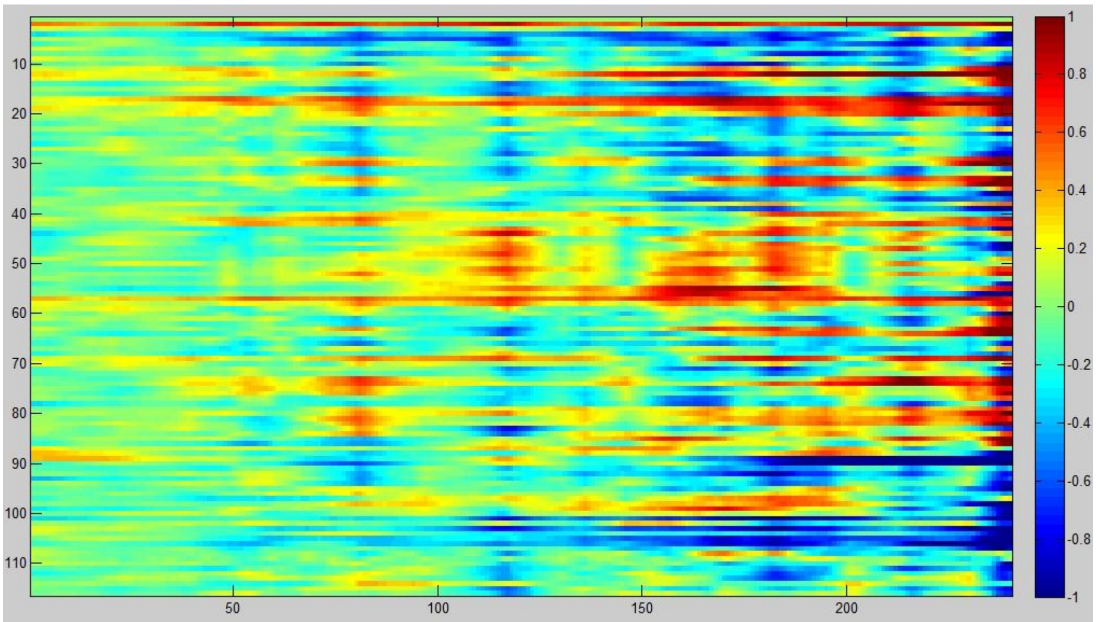


FLS

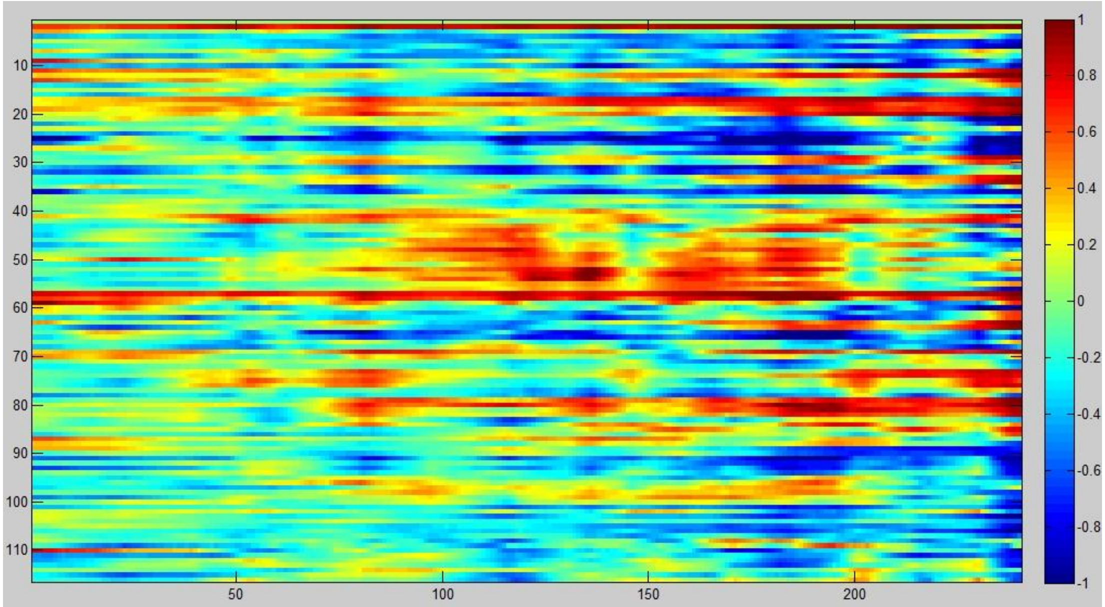


$(FLS+FLS^T)/2$

ROI 1 to ROI 1-116:

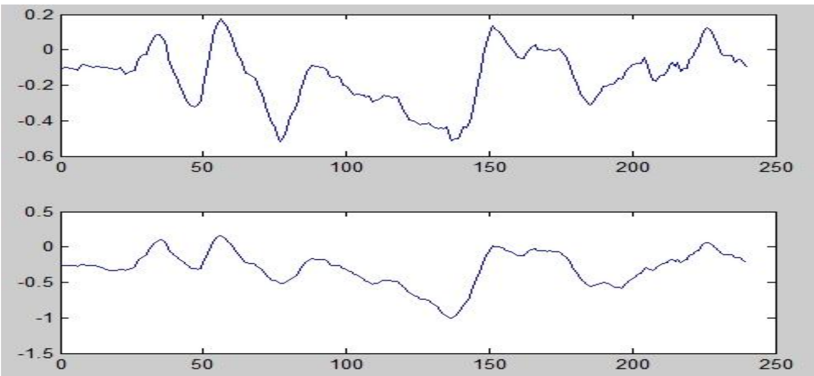


FLS



(FLS+FLS^T)/2

ROI 10 to ROI 40:



4.1.4 Dynamic FC: ROI wise: TXT

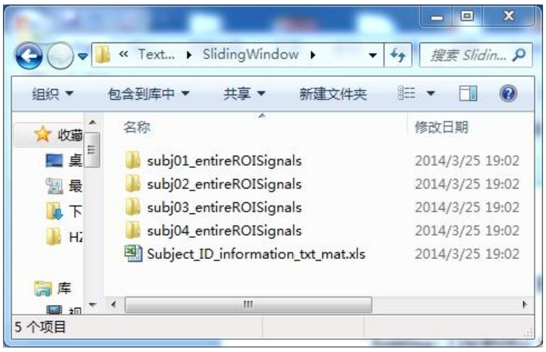
Settting: 116(ROIs) * 240(timepoints), TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Prefix: TV

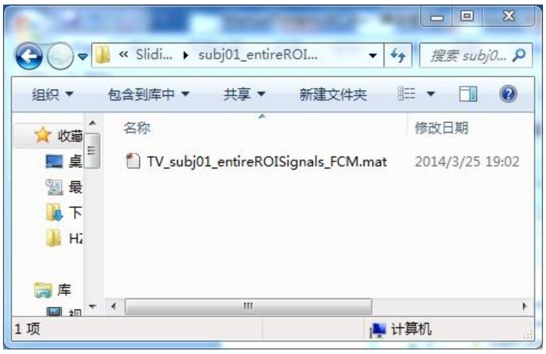
Result Folder:

The result folder contains n+1 items, n subfolders and one Excel file. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis, and the result folder contains 4 subfolders and 1 Excel file.

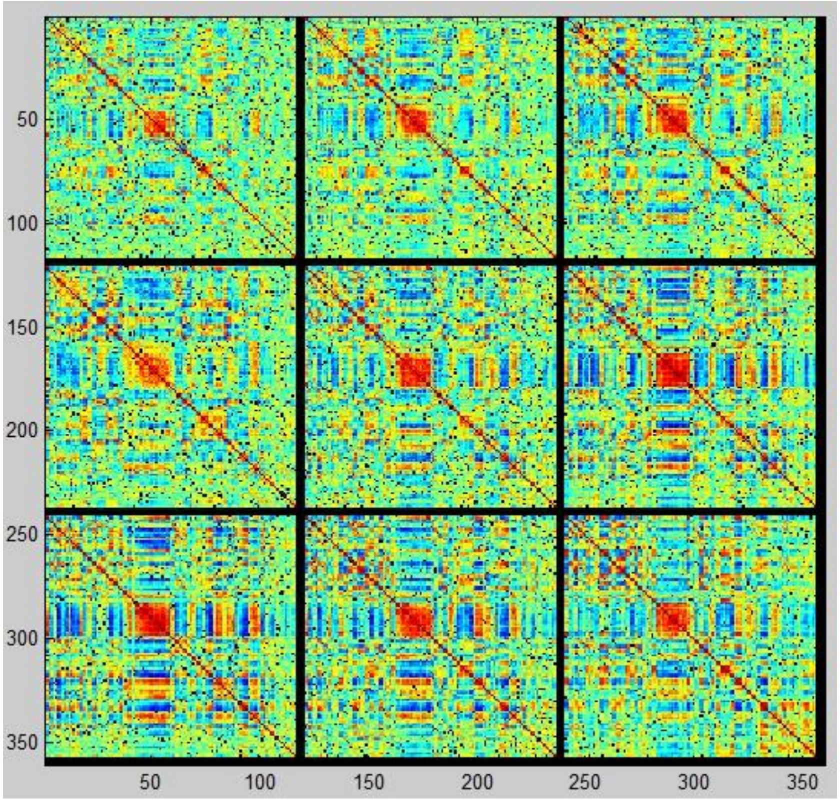
Each subfolder contains a MAT file, which kept the dynamic FC matrix in a struct.

Output name : ***<Prefix>_<subject name>_FCM.mat***

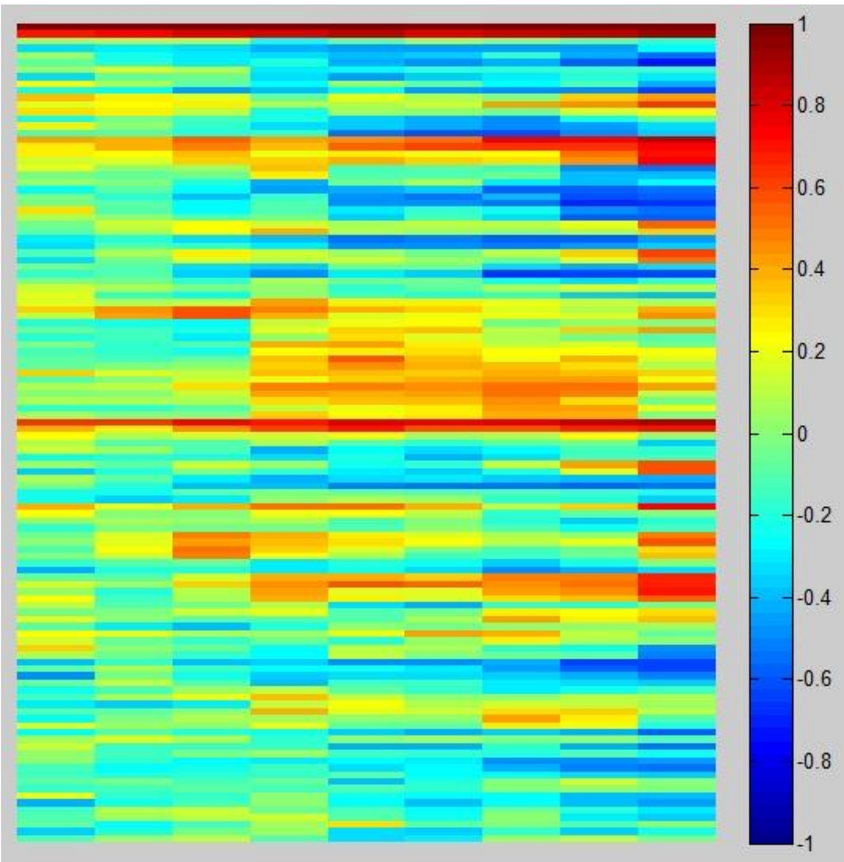




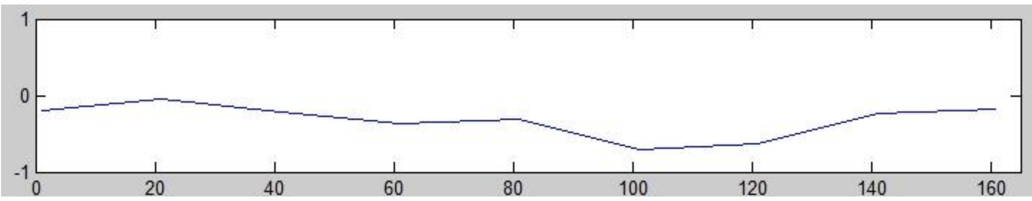
The following show is only Subj01:



ROI 1 to ROI 1-116:



ROI 10 to ROI 40:



4.1.5 Dynamic FC: ROI wise: MAT

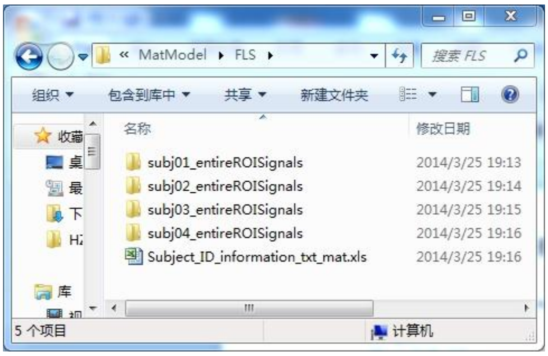
Setting: 116(ROIs) * 240(timepoints), TV mode: FLS, FLS Parameter: Fixed 100, Prefix: TV

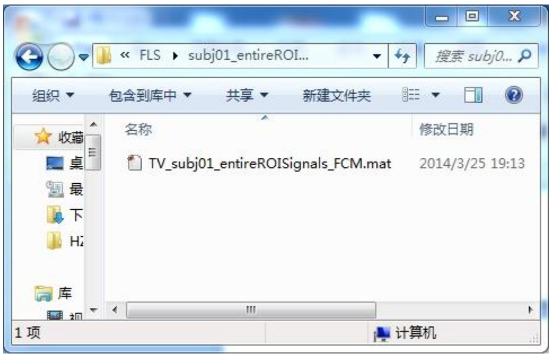
Result Folder:

The result folder contains n+1 items, n subfolds and one Excel file. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis, and the result fold contains 4 subfolders and 1 Excel file.

Each subfolder contains a MAT file, which kept the dynamic FC matrix in a struct.

Output name : ***<Prefix>_<subject name>_FCM.mat***





The result matrices are the same as 4.1.3

4.1.6 Dynamic FC: FCD

Setting: Mask: gray mask, TV mode: Sliding-window, Window Size: 50, Overlap: 0.6, Prefix: TV, pvalue: fixed 0.001, Time Alignment: 'Ahead'

Result Folder:

The result folder contains n items, n subfolders. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis, and the result folder contains 4 subfolders.

Each subject contains (N-Winlen)/(Winlen*(1-Overlap))*4 Maps (Positive only/Absolute & Weight/Binary). In our demonstration, the signal length is 240. Then in our result subfolder, it containes 36 maps.

The rule of the output filename:

<Prefix>_<subject name>_FCM_pos_wei??.nii

<Prefix>_<subject name>_FCM_abs_wei??.nii

<Prefix>_<subject name>_FCM_pos_bin??.nii

<Prefix>_<subject name>_FCM_abs_bin??.nii

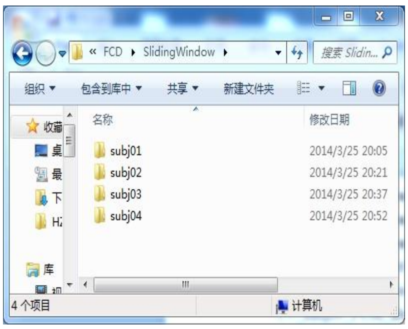
Therefore, the output filename of our demonstration is like this:

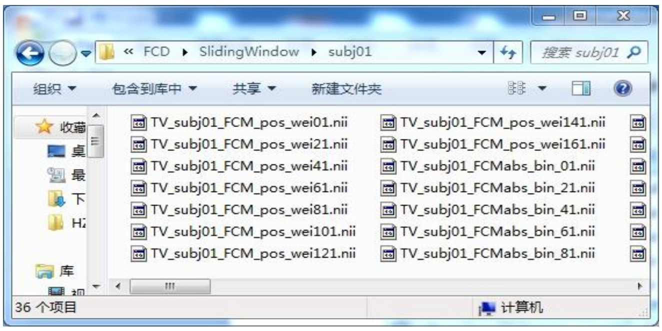
TV_subj0#_FCM_pos_wei01.nii ~ TV_subj0#_FCM_pos_wei161.nii

TV_subj0#_FCM_abs_wei01.nii ~ TV_subj0#_FCM_abs_wei161.nii

TV_subj0#_FCM_pos_bin01.nii ~ TV_subj0#_FCM_pos_bin161.nii

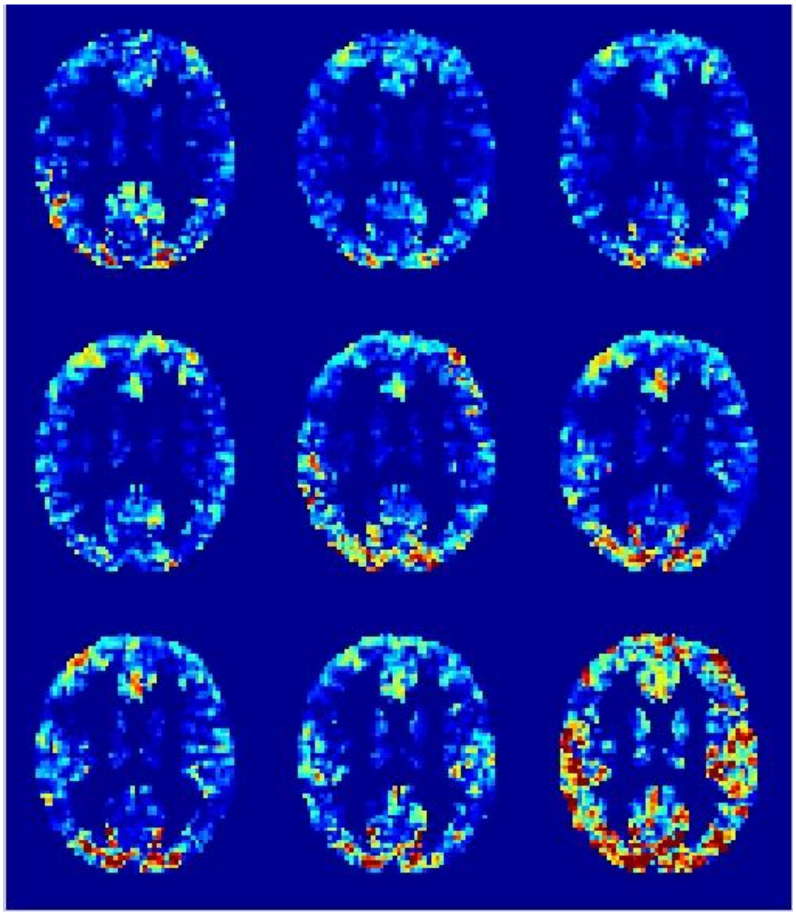
TV_subj0#_FCM_abs_bin01.nii ~ TV_subj0#_FCM_abs_bin161.nii

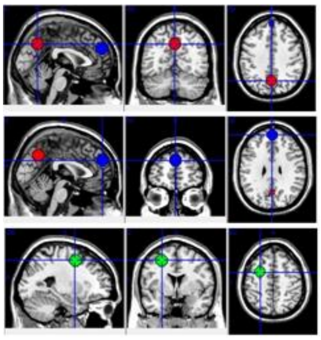


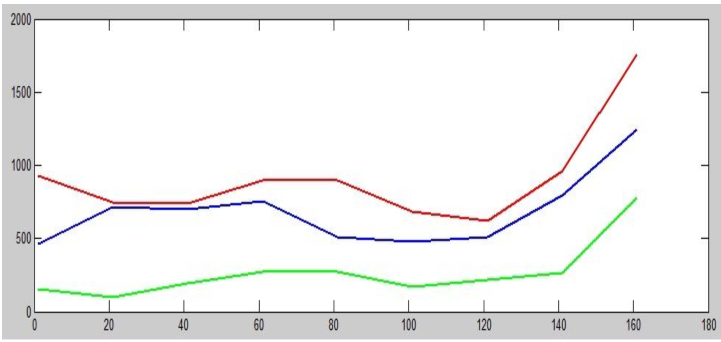


The following figures of Subj01 are:

Positive Weight:

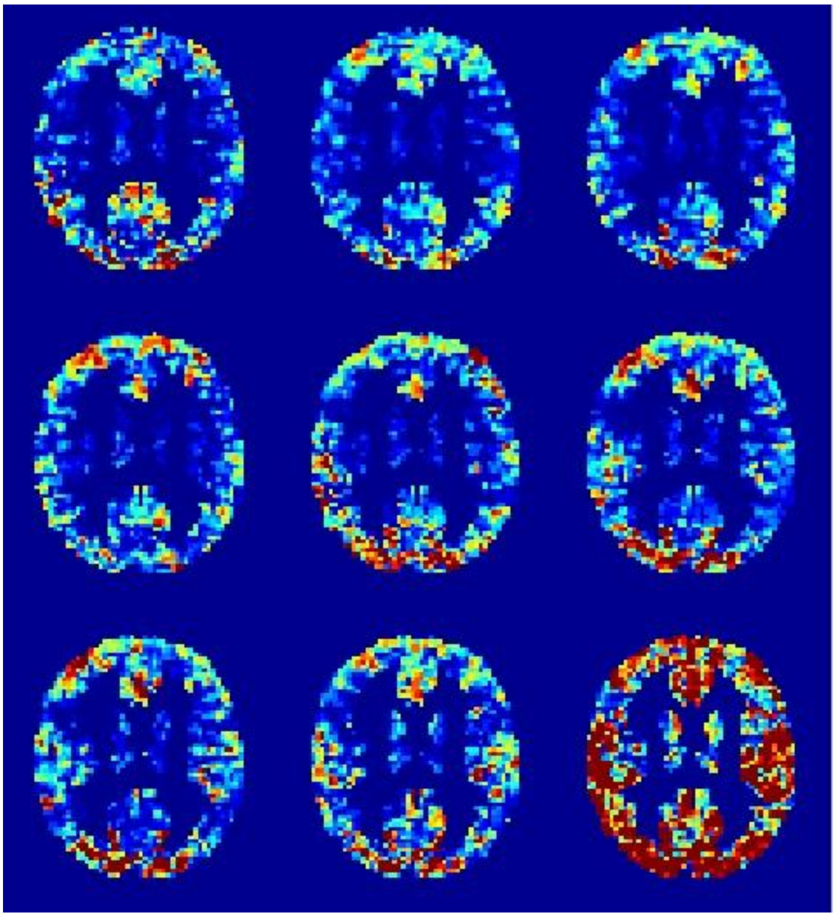


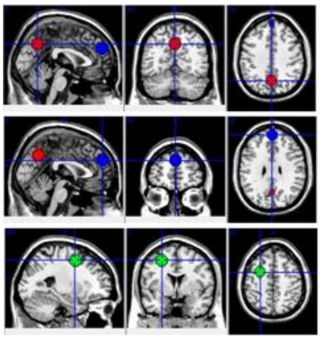


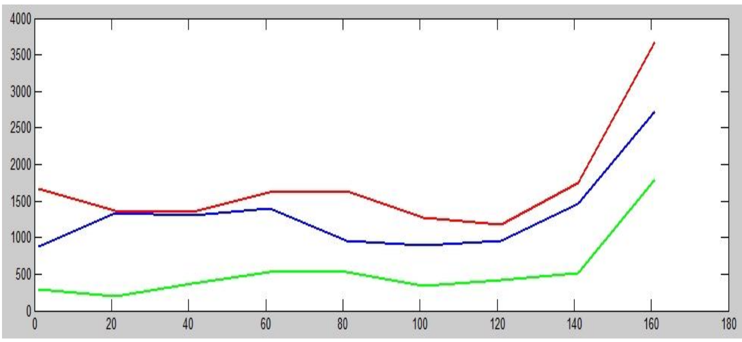


ROI: PCC/PCUN (red), DMPFC(blue)&FEF(green)

Positive Binary:

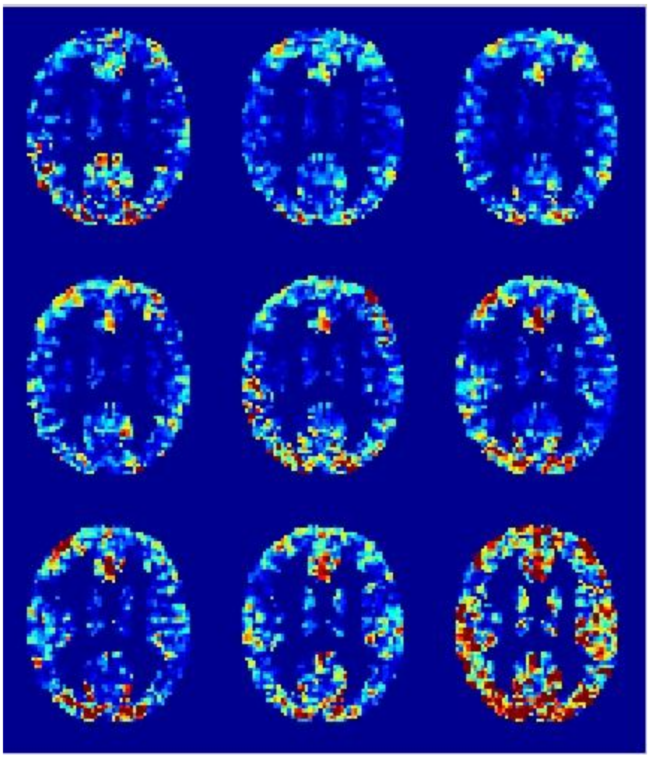


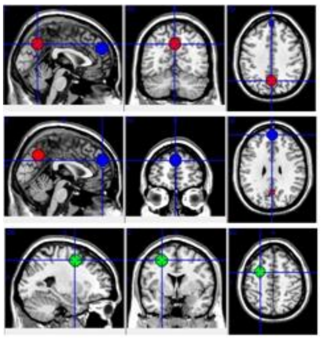


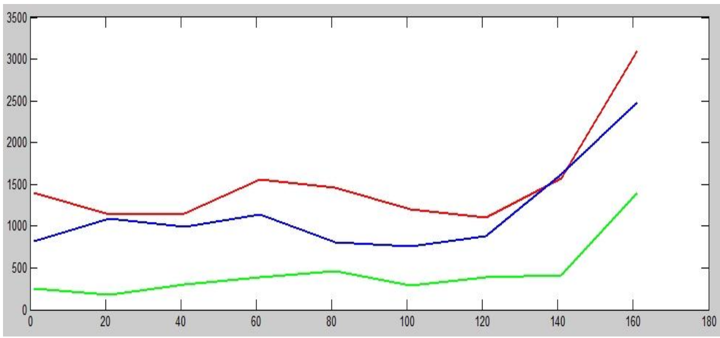


ROI: PCC/PCUN (red), DMPFC(blue)&FEF(green)

Absolute Weight:

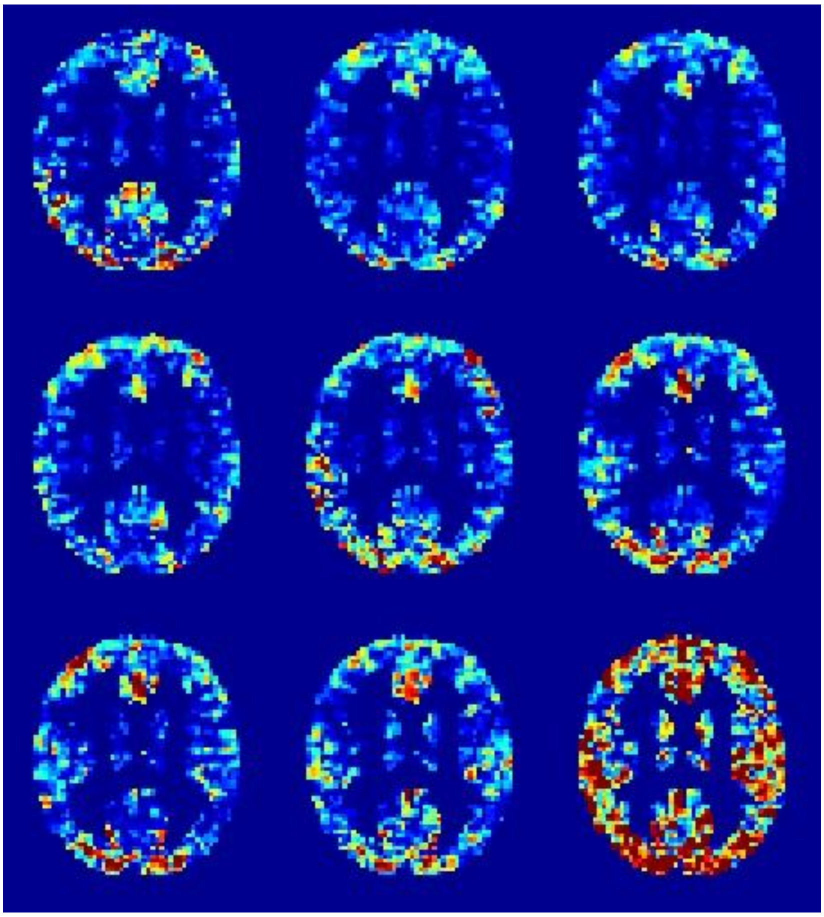


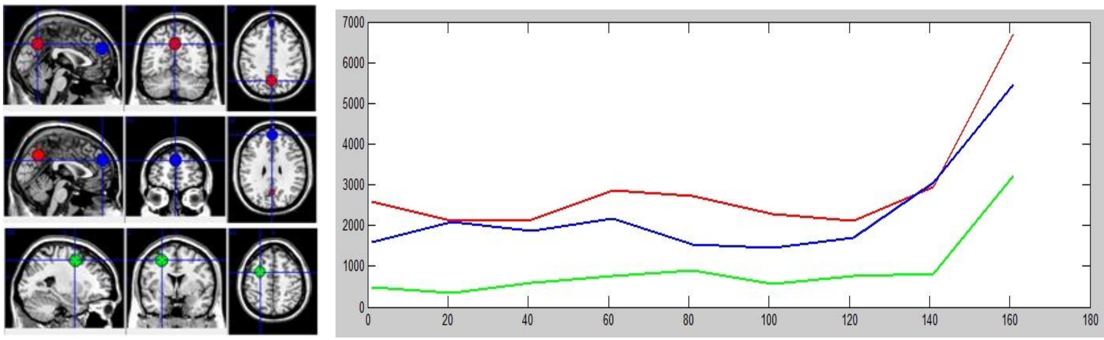




ROI: PCC/PCUN (red), DMPFC(blue)&FEF(green)

Absolute Binary:





ROI: PCC/PCUN (red), DMPFC(blue)&FEF(green)

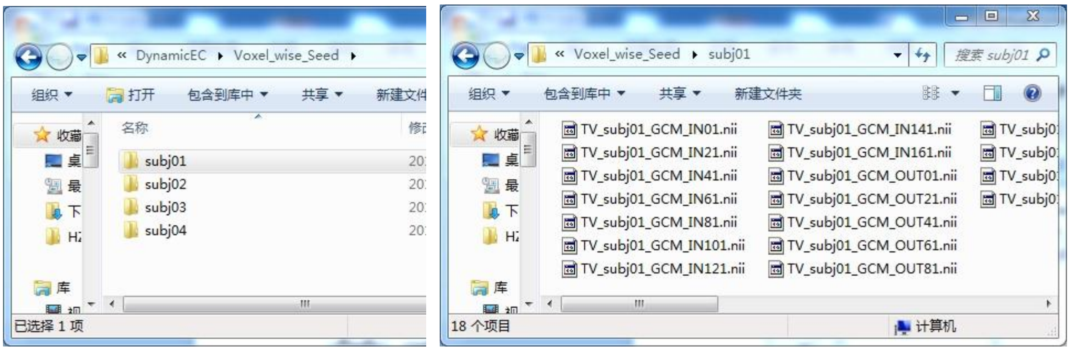
4.2 Dynamic EC

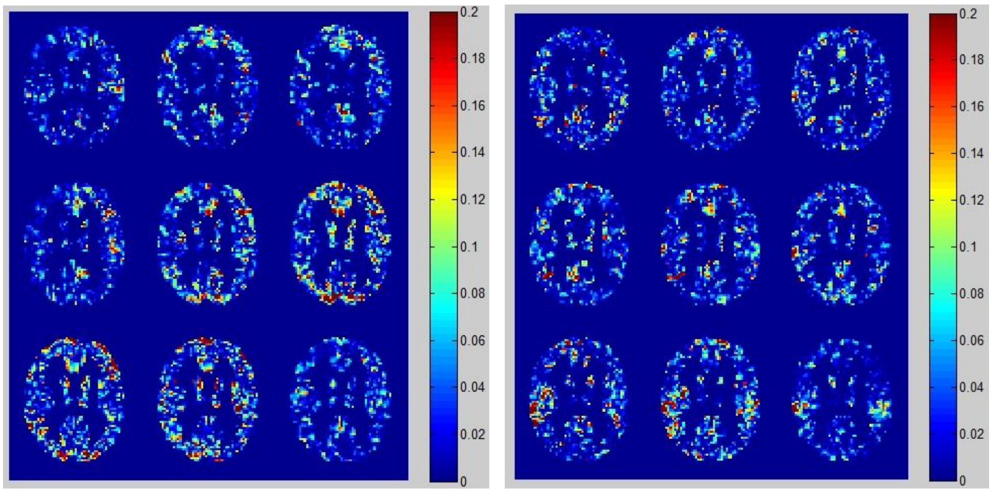
4.2.1 Dynamic EC: Voxel wise: Seed(MNI)

Setting: MNI center: 0 -63 39, radius 10 mm, TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Mask: gray mask, Prefix: TV

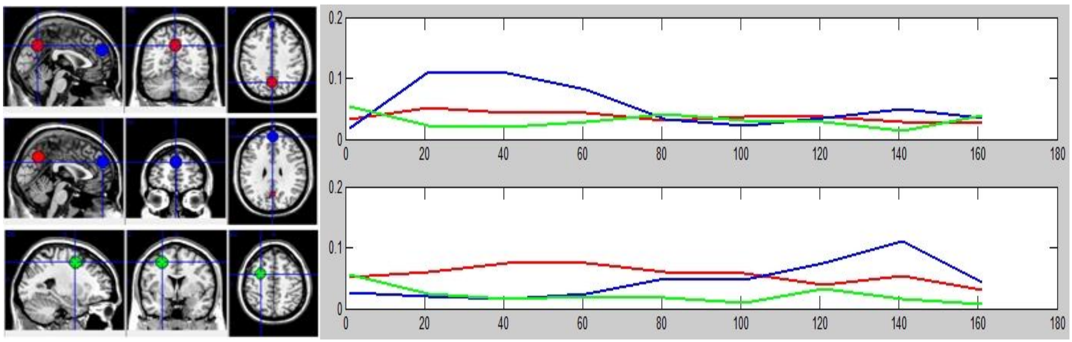
The result folder contains n items, n subfolders. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis, and the result fold contains 4 subfolders.

Each subject contains (N-Winlen)/(Winlen*(1-Overlap)) INmaps and (N-Winlen)/(Winlen*(1-Overlap)) OUTmaps. In our demonstration, the signal length is 240. Then in our result subfolder, it containes 9 INmap and 9 OUTmap.
The rule of the output filename: ***<Prefix>_<subject name>_ GCM_IN??.nii*** and ***<Prefix>_<subject name>_ GCM_OUT??.nii***
Therefore, the output filename of our demonstration is like this:
TV_subj0#_GCM_IN01.nii ~ TV_subj0#_GCM_IN161.nii
TV_subj0#_GCM_OUT01.nii ~ TV_subj0#_GCM_OUT161.nii.





IN OUT



ROI: Seed (red), DMPFC(blue)&FEF(green)

4.2.2 Dynamic EC: Voxel wise: ROI-mask

Setting: ROI: Precuneus_L, TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Mask: gray mask, Prefix: TV

The result folder contains n items, n subfolders. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis, and the result folder contains 4 subfolders.

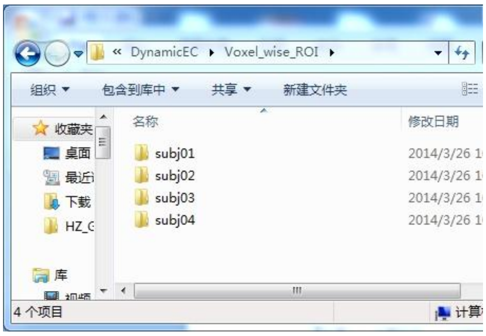
Each subject contains (N-Winlen)/(Winlen*(1-Overlap)) INmaps and (N-Winlen)/(Winlen*(1-Overlap)) OUTmaps. In our demonstration, the signal length is 240. Then in our result subfolder, it containes 9 INmap and 9 OUTmap.

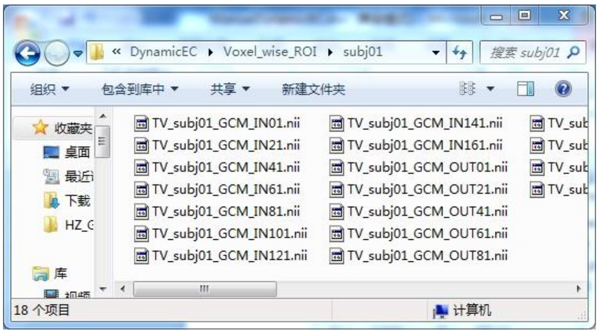
The rule of the output filename: ***<Prefix>_<subject name>_ GCM_IN??.nii*** and ***<Prefix>_<subject name>_ GCM_OUT??.nii***

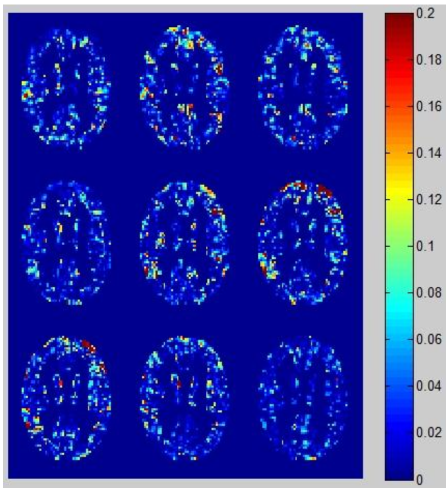
Therefore, the output filename of our demonstration is like this:

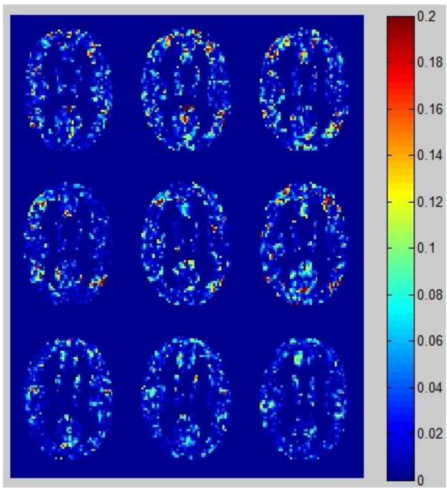
TV_subj0#_GCM_IN01.nii ~ TV_subj0#_GCM_IN161.nii

TV_subj0#_GCM_OUT01.nii ~ TV_subj0#_GCM_OUT161.nii.

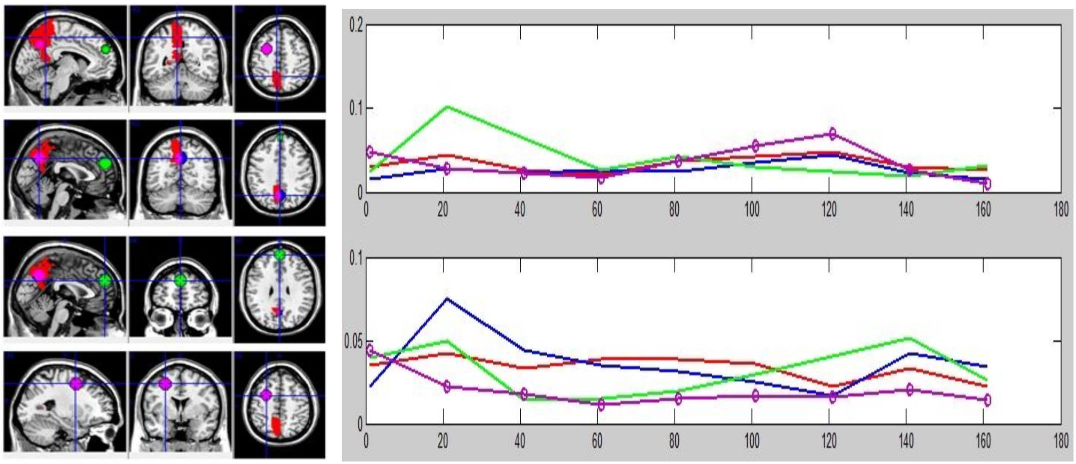








IN OUT



4.2.3 Dynamic EC: ROI wise: Nifti Label

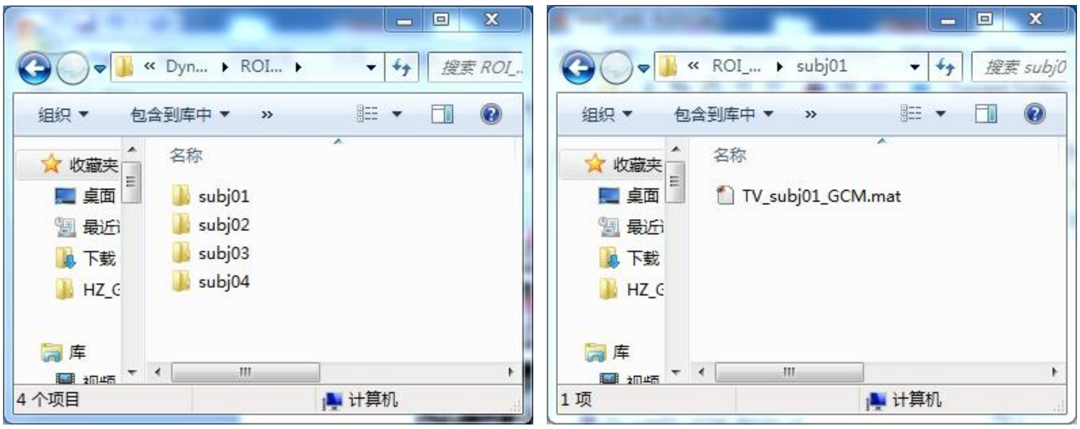
Setting: template: random select 10 AAL regions, TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Mask: gray mask, Prefix: TV

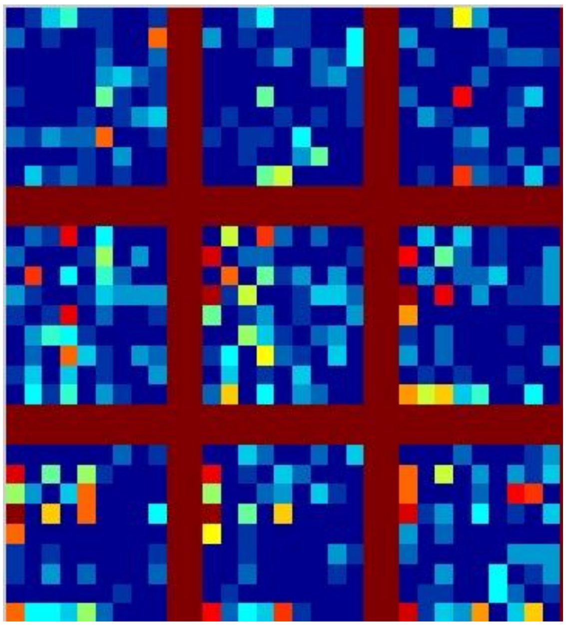
Result Folder:

The result folder contains n items, n subfolders. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis, and the result fold contains 4 subfolders.

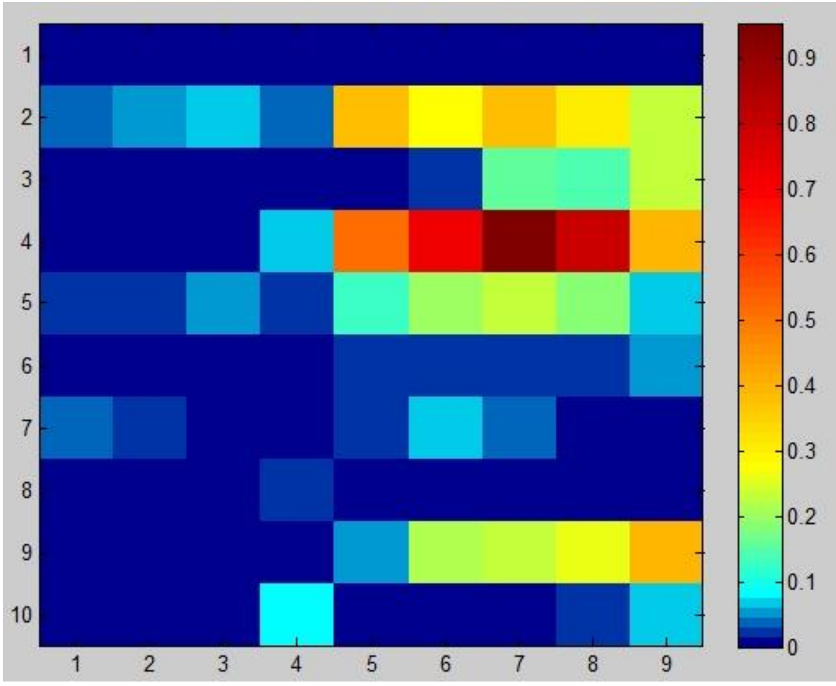
Each subfolder contains a MAT file, which kept the dynamic FC matrix in a struct.

Output name : ***<Prefix>_<subject name>_GCM.mat***

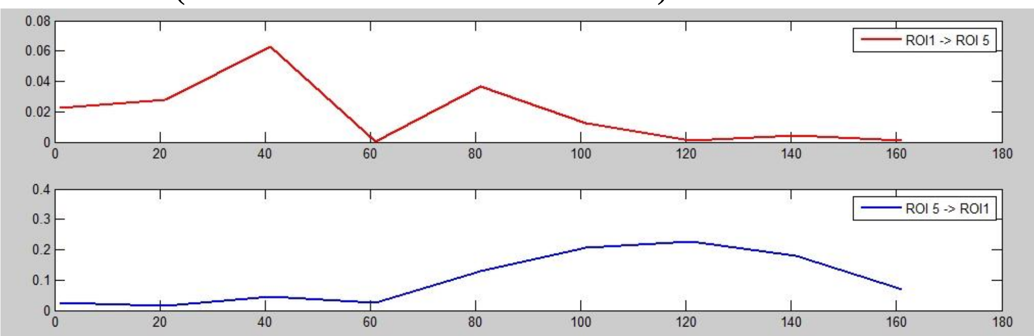




ROI 1 -> ROI 1-10



ROI 1 vs ROI 5 (ROI 1 -> ROI 5 && ROI 5 -> ROI 1)



4.2.4 Dynamic EC: ROI wise: TXT

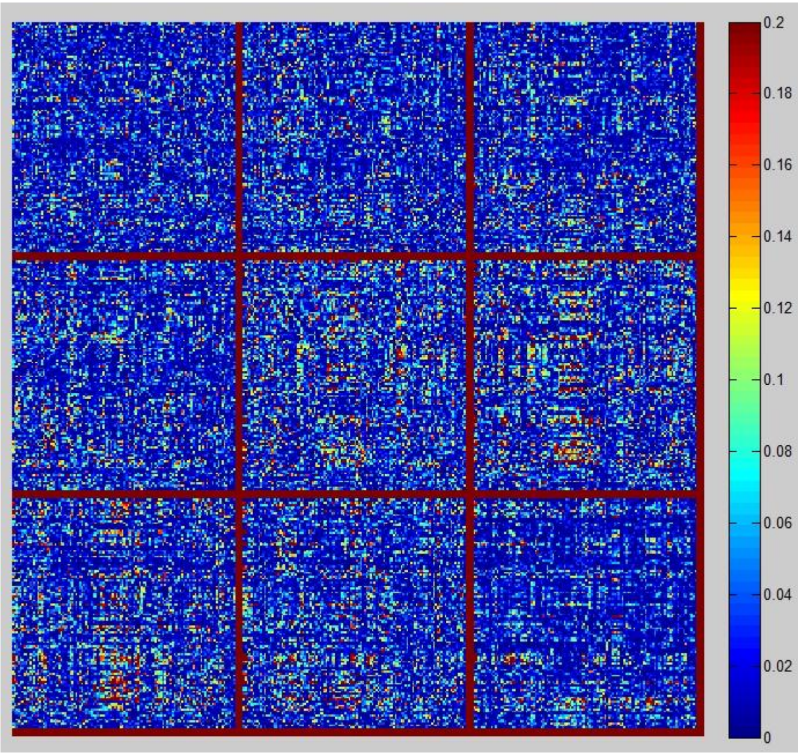
Settting: 116(ROIs) * 240(timepoints), TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Prefix: TV

Result Folder:

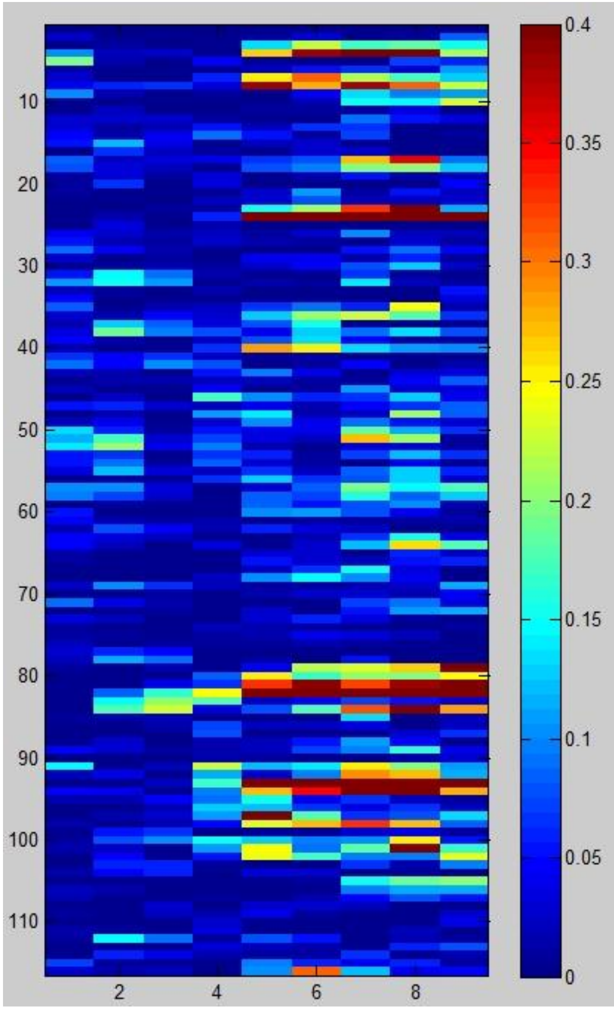
The result folder contains n+1 items, n subfolders and one Excel file. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis, and the result fold contains 4 subfolders and 1 Excel file.

Each subfolder contains a MAT file, which kept the dynamic FC matrix in a struct.

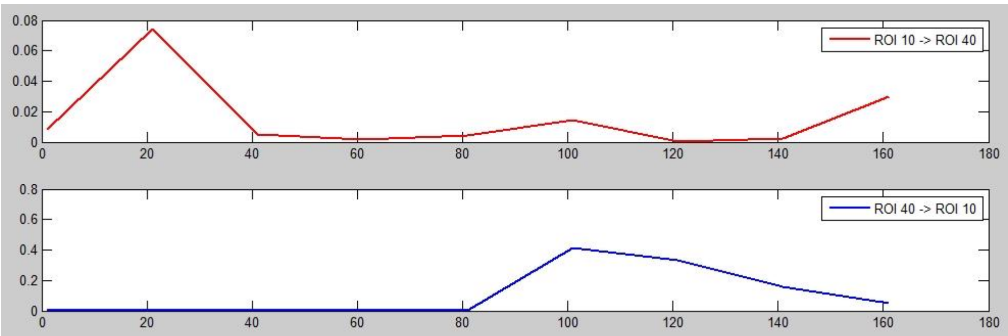
Output name : ***<Prefix>_<subject name>_GCM.mat***



ROI 1 -> ROI 1-116



ROI 10 vs ROI 40 (ROI 10 -> ROI 40 && ROI 40 -> ROI 10)



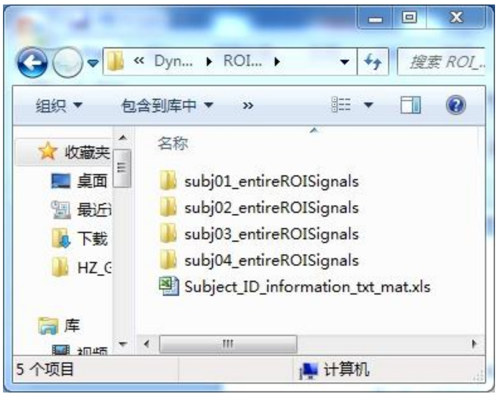
4.2.5 Dynamic EC: ROI wise: MAT

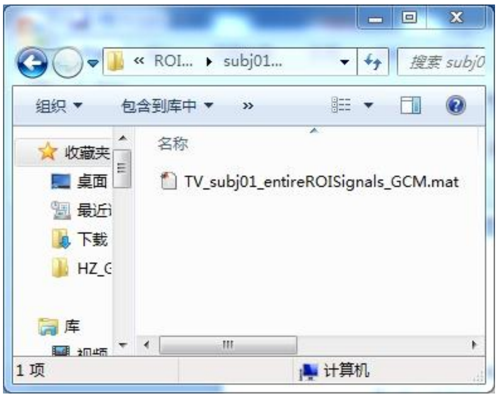
Setting: 116(ROIs) * 240(timepoints), TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Prefix: TV

Result Folder:

The result folder contains n+1 items, n subfolders and one Excel file. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis,

and the result fold contains 4 subfolders and 1 Excel file.
Each subfolder contains a MAT file, which kept the dynamic FC matrix in a struct.
Output name : ***<Prefix>_<subject name>_FCM.mat***



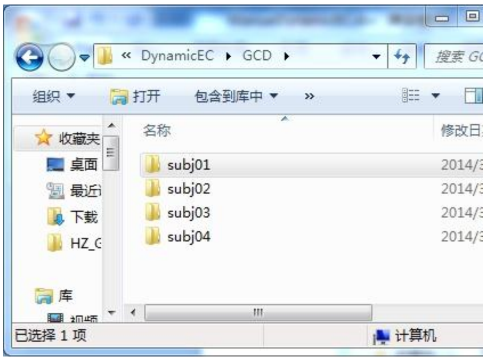


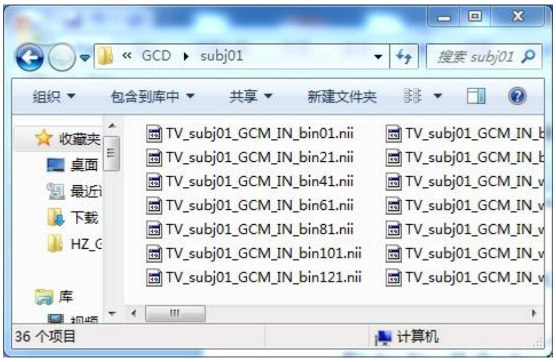
The result matrices are the same as 4.2.4

4.2.6 Dynamic EC: GCD

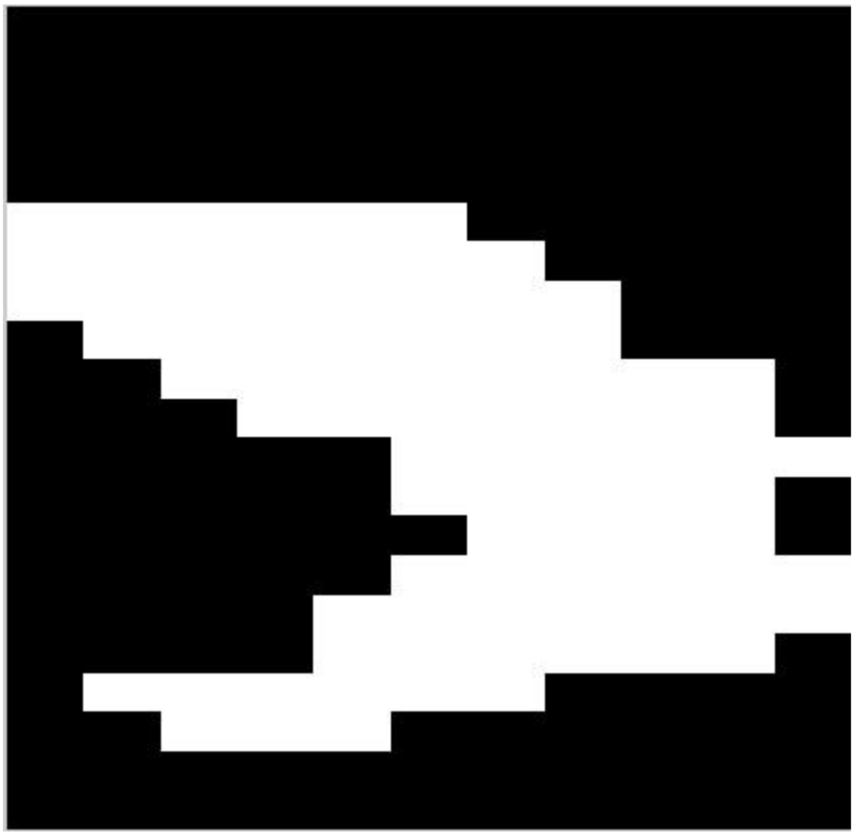
Setting: Mask: Cingulum_Ant_L from AAL template, TV mode: sliding-window, Window Size: 50, Overlap: 0.6, Prefix: TV, pvalue: $p<0.05$ FWE corrected
The result folder contains n items, n subfolders. Each subfolder represent a subject. In our test demonstration, there are 4 subjects used in the analysis, and the result folder contains 4 subfolders.
Each subject contains (N-Winlen)/(Winlen*(1-Overlap))*2 INmaps (binary& weight) and (N-Winlen)/(Winlen*(1-Overlap))*2 OUTmaps (binary& weight). In our demonstration, the signal length is 240. Then in our result subfolder, it containes 18 INmap and 18 OUTmap.
The rule of the output filename:
<Prefix>_<subject name>_ GCM_IN_bin??.nii
<Prefix>_<subject name>_ GCM_OUT_bin??.nii
<Prefix>_<subject name>_ GCM_IN_wei??.nii
<Prefix>_<subject name>_ GCM_OUT_wei??.nii

Therefore, the output filename of our demonstration is like this:
TV_subj0#_GCM_IN_bin01.nii ~ TV_subj0#_GCM_IN_bin161.nii
TV_subj0#_GCM_IN_wei01.nii ~ TV_subj0#_GCM_IN_wei 161.nii
TV_subj0#_GCM_OUT_bin01.nii ~ TV_subj0#_GCM_OUT_bin161.nii.
TV_subj0#_GCM_OUT_wei01.nii ~ TV_subj0#_GCM_OUT_wei161.nii.

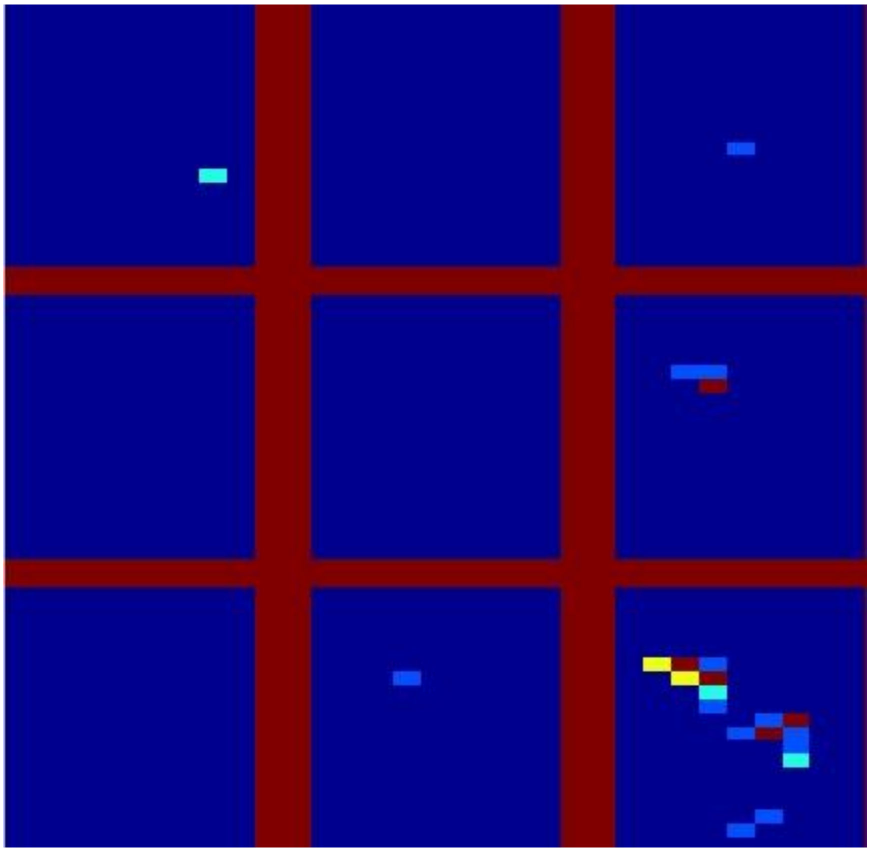




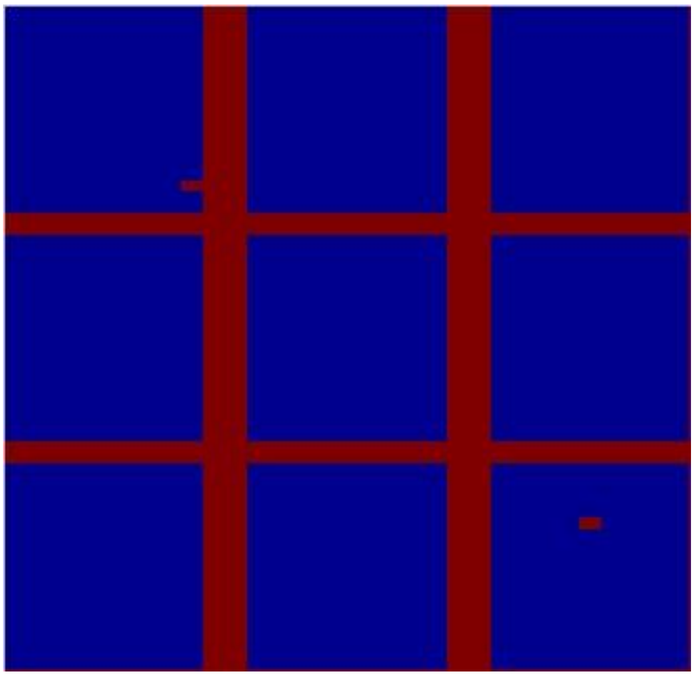
Mask:



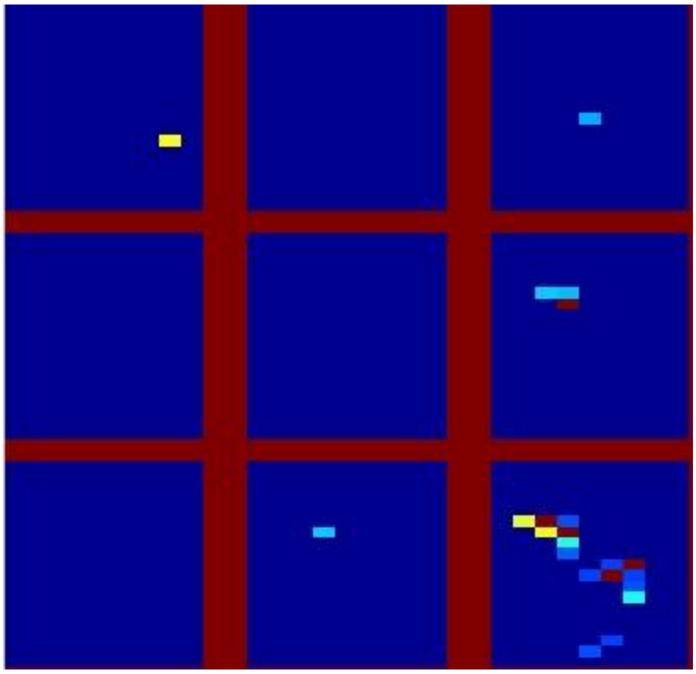
IN Binary:



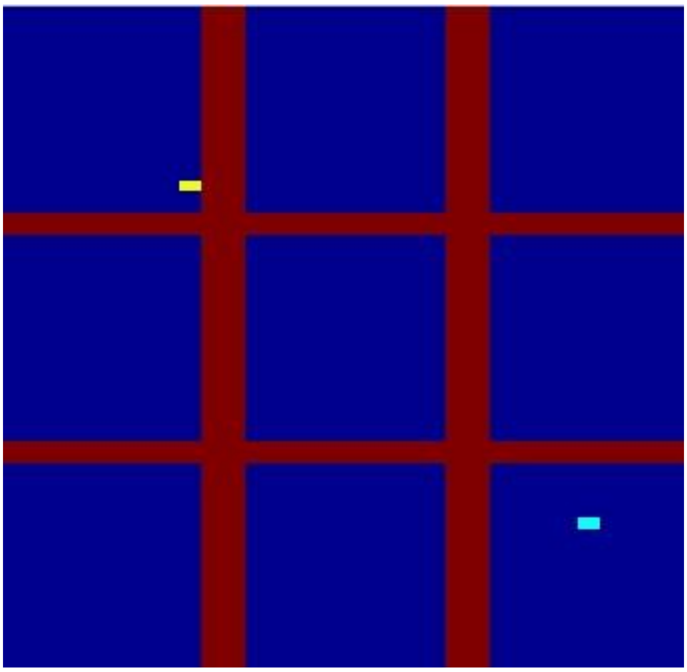
OUT Binary:



IN weight:



OUT weight:

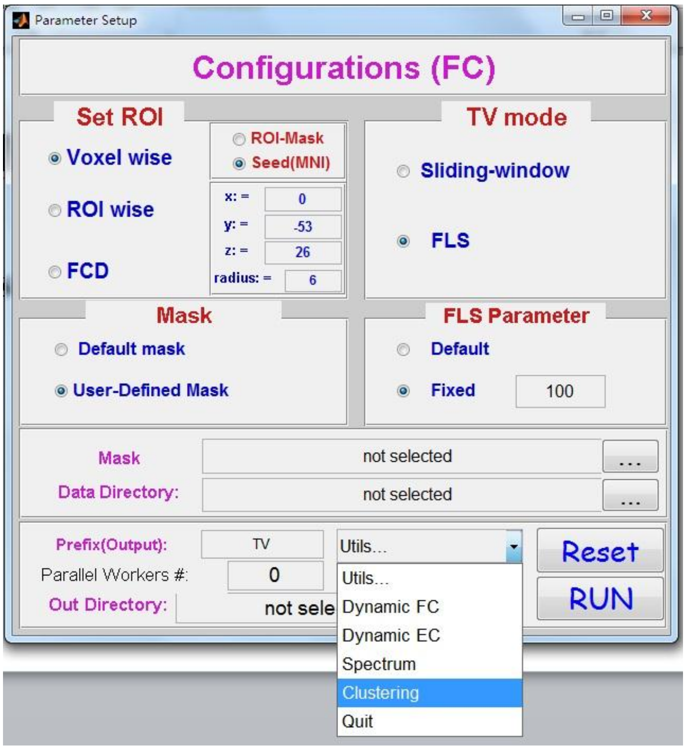


5 Utils...

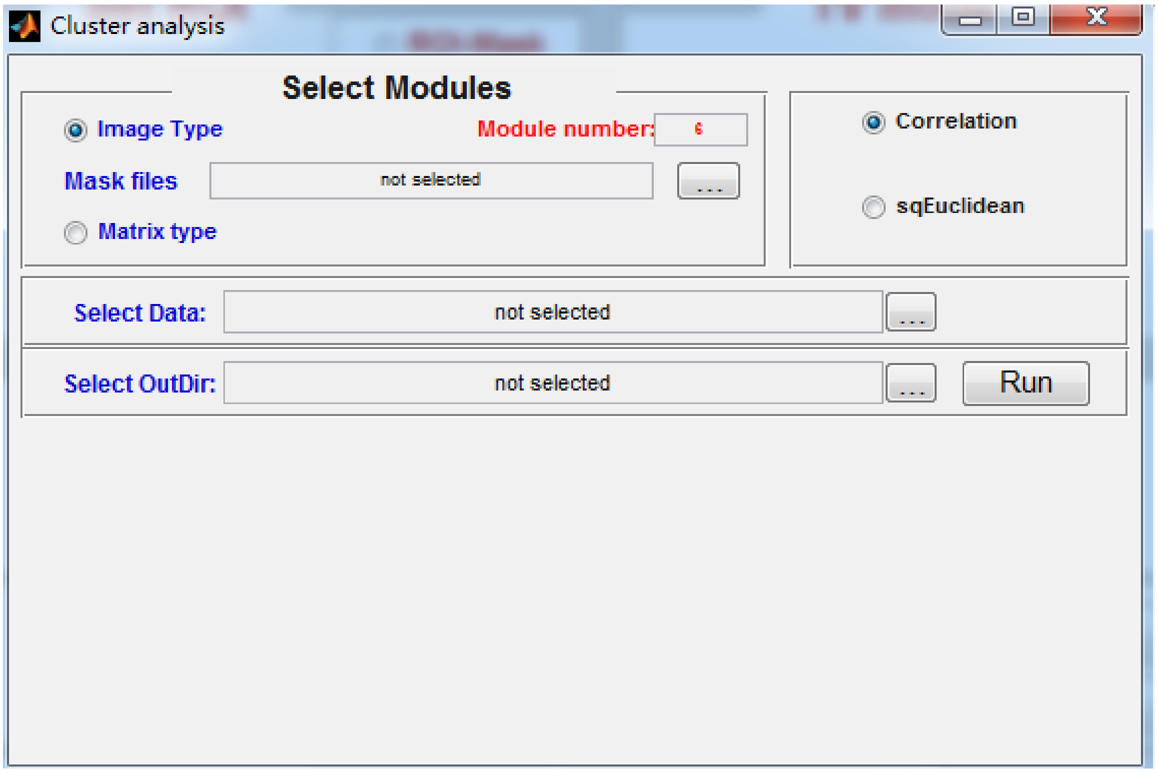
When you are in the FC/EC module, the Parameter Setup window have a pull-down list ‘Utils’. Here we support two new functions for later analysis: Clustering and Spectrum.

5.1 Clustering

Click the button 'Clustering' in the pull-down list, then the cluster analysis window will appear.



The parameter Setup window.



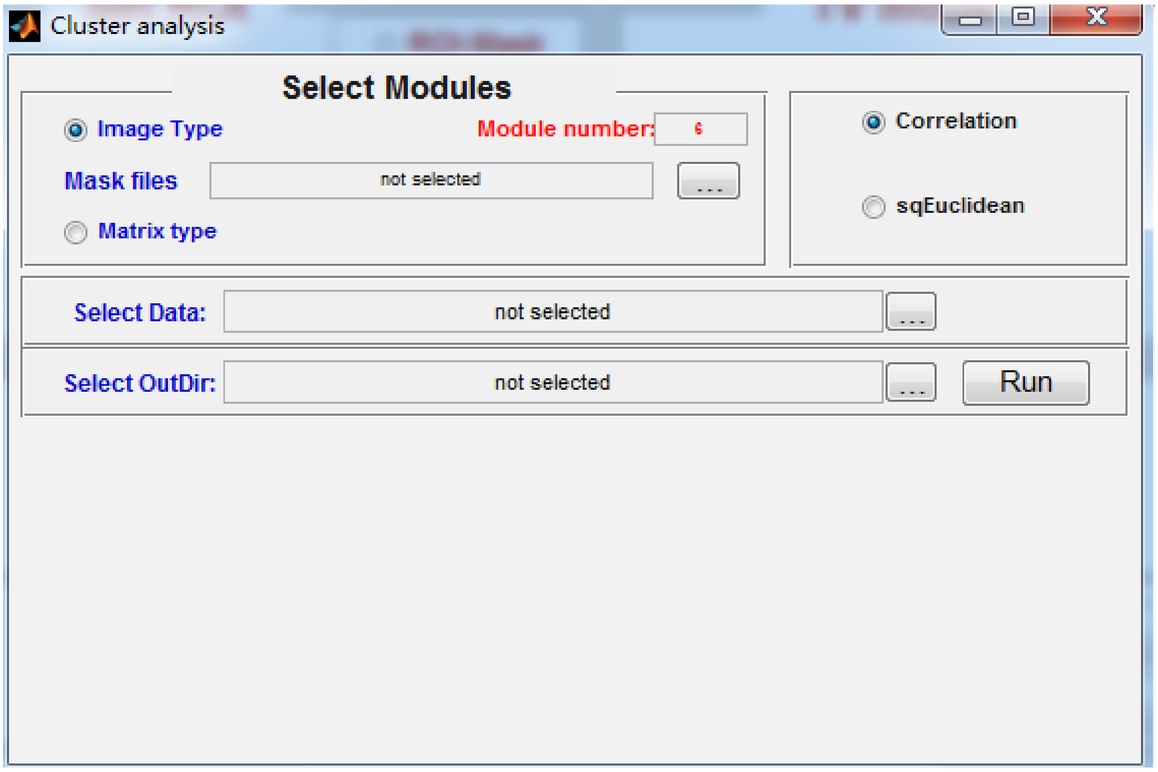
The Cluster analysis window

There two kinds of data types for the cluster analysis: ‘Image Type’ and ‘Matrix’. Also, there two kinds of methods for the k-means cluster analysis: ‘Correlation’ and ‘sqEuclidean’, which are supplied by Matlab toolbox.
Besides, you need to set the number of cluster.

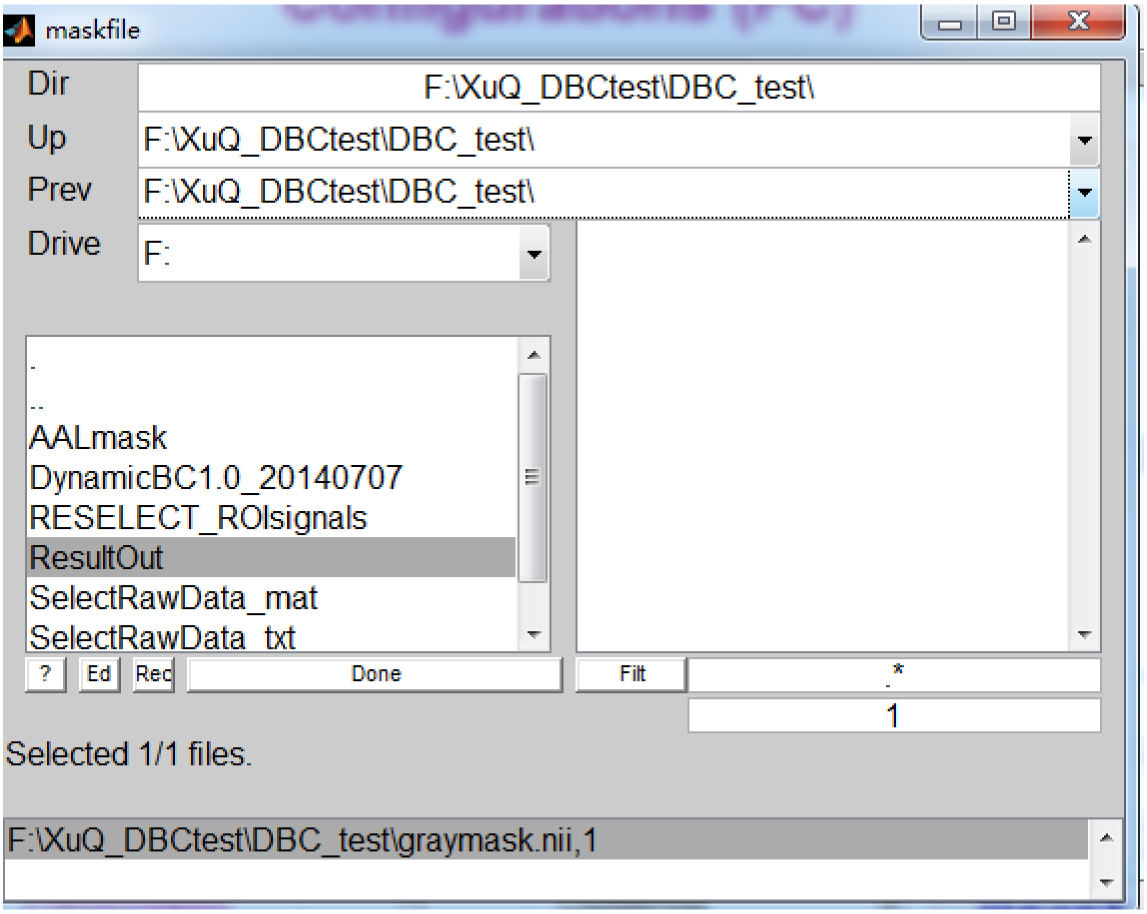
5.1.1 Image Type

Here we select the ‘Voxel wise: Seed(MNI)’ results for the cluster analysis, and we select the ‘Correlation’ method for cluster analysis. The cluster number is 6.
The final parameter:
Cluster number :6, method: ‘Correlation’, Input dir: ‘*.\DBC_FC_VW_Seed\FC_FLS_map\’, Output dir: ‘*.\ClusterAnalysis\MapCondition’

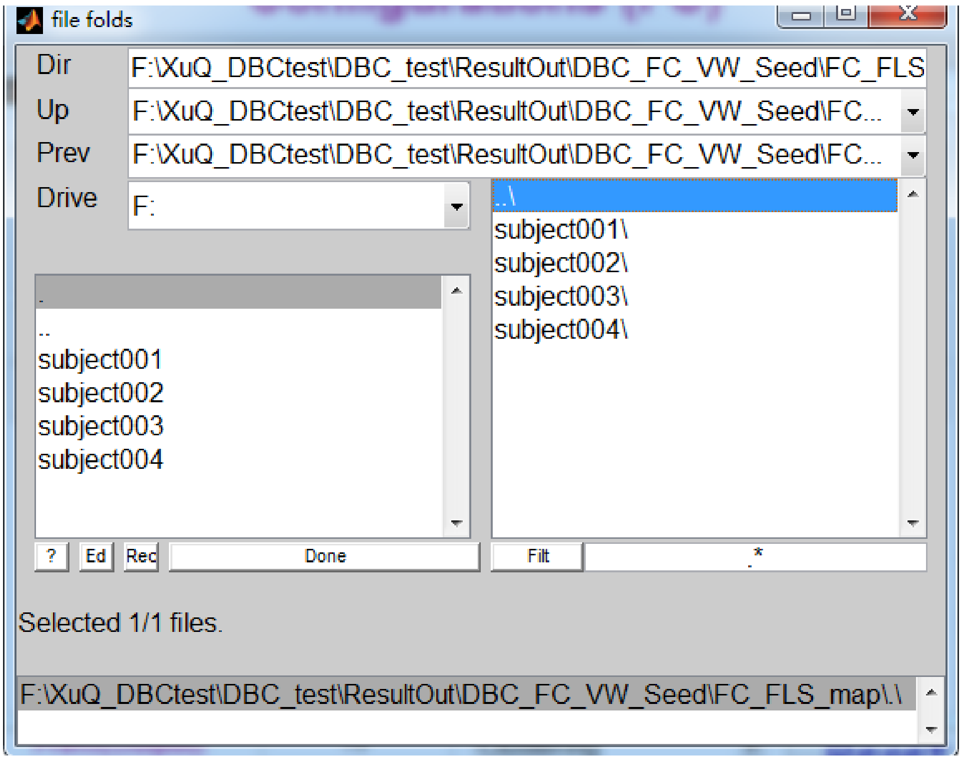
Here are some pictures for the selection:
1.
Select the ‘Image type’, input 6 into the ‘Module number’, and select ‘Correlation’



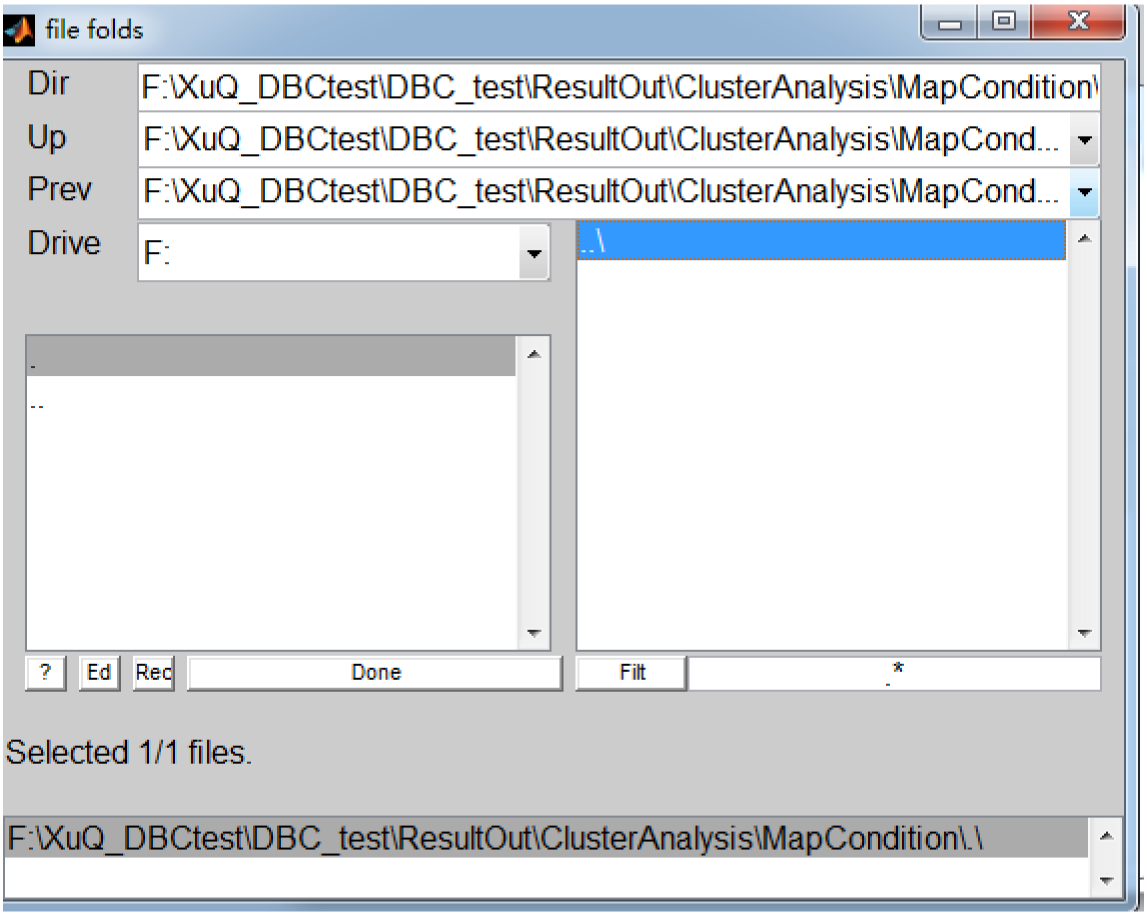
2.
Select the Mask files:



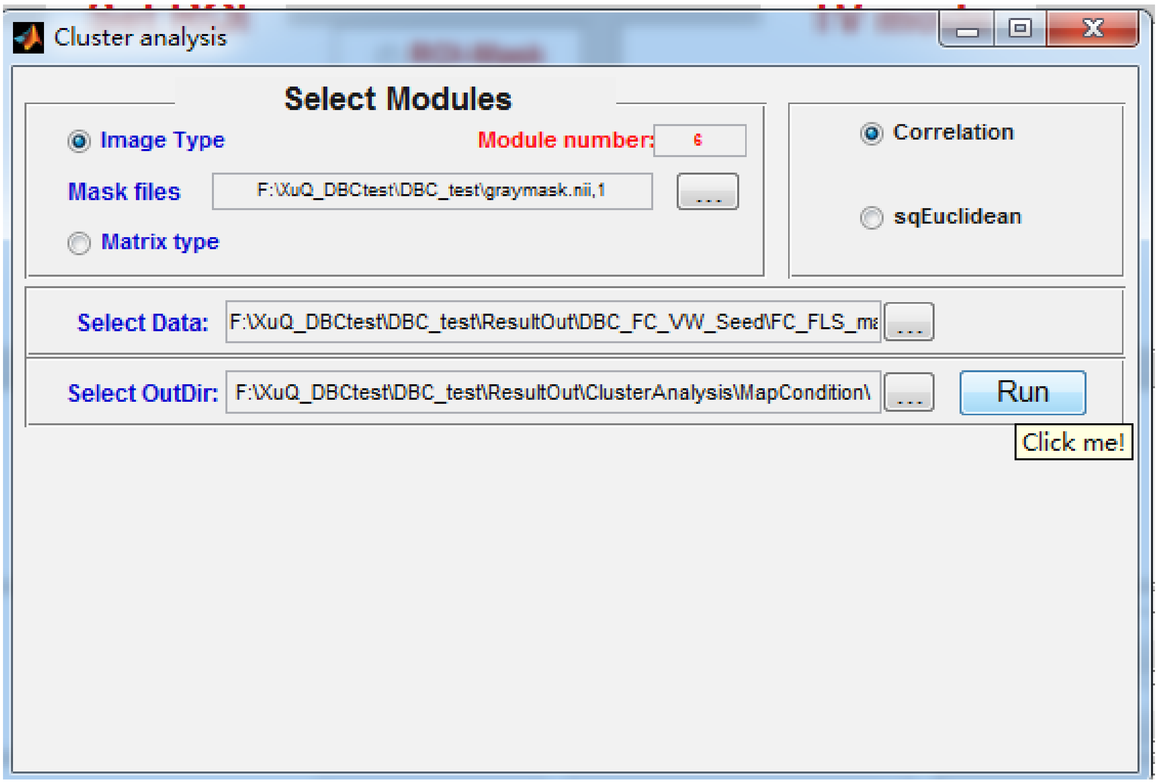
3. Select the input data, please select the fold which contains the subfolds of subjects' results



4. Select the output directory:

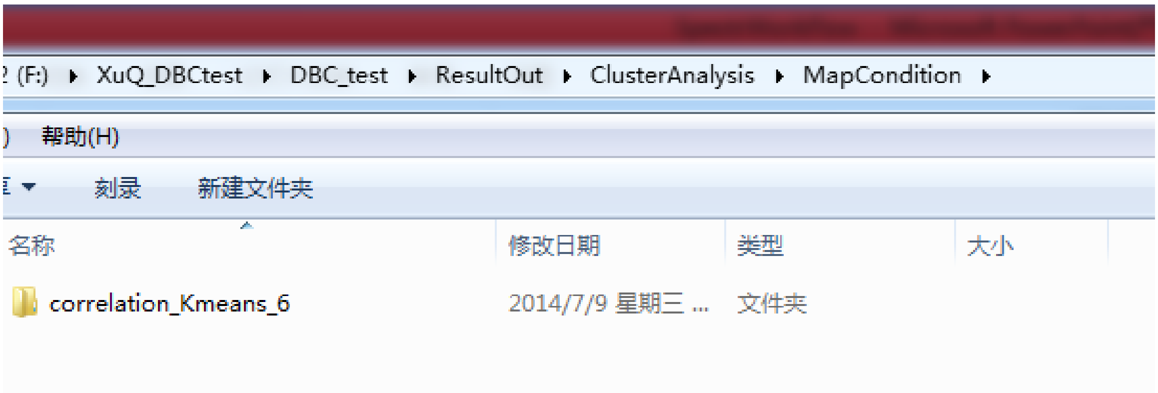


5. Final parameter window:

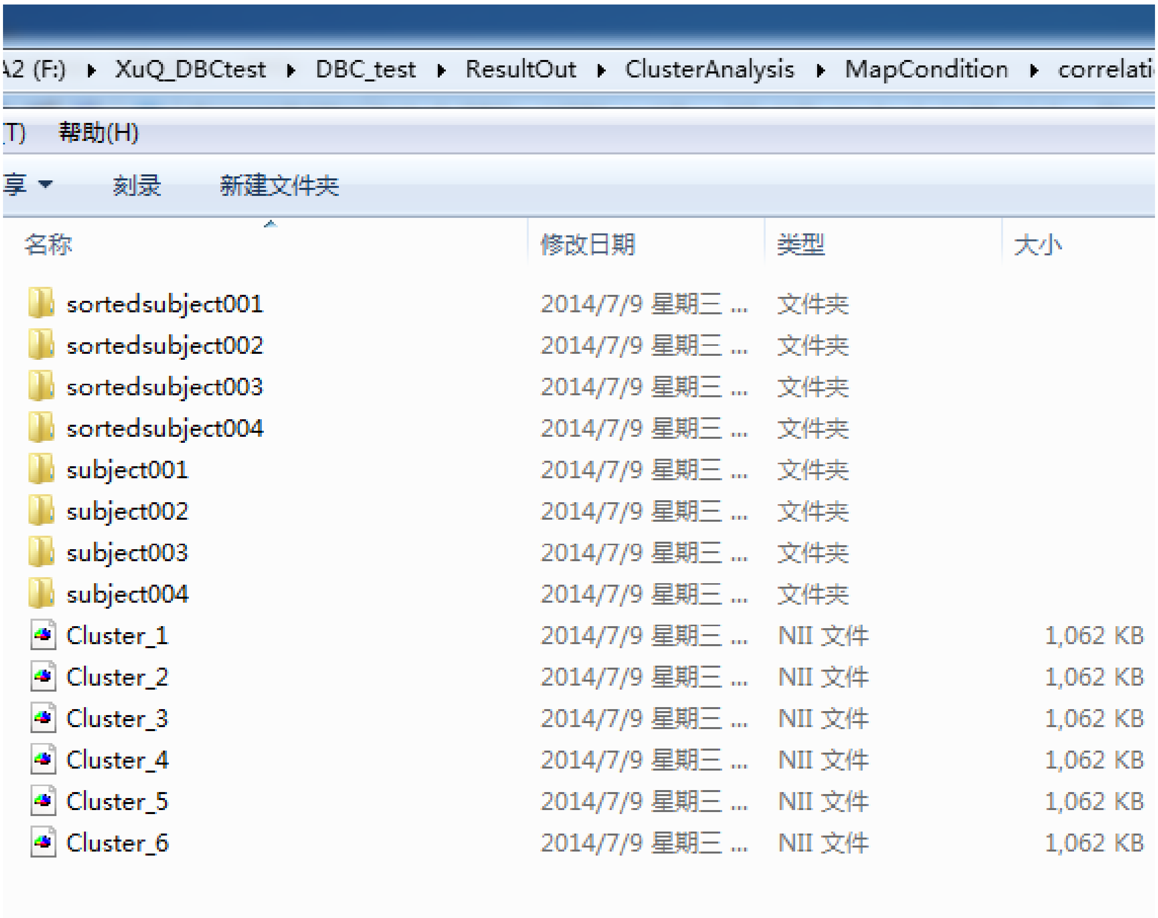


6. Click ‘***Run’***.

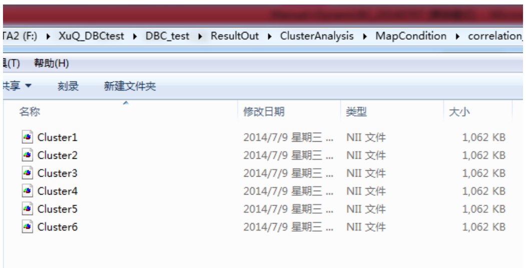
Results for the cluster analysis:

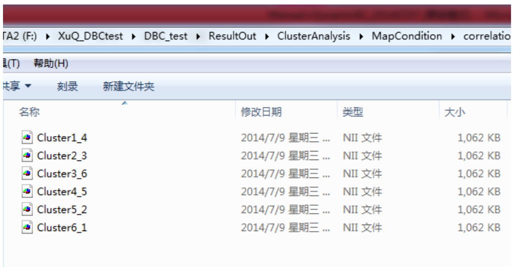


Result fold name type: ***[methods]_Kmeans_[cluster number]***. So here we got the result fold: ‘correlation_Kmeans_6’.

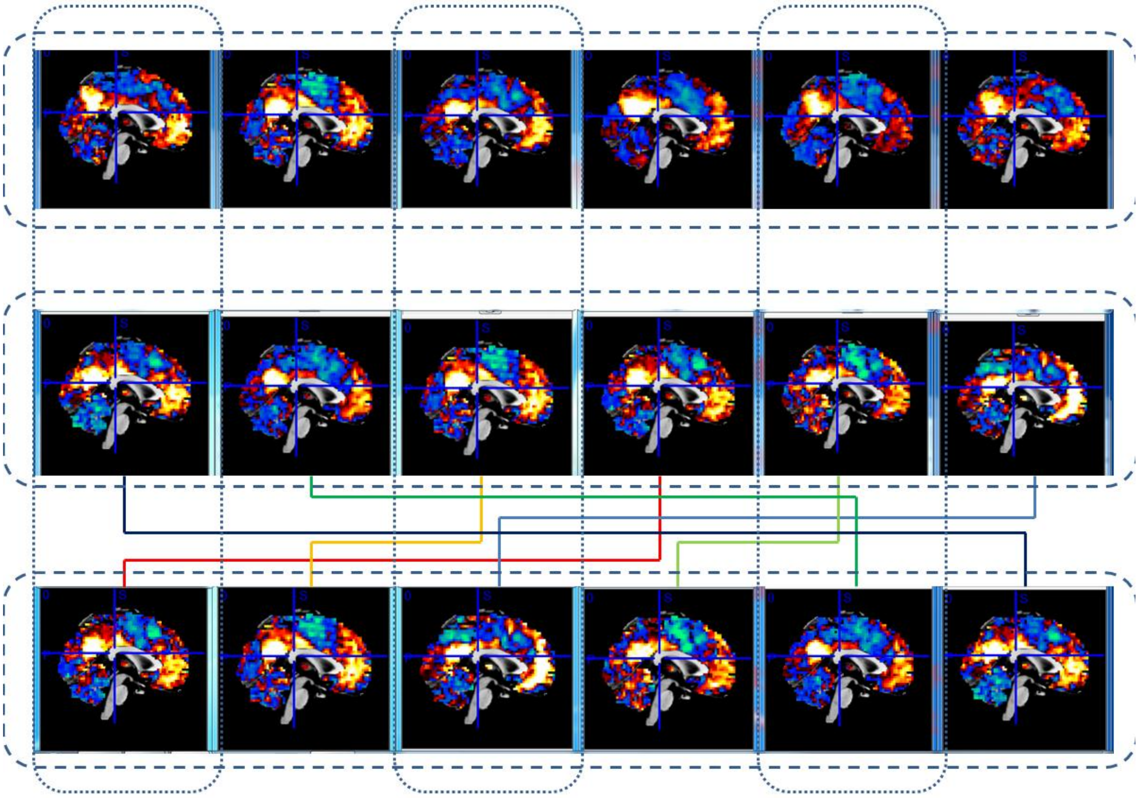


Into the ‘correlation_Kmeans_6’, there are three kinds of objects: 6 Nifti_1(‘***Cluster_*.nii***’) maps for group results, N*2 folds (N is the subject number) for the individual results. Each fold contains 6 Nifti_1 maps. The prefix ‘***sorted’*** means that fold is rebuilt for the match between Group results and individual results. Use subject001 as the example:





Original subject001 Sorted subject001



Use MRIcron to show the demo results. First row is the group results. Second row is the original subject001 results. Third row is the sorted subject001 results.

5.1.2 Matrix type

Similar to the ‘Image type’, you need to select the data fold which contain subfolds of subjects results, and you need to select the output fold. Also, select the method for cluster and the number of cluter.

There are some differences between ‘Image type’ and ‘Matrix type’. You need to point out the variable for the analysi which is saved in the Mat file. Usually, when you select the Dynamic FC, the name of variable is ‘***FCM.Matrix***’, otherwise, the name of variable is ‘***GCM.Matrix***’.

Here we select the Dynamic FC for the matrix cluster analysis.

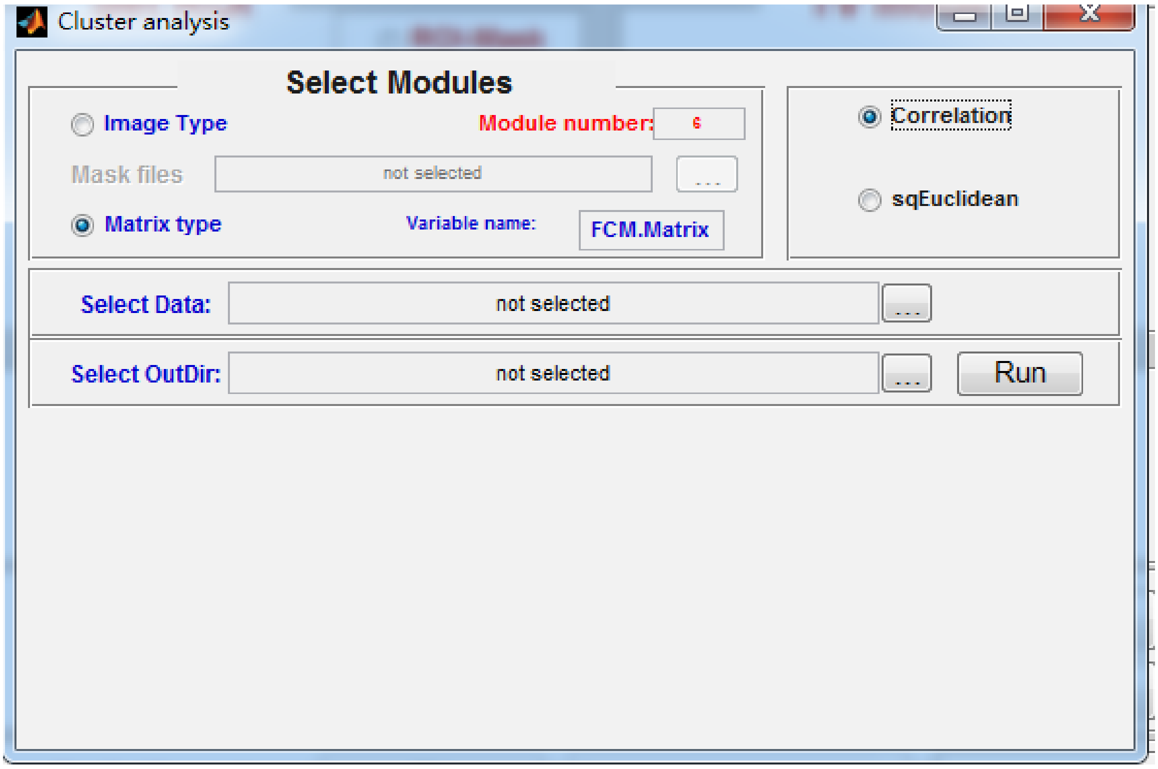
So this is the parameter:

Cluster number :5, method: ‘sqEuclidean’, Input dir: ‘*.\ DBC_FC_RW_TXT\FCM\’, Output dir: ‘*.\ClusterAnalysis\MatrixCondition’, Variable name: ‘FCM.Matrix’

Here are some pictures for the whole selections:

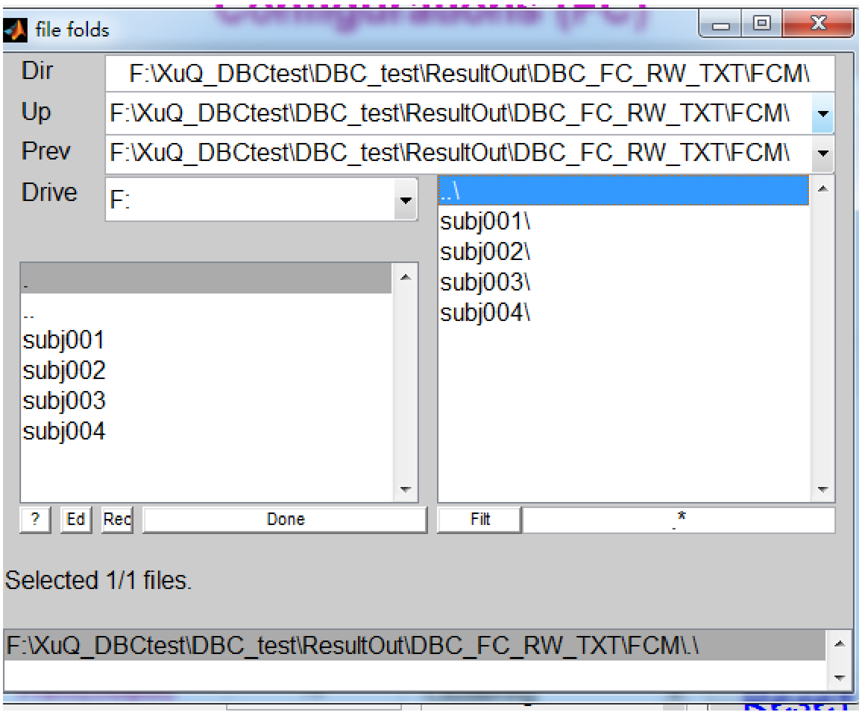
1.

Original ‘Matrix type’ parameter window.



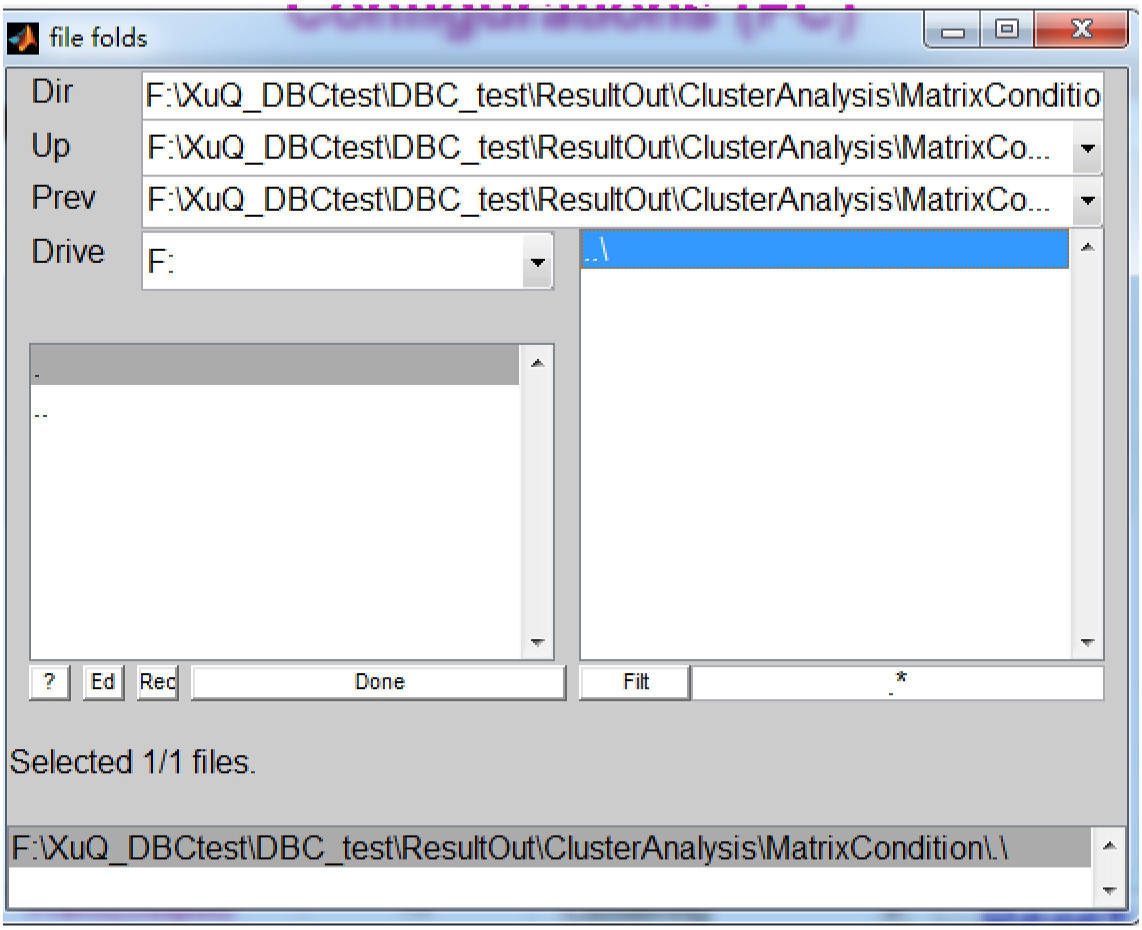
2.

Select the input data.

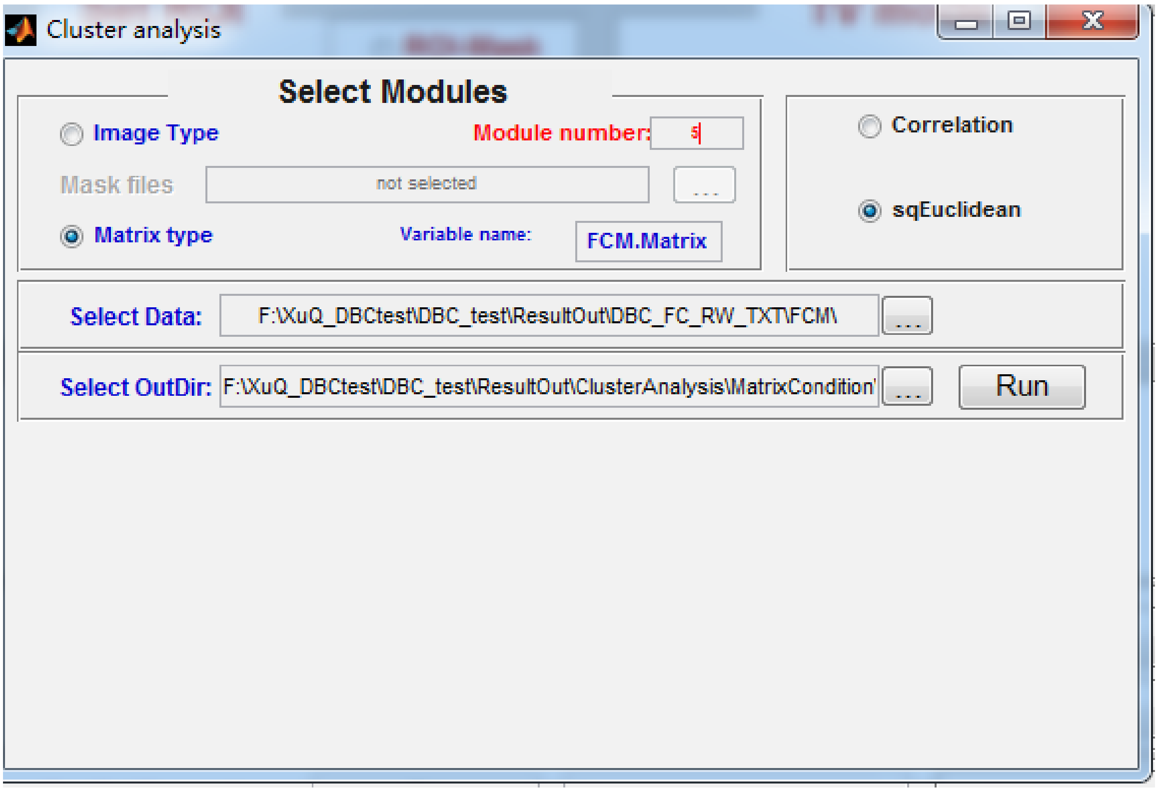


3.

Select the output directory:

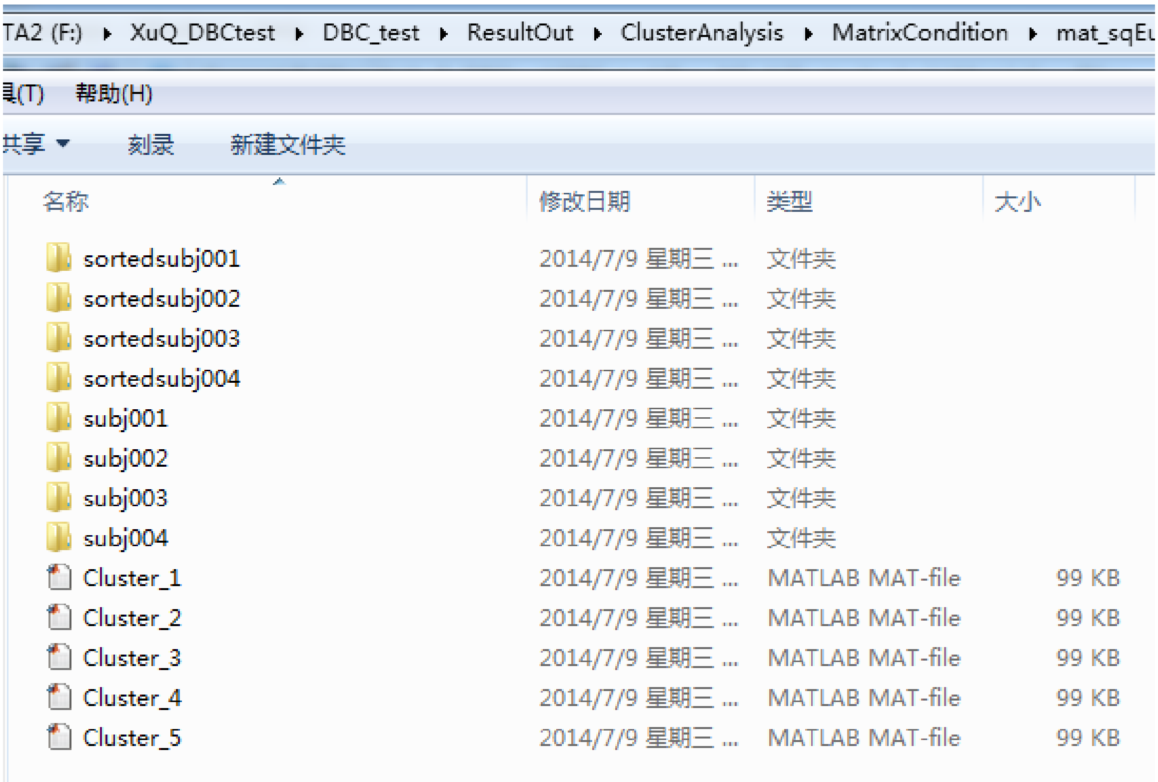


4.
Final parameter window:

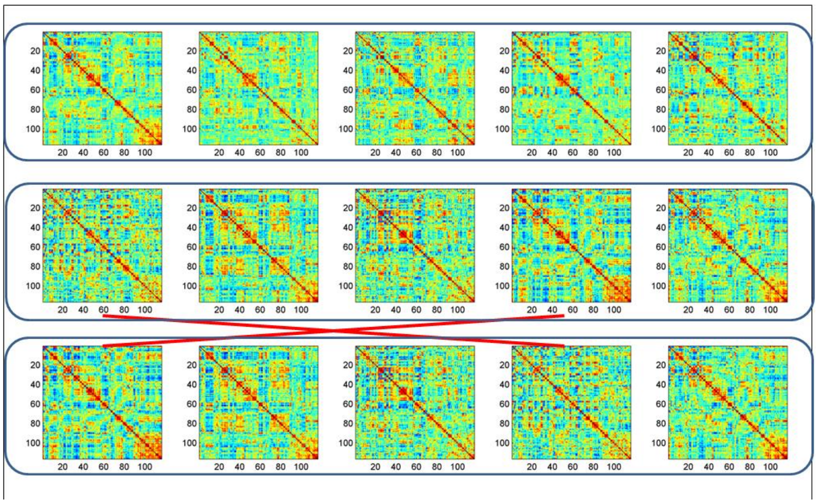


5.
Click ‘***Run***’

Results for the cluster analysis:
Similar to the ‘Image type’, some explains will abridged.



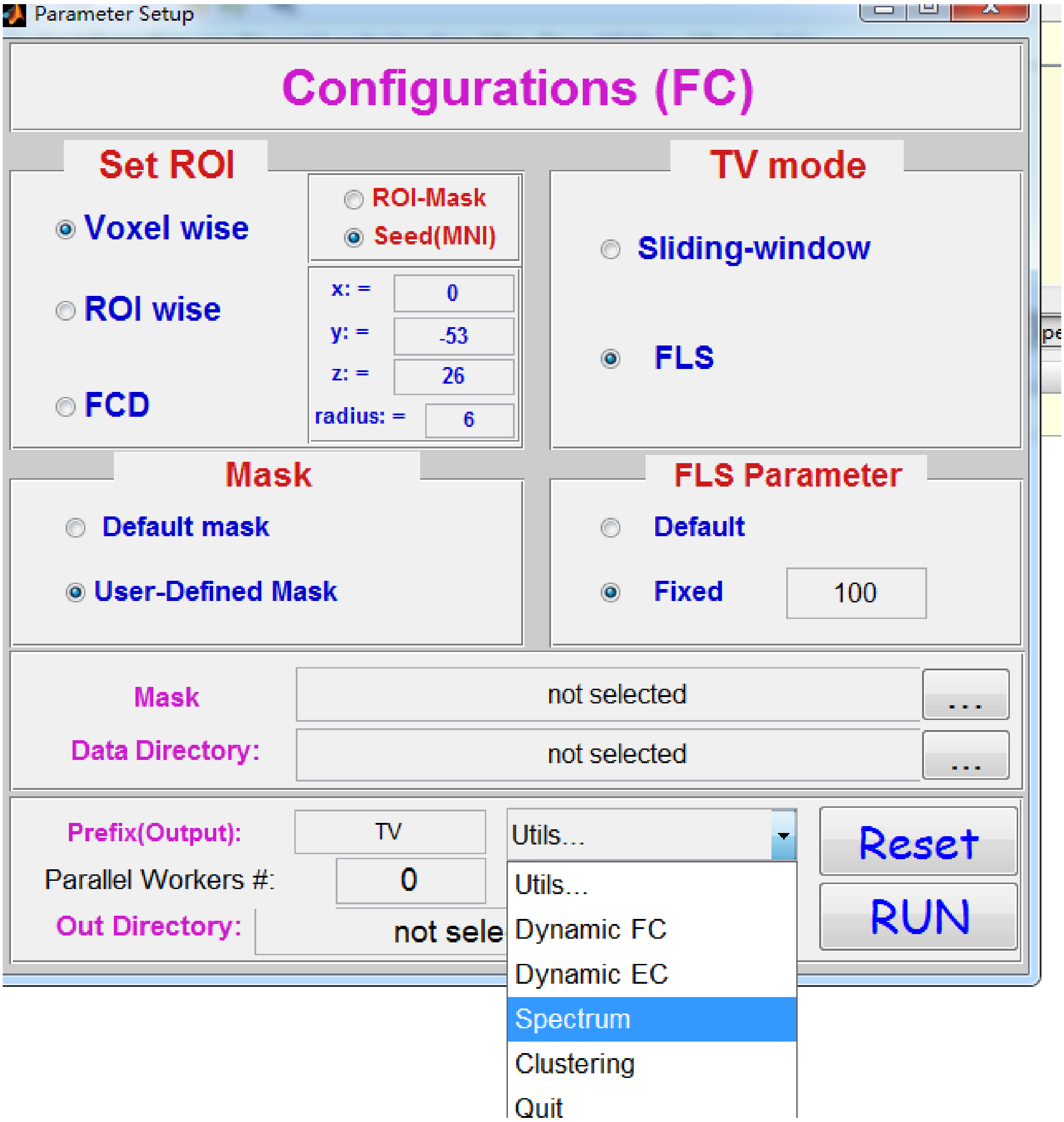
There are 5 mat files in the fold. Each mat contain the mean cluster matrix. The variable names saved in the mat are same one, ‘DAT’. When you analysis later, please note that not only use simple command: ‘load *.mat’, use ‘a = load(‘*.mat’)’ instead.

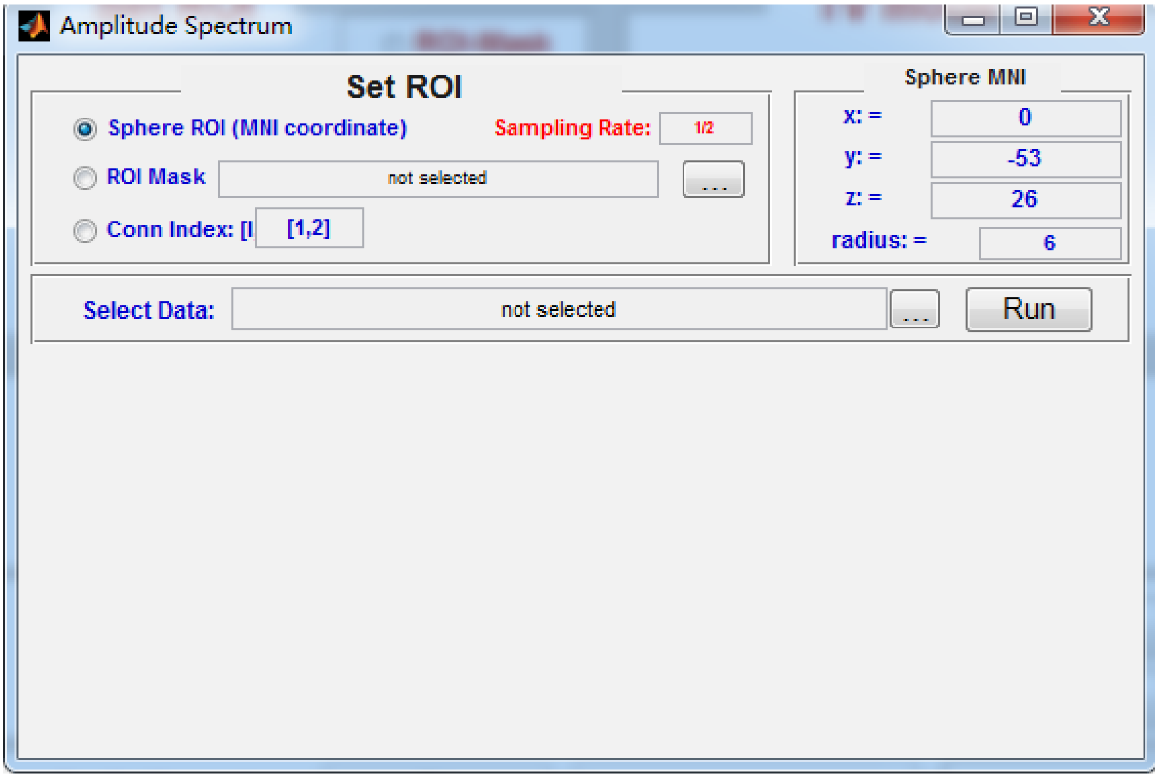


The first row is the group results. The second row is the original subj001 results. The third row is the sorted subj001 result. The red lines are the exchange demo.

5.2 Spectrum

Click ‘Utils’->’Spectrum’, the main window for spectrum show will appear.


Parameter Setup
Configurations (FC)
Set ROI
Voxel wise
ROI wise
FCD
ROI-Mask
Seed(MNI)
x: = 0
y: = -53
z: = 26
radius: = 6
TV mode
Sliding-window
FLS
Mask
Default mask
User-Defined Mask
FLS Parameter
Default
Fixed 100
Mask not selected ...
Data Directory: not selected ...
Prefix(Output): TV
Parallel Workers #: 0
Out Directory: not sele
Utils...
Utils...
Dynamic FC
Dynamic EC
Spectrum
Clustering
Quit
Reset
RUN



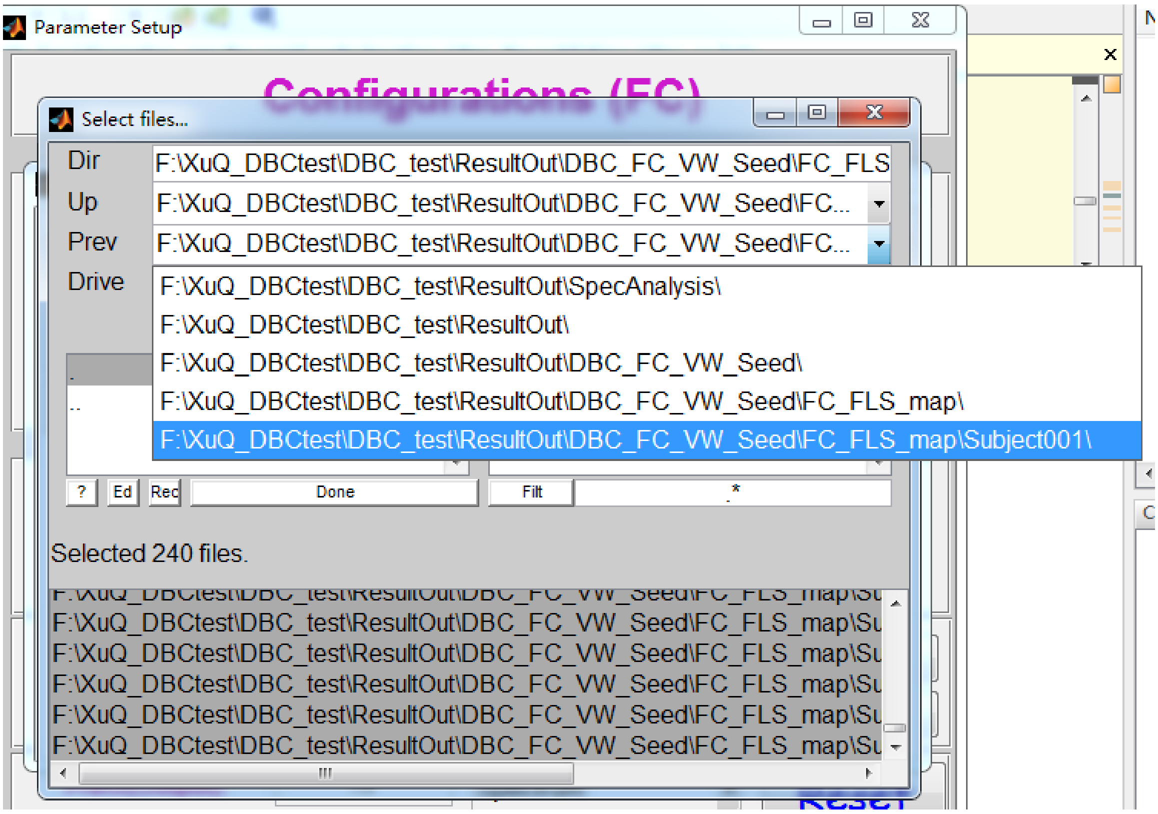
There are two kinds of Spectrum: 'Image type' and 'Matrix'. There are two kinds for the Image type: 'Sphere ROI' and 'ROI mask'.

5.2.1 Image type

5.2.1.1 Sphere ROI

1

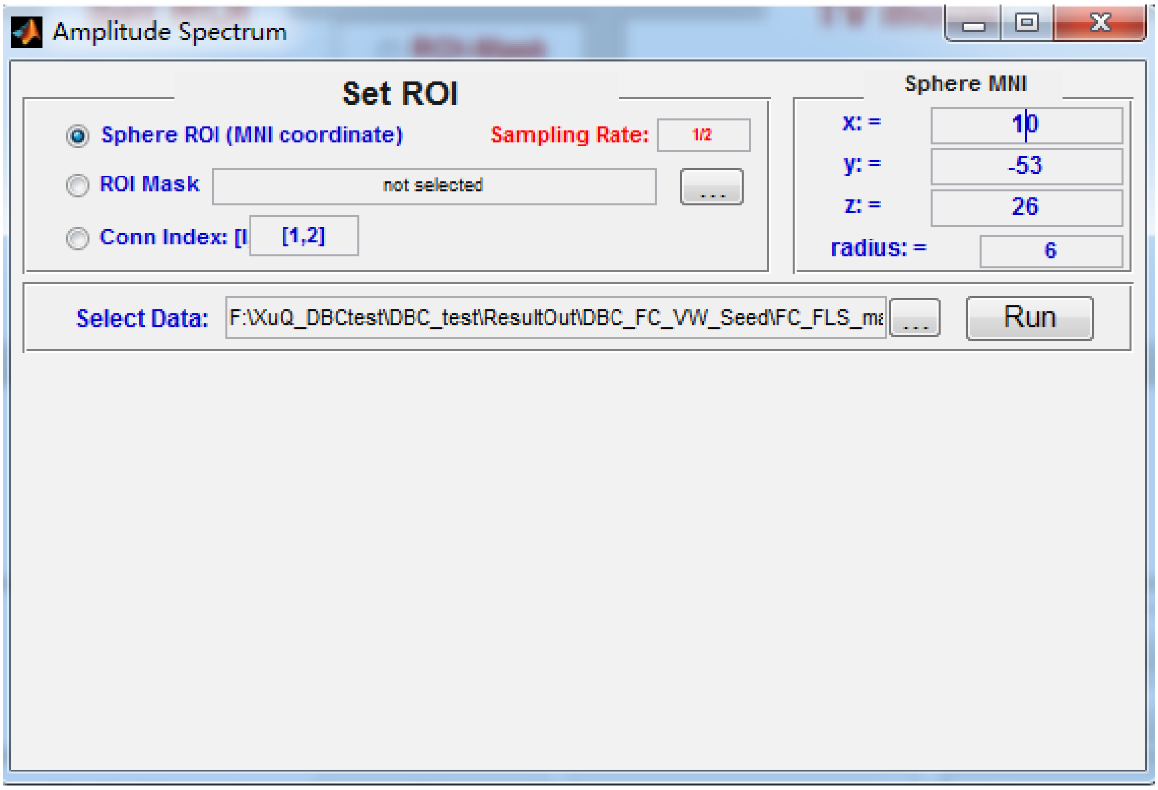
Select 'Sphere ROI'. Select the Input data.



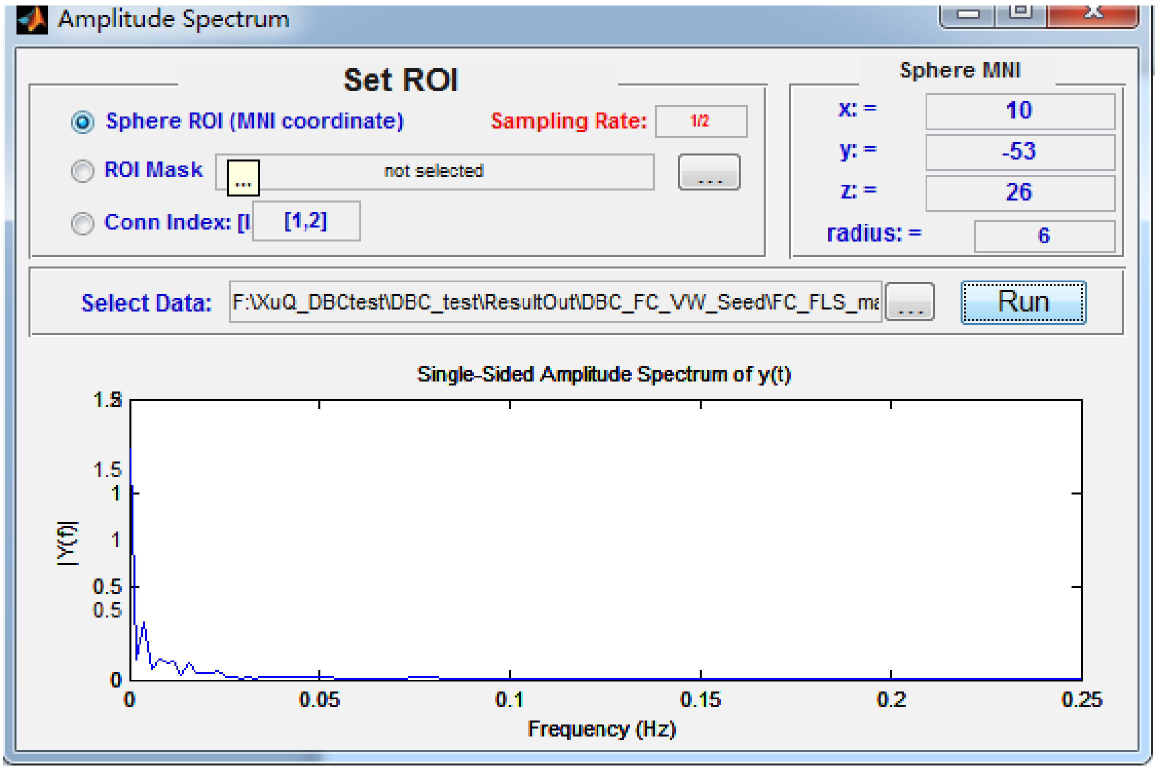
Select all results files.

2.

Set the Sphere MNI coordinate and radius and the Sampling Rate. Sampling Rate: for FLS, it is the same as 1/TR (in our demo, 1/ 2); and for sliding window, it is 1/Dur (Dur is the time length between two window). Here in the condition of 'Image type', we used the FLS method maps, the Sampling Rate is 1/2. In the next condition of 'Matrix type', we used the sliding window, which the duration was 20TR, and the Sampling Rate: 1/40.



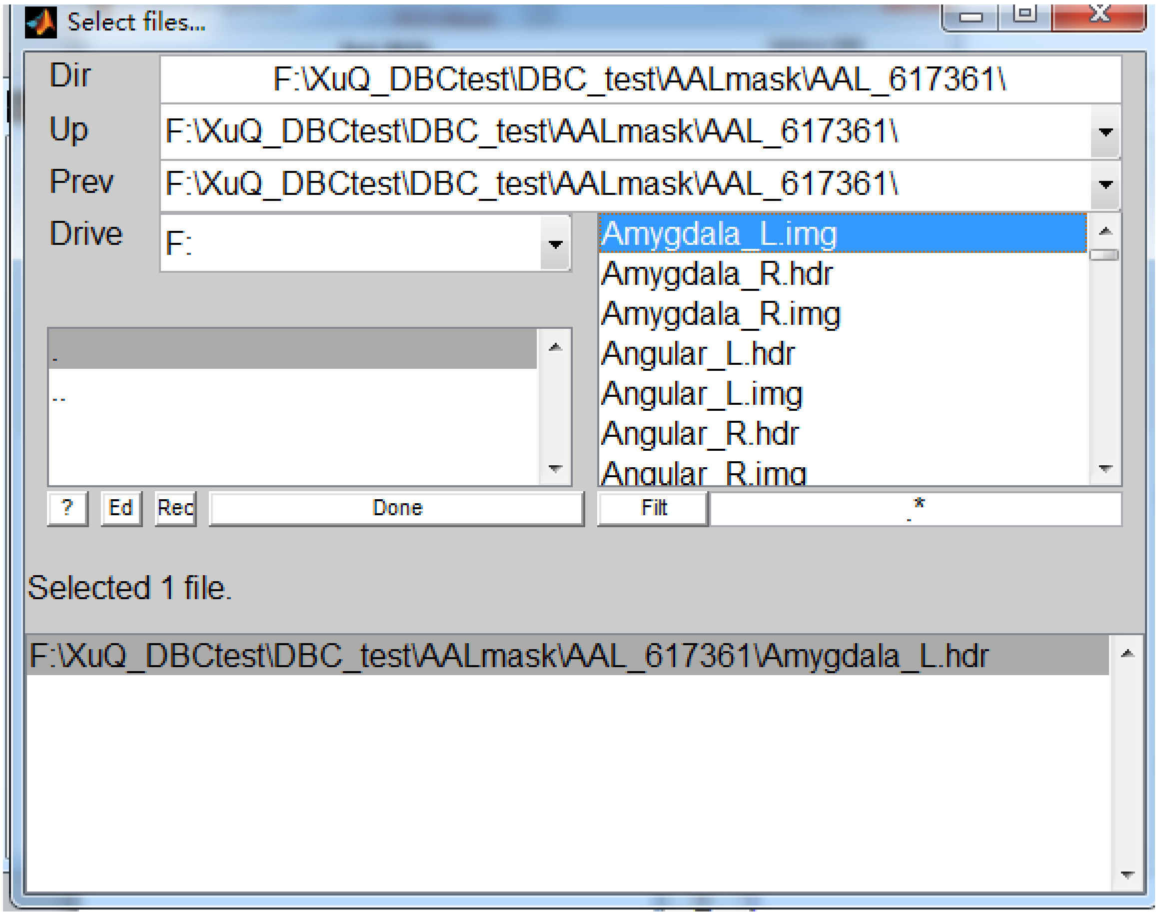
Click ‘***Run***’



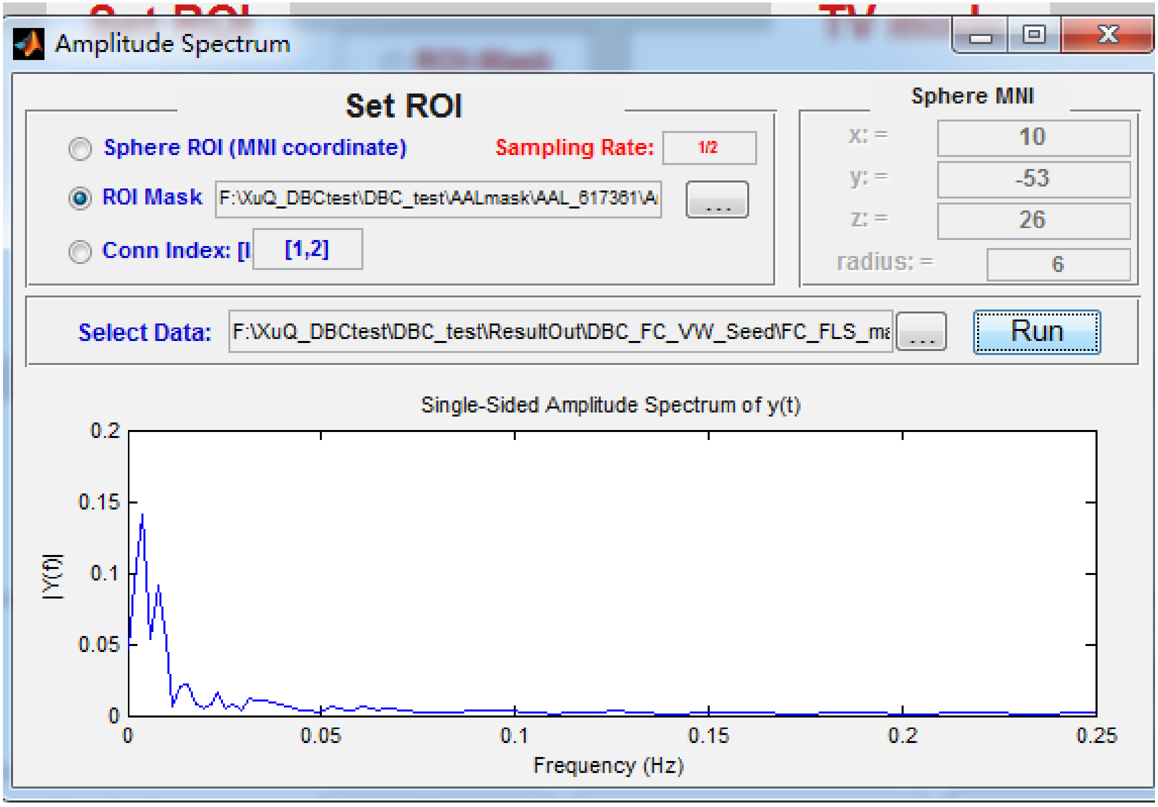
The spectrum showed in the bottom of parameter window.

5.2.1.2 ROI Mask

Click the 'ROI Mask', the MNI coordinate selection will be grayed.
Similar to the setting of 'Sphere ROI', Sampling Rate is 1/2, and the input data is the same.
Select the amygdala_L from AAL for the demo.



Click '***Run'***



The spectrum showed in the bottom of parameter window.

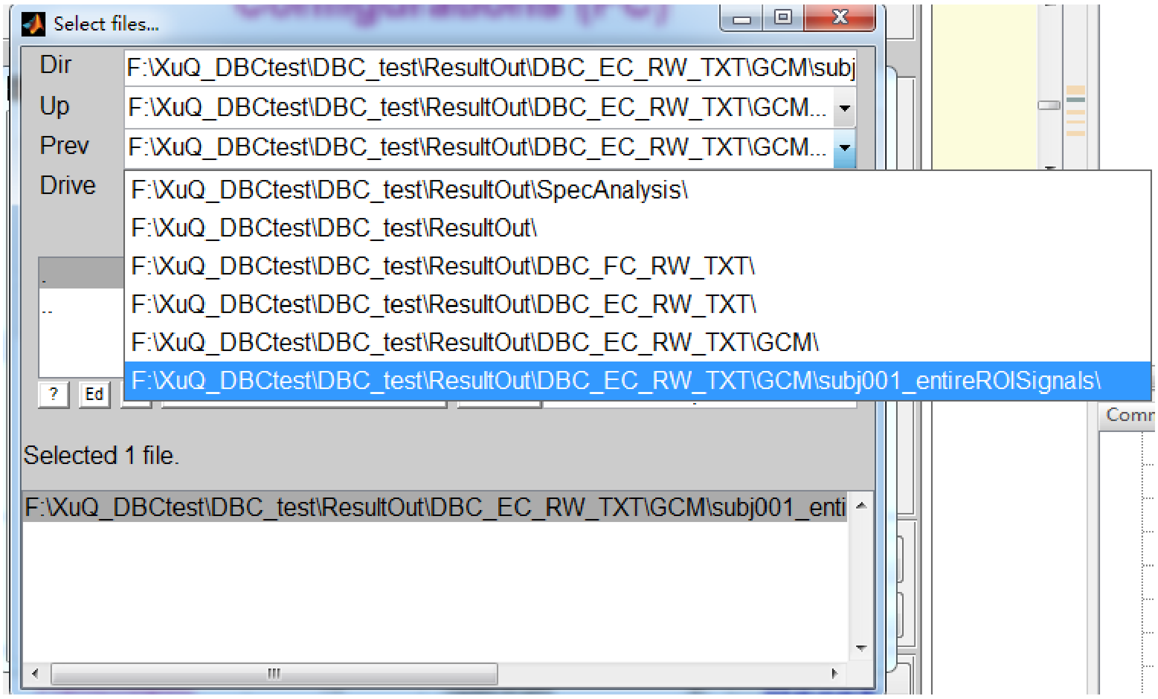
5.2.2 Matrix Type

Click ‘Conn Index’, and the MNI coordinate selection will be grayed.

We select the Sliding window results, and the duration between two window is 20TR, so we change the Sampling Rate to ***1/40***.

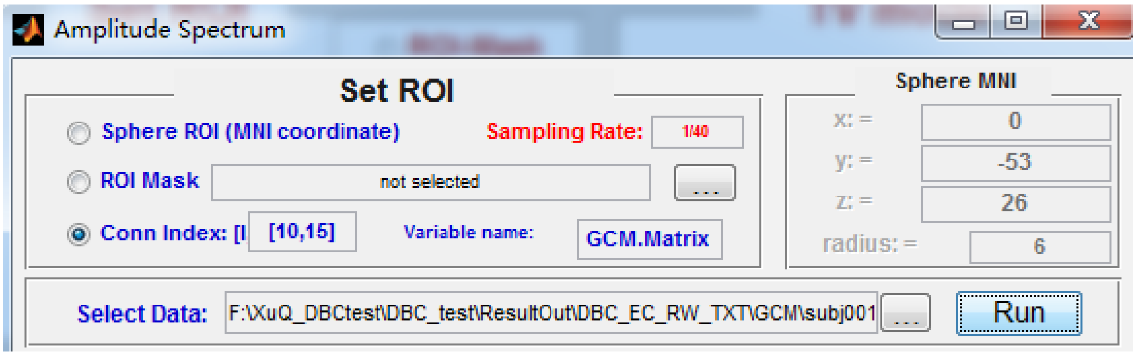
1

Select the input matrix



2.

Set the matrix index and variable name

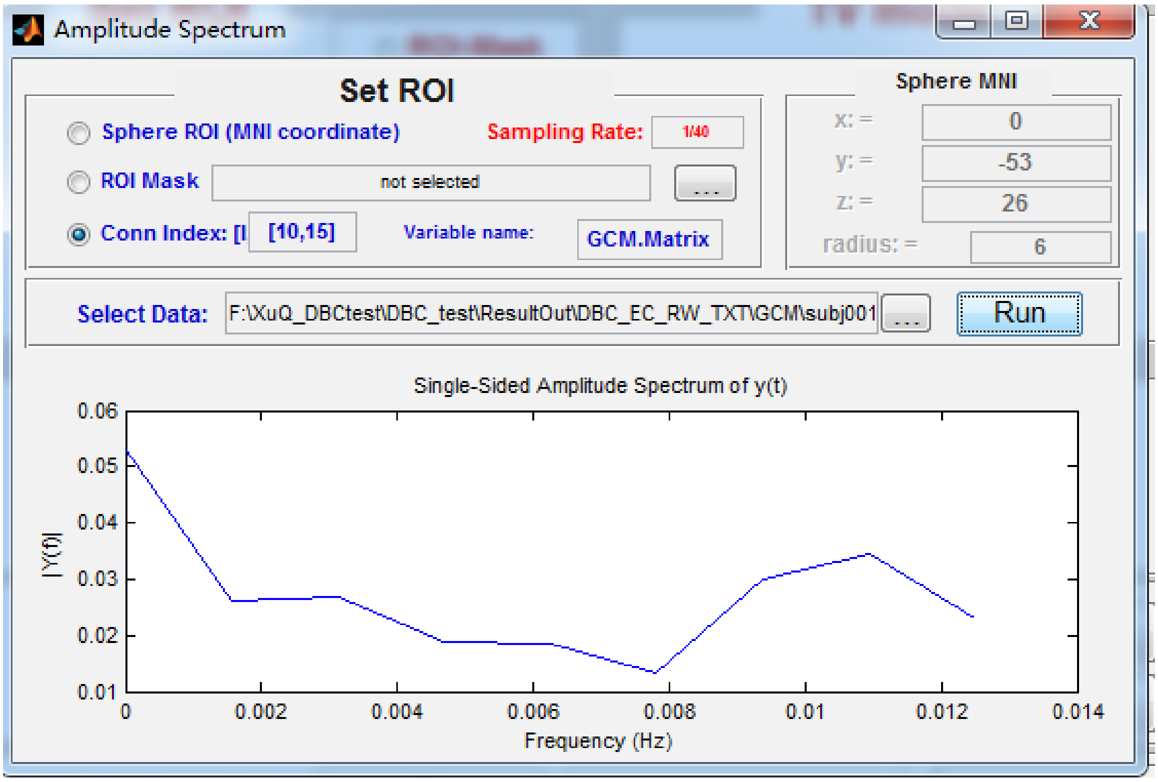


Here we select the Dynamic GC result for demo.

Conn Index represents the edge coordinate. In the demo, we set it to be [10,15], which means that we want to see the GC flow from region 10 (AAL) to region 15 (AAL).

Also we need to change the variable name to be '***GCM.Matrix***'.

Click 'Run'



The spectrum showed in the bottom of parameter window.