

Practice in resting-state fMRI (rs-fMRI) Analysis: PART II

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Course Arrangement

PART I (10/3)

- rs-fMRI pre-processing
- REST and DPARSF
- REST go through: ReHo, Functional Connectivity, ALFF, fALFF, utilities

PART II (10/4)

- Advanced connectivity analysis, connectivity matrix
- Statistics
- DPARSF go through



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Download Demo Materials

心智科學腦研究推動網

心智影像研究(MRI)中心 @成大 活動網頁 → 實作資料

http://fmri.ncku.edu.tw/tw/course_view.php?no=126

盧家鋒 個人網頁

靜息態功能性磁振影像分析實作 → 實作資料、課程講義

http://www.ym.edu.tw/~cflu/CFLu_course_speech.html

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Employed Software/Package



1. SPM preprocessing

<http://www.fil.ion.ucl.ac.uk/spm/>

2. REST functional connectivity, ReHo, ALFF, fALFF, VMHC

<http://restfmri.net/forum/index.php?q=rest>

3. DPARSF/DPABI

<http://rfmri.org/DPARSF>

◦ Data Processing Assistant for Resting-State fMRI (DPARSF)

◦ Based on SPM and REST toolbox

REST: Song et al., PLoS ONE, 2011.

DPARSF: Yan et al., Frontiers in System Neuroscience, 2010.

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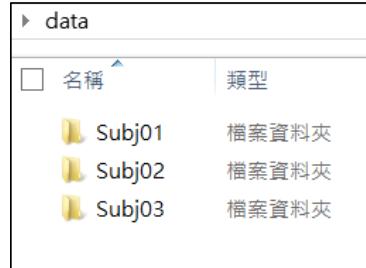
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Switch current folder to data folder



More convenient to execute the subsequent processing steps....



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Functional Connectivity Analysis using REST toolbox

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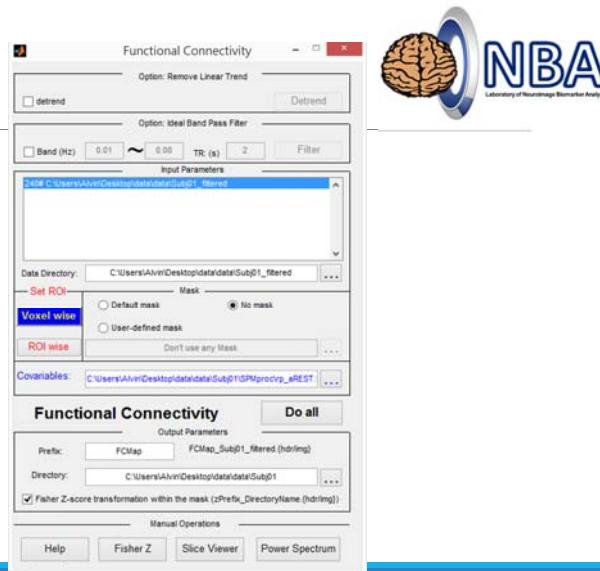
FunctCon

Functional Con.

Select folder of Subj01_filtered
(No need to apply filter and
mask again)

Voxel wise ⇔ ROI wise

6 motion parameters as
covariates



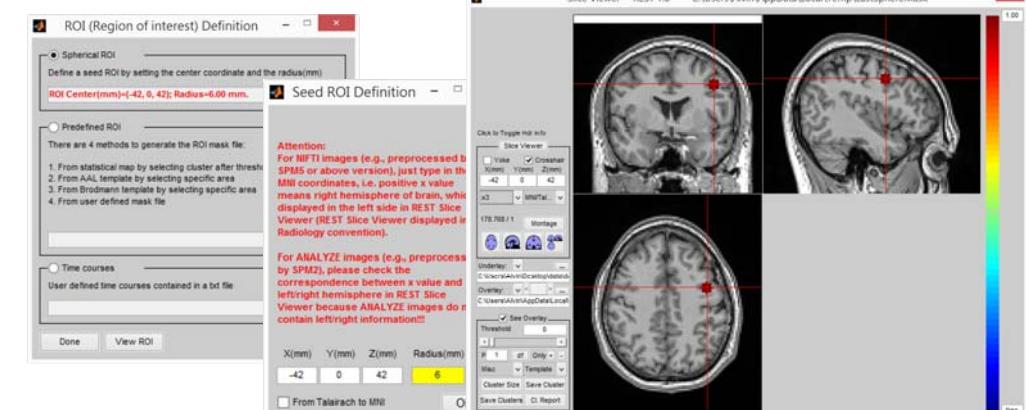
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FunctCon

Spherical ROI

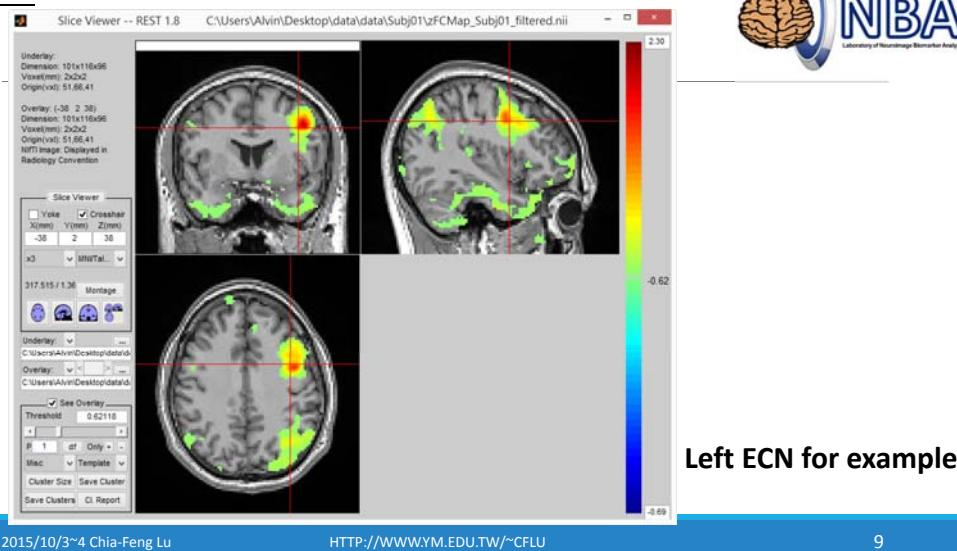


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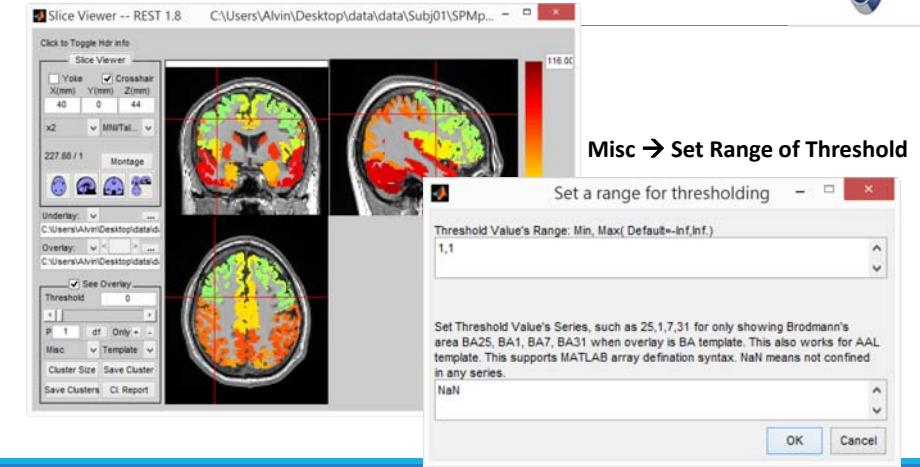
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FunctCon



FunctCon

Atlas ROI

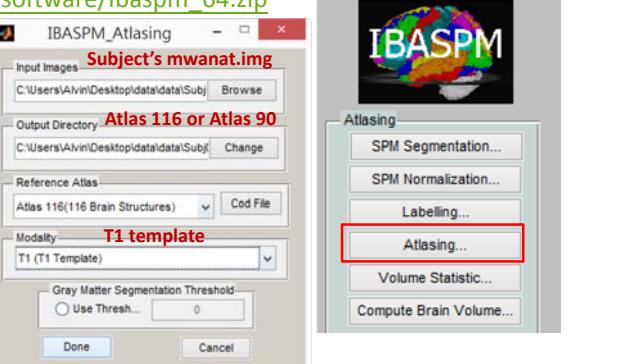
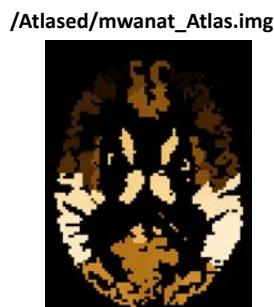


Extract Subject's Atlas

Only include the root folder of IBASPM!!

IBASPM 64-bit version

http://www.ym.edu.tw/~cflu/software/lbaspm_64.zip



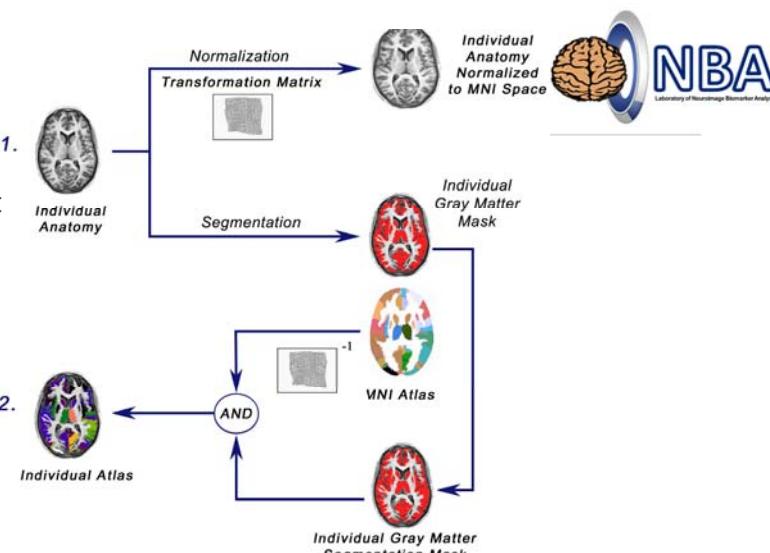
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IBASPM

Individual atlas flowchart

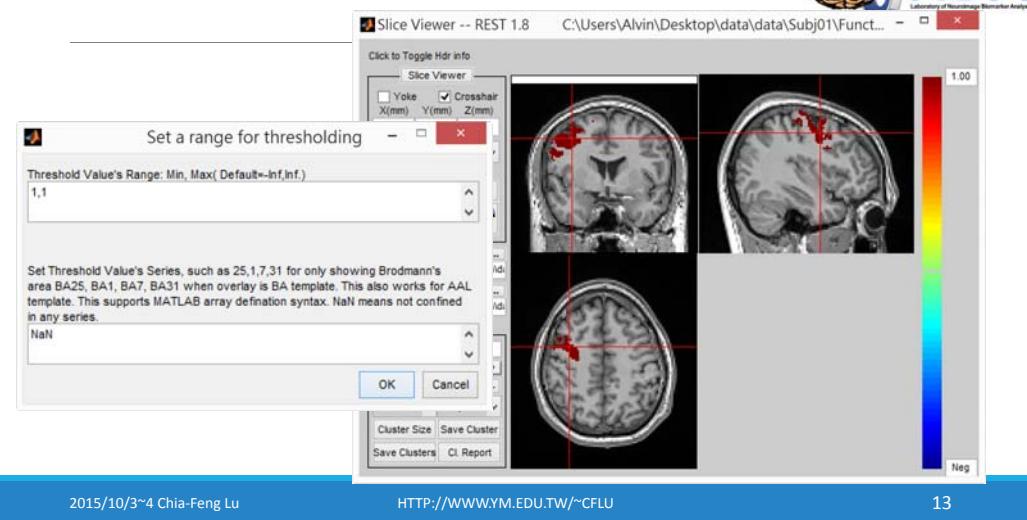


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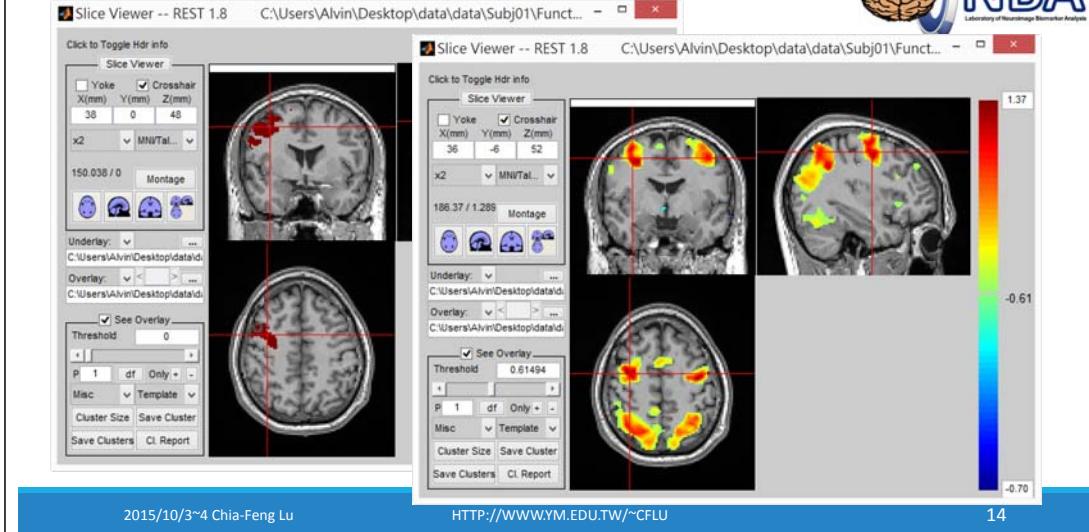
HTTP://WWW.YM.EDU.TW/~CFLU

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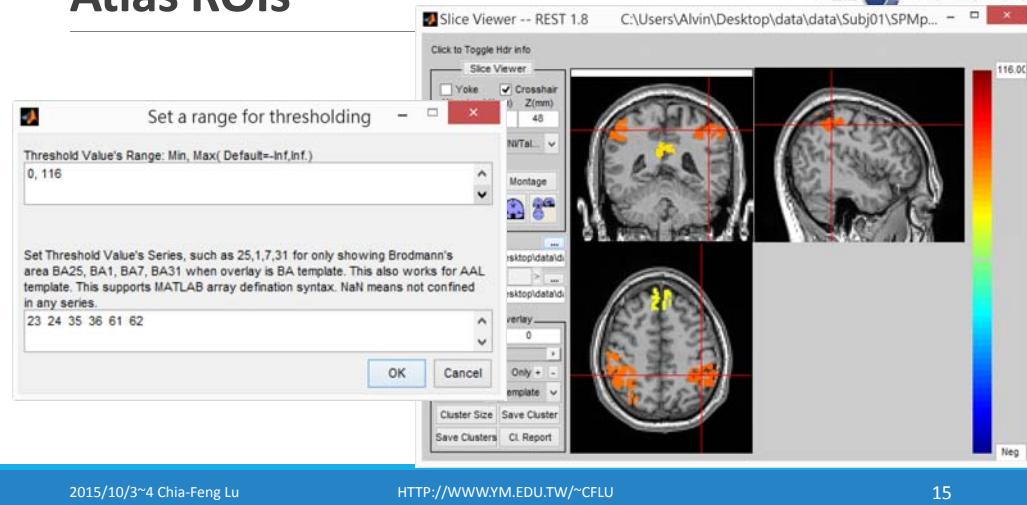
Atlas ROI



Connectivity Maps

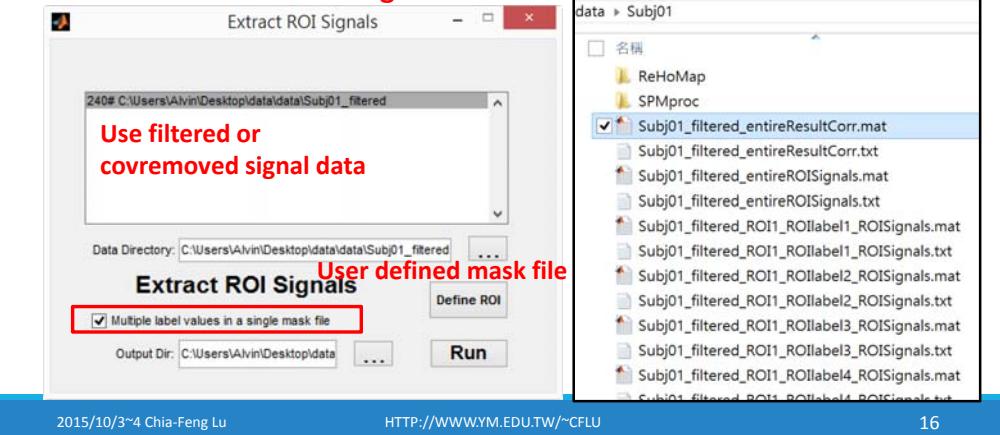


Atlas ROIs



Extract Atlas ROI signals

Utilities → Extract ROI Signals



Extract Atlas ROI signals



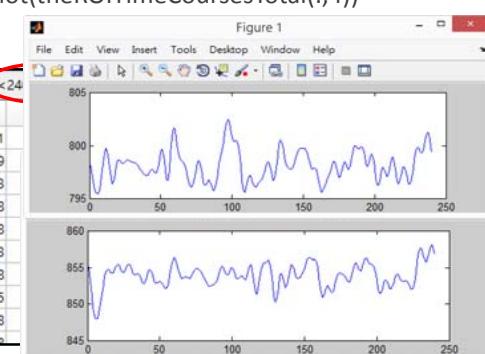
figure, plot(theROITimeCoursesTotal(:,2))
figure, plot(theROITimeCoursesTotal(:,4))

名稱	Subj01_filtered_entireResultCorr.mat	Subj01_filtered_entireResultCorr.txt	theROITimeCoursesTotal <24>
	Subj01_filtered_entireResultCorr.mat	Subj01_filtered_entireResultCorr.txt	
	Subj01_filtered_entireROISignals.mat	Subj01_filtered_entireROISignals.txt	
✓	Subj01_filtered_entireROISignals.mat	Subj01_filtered_ROI1_ROIlabel1_ROI1	1 2 1 869.8929 798.1161
	Subj01_filtered_ROI1_ROIlabel1_ROI1	Subj01_filtered_ROI1_ROIlabel1_ROI1	2 869.4746 797.0249
	Subj01_filtered_ROI1_ROIlabel1_ROI1	Subj01_filtered_ROI1_ROIlabel1_ROI1	3 869.4209 796.2333
	Subj01_filtered_ROI1_ROIlabel2_ROI1	Subj01_filtered_ROI1_ROIlabel2_ROI1	4 869.6546 795.7288
	Subj01_filtered_ROI1_ROIlabel2_ROI1	Subj01_filtered_ROI1_ROIlabel2_ROI1	5 870.0611 795.4528
	Subj01_filtered_ROI1_ROIlabel3_ROI1	Subj01_filtered_ROI1_ROIlabel3_ROI1	6 870.5762 795.4193
	Subj01_filtered_ROI1_ROIlabel3_ROI1	Subj01_filtered_ROI1_ROIlabel3_ROI1	7 871.1823 795.7328
	Subj01_filtered_ROI1_ROIlabel4_ROI1	Subj01_filtered_ROI1_ROIlabel4_ROI1	8 871.8634 796.4895
	Subj01_filtered_ROI1_ROIlabel4_ROI1	Subj01_filtered_ROI1_ROIlabel4_ROI1	9 872.4967 797.6218
	Subj01_filtered_ROI1_ROIlabel4_ROI1	Subj01_filtered_ROI1_ROIlabel4_ROI1	10 873.0459 798.8260

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Regress Out Covariates



Utilities → Regress Out Covariates

data

- 名稱
 - Subj01
 - Subj01_filtered
 - Subj01_filtered_Covremoved
 - Subj02
 - Subj03

Regress Out Covariates

240# C:\Users\Alvin\Desktop\data\Subj01_filtered

Data Directory: C:\Users\Alvin\Desktop\data\Subj01_filtered

Default mask No Mask User-defined mask

User's mask: Don't use any Mask

Covariates: C:\Users\Alvin\Desktop\data\Subj01SPMprc

Suffix: Covremoved

Run

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Correlation/Connectivity Matrix



load entireResultCorr.mat
figure, imagesc(ResultCorr)

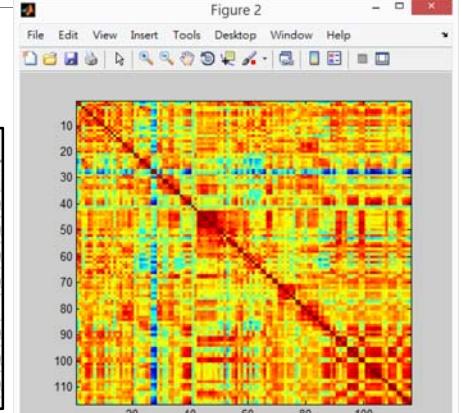
ResultCorr <116x116 double>

1	2	3	4	5
1	0.8071	0.1583	0.2188	0.
2	0.8071	1	0.2747	0.5703
3	0.1583	0.2747	1	0.6204
4	0.2188	0.5703	0.6204	1
5	0.4768	0.7410	0.5514	0.6922
6	0.4577	0.7162	0.5147	0.7309
7	0.5477	0.5605	0.7443	0.5227
8	0.4411	0.7293	0.5922	0.9124
9	0.5072	0.7304	0.4864	0.6655

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Correlation/Connectivity Matrix



load entireResultCorr.mat
figure, imagesc(ResultCorr)

Using Covariate-removed images

ResultCorr <116x116 double>

1	2	3	4	5
1	0.7673	0.1024	0.1360	0
2	0.7673	1	0.2434	0.5229
3	0.1024	0.2434	1	0.6278
4	0.1360	0.5229	0.6278	1
5	0.4050	0.7013	0.5632	0.6683
6	0.3617	0.6592	0.5073	0.7077
7	0.4778	0.5240	0.7467	0.5242
8	0.3612	0.6848	0.5983	0.9049
9	0.4162	0.6295	0.4955	0.6655

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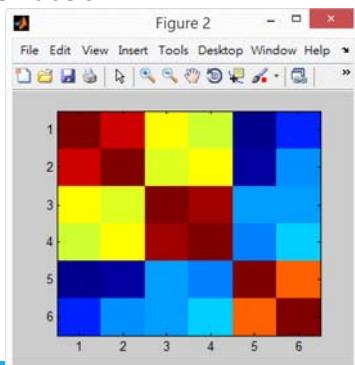
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Exercise

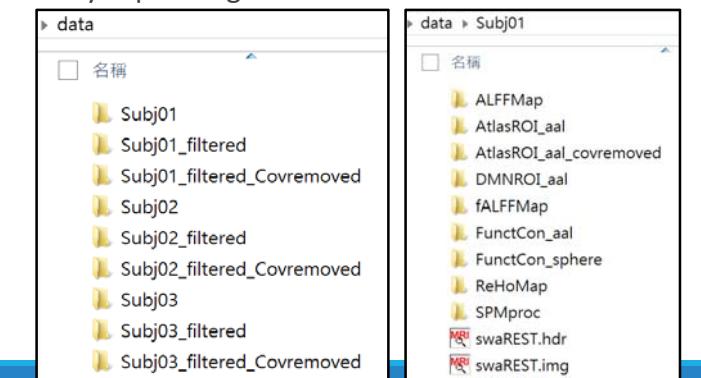
Extract AAL 23,24,35,36,61,62 ROI signals and correlation matrix.

- Create a mask image with selected ROI labels
- Extract ROI signals
- Plot correlation/connectivity matrix



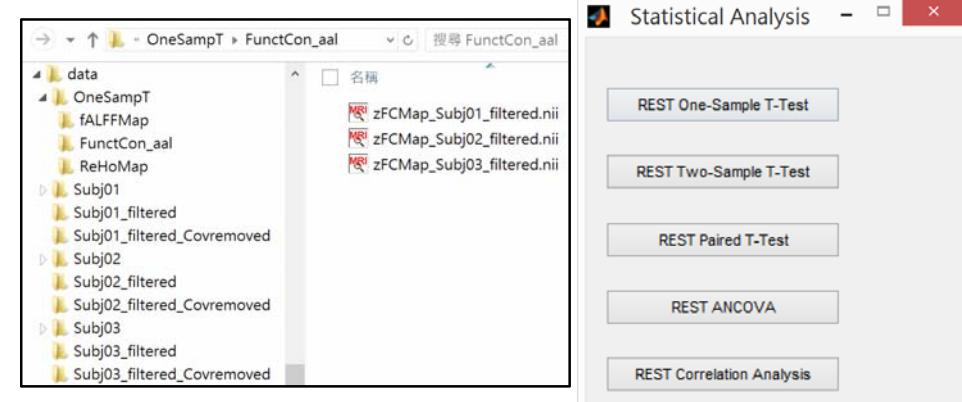
Organize data folder

After all the processes by using REST toolbox, please organize your data folder by separating results into different folders

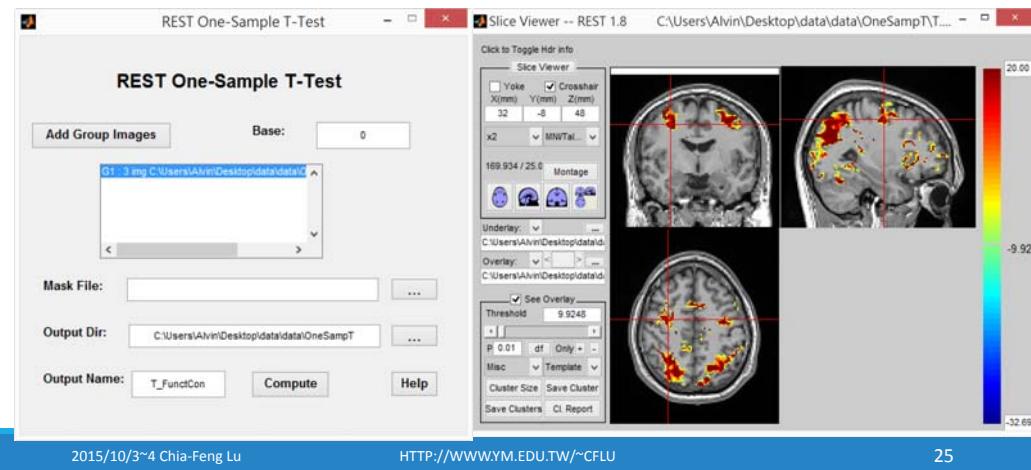


Perform Statistics using REST

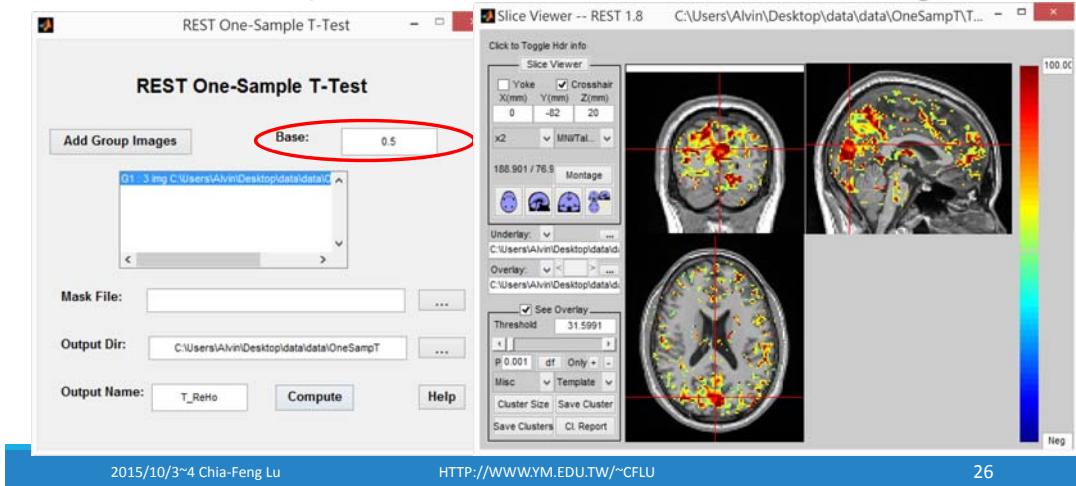
Statistical Analysis



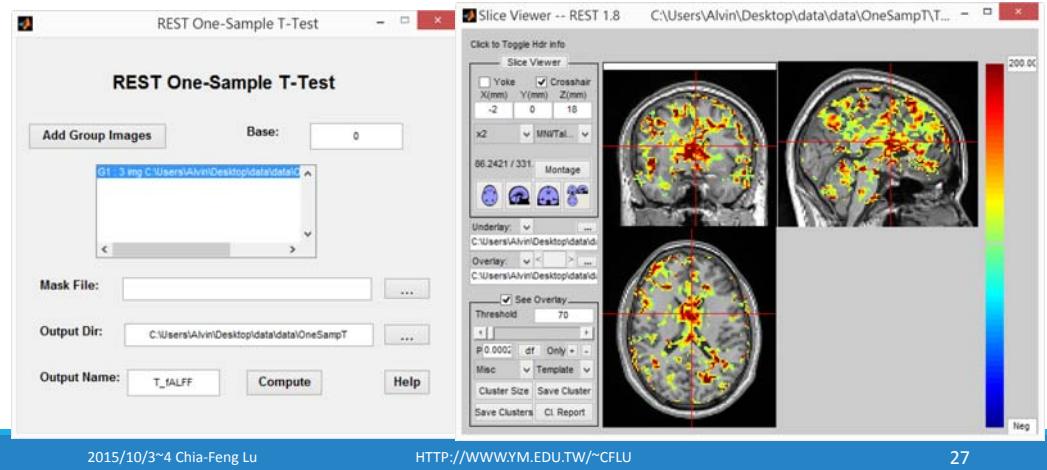
One sample T-test - FunctCon



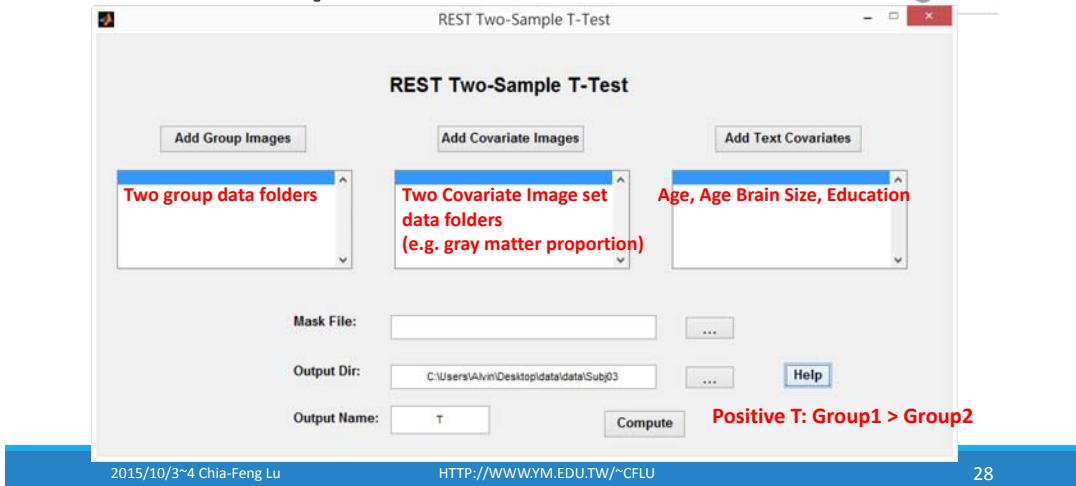
One sample T-test - ReHo



One sample T-test - fALFF



Two-sample T-test



Paired T-test

Task1 vs Task2
Task vs Resting
Pre vs Post



REST Paired T-Test

Add Condition Images

Condition 1: 1 img C:\Users\Alvin\Desktop\data\data\Subj01
Condition 2: 1 img C:\Users\Alvin\Desktop\data\data\Subj02

Mask File: ...

Output Dir: C:\Users\Alvin\Desktop\data\...

Output Name: T

Positive T: Condition1 > Condition2

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One-way ANOVA

REST One-way ANOVA (or ANCOVA)

REST One-way ANOVA (or ANCOVA)

Add Group Images

Add Covariate Images

Add Text Covariates

Mask File: ...

Output Dir: C:\Users\Alvin\Desktop\data\Subj03

Output Name: F

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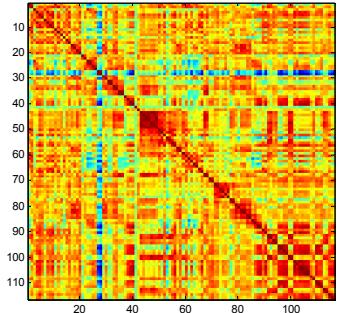
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Statistics on Connectivity Matrices

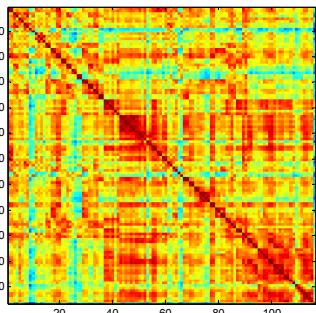


Descriptive statistics, one-sample t-test, two-sample t-test, paired t-test,....

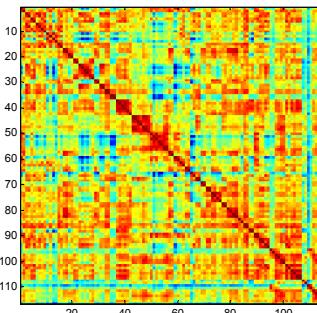
Subj01



Subj02



Subj03



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Perform ttest on Correlation Maps



Put all Correlation Maps file in a "CorrMap" directory

OneSampT > CorrMap

名稱

Subj01_filtered_Covremoved_entireRe...
Subj02_filtered_Covremoved_entireRe...
Subj03_filtered_Covremoved_entireRe...

```
1 - clear all
2 -
3 - dirname='.\CorrMap';
4 - dirinfo=dir(dirname);
5 - dirinfo(1:2)=[];
6 -
7 - CorrMapall=[];
8 - for i=1:length(dirinfo)
9 -   load([dirname '\\' dirinfo(i).name])
10 -  CorrMapall(:,i)=ResultCorr;
11 - end
12 - figure,imagesc(mean(CorrMapall,3))
```

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Perform ttest on Correlation Maps



```

14 - pMap=zeros(size(CorrMapall,1),size(CorrMapall,2));
15 - hMap=zeros(size(CorrMapall,1),size(CorrMapall,2));
16 - for i=1:size(CorrMapall,1)
17 -   for j=i+1:size(CorrMapall,2)
18 -     tmp=squeeze(CorrMapall(i,j,:));
19 -     tmp(isnan(tmp))=[];
20 -     [hMap(i,j),pMap(i,j)]=ttest(tmp,0); % one-sample
21 -   end
22 - end
23
24 %% hint for two-sample t-test, and paired t test
25 % [hMap(i,j),pMap(i,j)]=ttest2(tmp1,tmp2,0); % two-sample
26 % [hMap(i,j),pMap(i,j)]=ttest(tmp1,tmp2,0); % paired ttest

```

Correct “nanvar_base” error in ttest.m

```

103 - df = max(samplesize - 1,0);
104 - xmean = nanmean(x,dim);
105 - % sdpop = nanstd(x,[],dim); % by
106 - sdpop = std(x,[],dim);
107 - ser = sdpop ./ sqrt(samplesize);
108 - tval = (xmean - m) ./ ser;

```

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DPARSF GUI

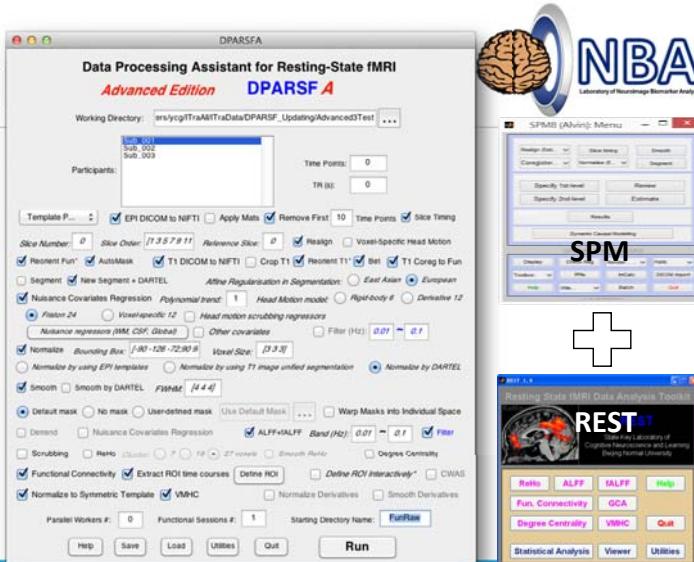
One-stop service

- Similar to the SPM batch

>> DPARSF

>> DPARSFA

>> dpabi



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DPARSF: walk through

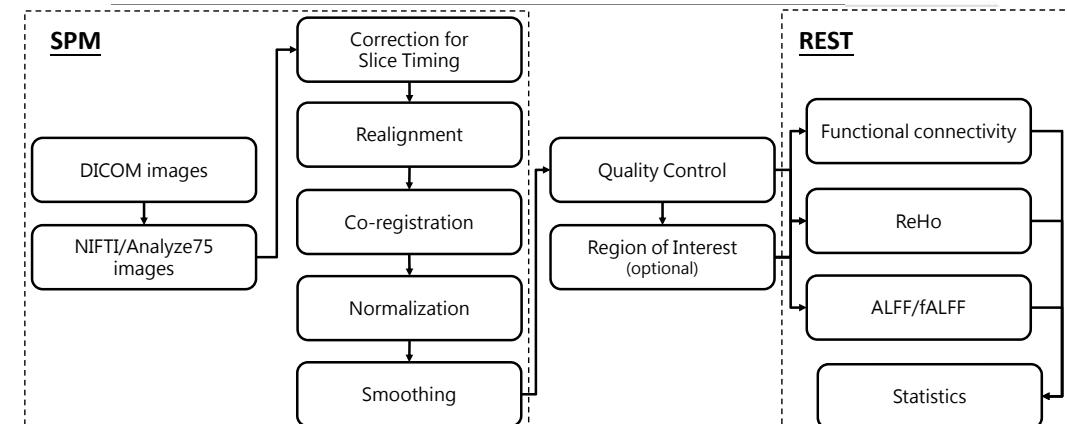
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Processing Flow in DPARSF



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Q & A

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轉譯影像研究中心

Translational Imaging Research Center
Taipei Medical University

TIRC Team

2015.7.20 at TMU

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