DPABISurf: A Surface-Based Resting-State fMRI Data Analysis Toolbox

Chao-Gan YAN, Ph.D.
ycg.yan@gmail.com
http://rfmri.org
Institute of Psychology, Chinese Academy of Sciences
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Linux:

```
sudo groupadd docker
sudo usermod -aG docker $USER
```
BIDS structure:
http://bids.neuroimaging.io

fMRIPrep

Voxel size (fMRIPrep)
Slice timing (fMRIPrep)
ICA-AROMA

IC ANON

ICA
Register IC spatial maps to MN122 2mm

Motion Component Classification
Based on four features:
- maximum RP correlation
- Edge fraction
- CSF fraction
- High-frequency content

fMRI data denoising
Removal of classified ICs from the fMRI data (fRgrp)

Pruim et al., 2015. Neuroimage

Ciric et al., 2017. Neuroimage

DPABI Surf Pipeline

Volume space can be restricted within freesurfer_subcortical_mask

E.g. {DPABIPath}/DPABISurf/SurfTemplate/save
age5_lh_cortex.label.gii
Re-Run fmriprep Failed Subjects

Organize the output files from fMRIPrep
Non-aggressively regressed out the covariates of ICA-AROMA noises.
Nuisance Regression Same as DPARSF

Spatial Smoothing

Why should you smooth?
• Might Improve CNR/SNR
• Improve intersubject registration

How much smoothing?
• Blob-size
• Typically 5-20 mm FWHM
• Surface smoothing more forgiving than volume-based

Volume-based Smoothing

• Smoothing is averaging of “nearby” voxels

Volume-based Smoothing

• 5 mm apart in 3D
• 25 mm apart on surface!
• Kernel much larger
• Averaging with other tissue types (WM, CSF)
• Averaging with other functional areas
Regional Homogeneity (ReHo)

Similarity or coherence of the time courses within a functional cluster

\[ R = \frac{\sum_i (R_i - \bar{R})^2}{\sum_i R_i^2 (n - 1)} \]

Zuo et al., 2013. Neuroimage

2D ReHo

Degree Centrality

Functional Connectivity

Extract ROI Time Courses

Define ROI

Zuo et al., 2013. Neuroimage
Define ROI

Left Surface
Right Surface
Volume

Define ROI

Left Surface
Right Surface
Volume

ROI order:
ROI signals_SurfLHSurfRHVolu_FunSurfWCF

Smooth Derivatives

Parallel Workers (if parallel computing toolbox is installed)

Each subject is distributed into a different worker. Do not be too much because of fMRIPrep processing.

Multiple functional sessions

1st session: FunRaw
2nd session: S2_FunRaw
3rd session: S3_FunRaw
...

If also have multiple sessions of T1 image data:
1st session: T1Raw
2nd session: S2_T1Raw
3rd session: S3_T1Raw
...

Starting Directory Name

If you do not start with raw DICOM images, you need to specify the Starting Directory Name.
E.g. “FunSurfWCF” means normalized, covariates regressed and filtered

W - Normalize
I - ICA-AROMA Noise non-aggressively regressed
C - Covariates Removed
S - Smooth
F - Filter
B - Scrubbing

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Save parameters to *.mat

Based on DPABISurf Preprocessed Data

Starting Directory Name
Participants
TR

In addition to the surface-based data, also process the data in volume space processed by DPABISurf

Based on DPARSF Preprocessed Data

Window Setup
Detrend
Dynamic Indices
If need filtering

Temporal Dynamic Analysis (for DPABISurf)

Functional Connectivity
Concordance
Concordance Settings
Smooth concordance maps
Parallel and Sessions setting
Delete Dynamic 4D files to save space
Save/Load parameters and Run

Output directory: left hemisphere and right hemisphere will be separated in different directories automatically
Smooth results: surface-based smoothing

Standardization across both hemispheres
Set data for both left hemisphere and right hemisphere
Masks for both hemispheres
Standardization methods
Space: fsaverage (anatomical) or fsaverage5 (functional)

Run
Optional: {DPABI}/DPABISurf/SurfTemplates/fsaverage5_lh_white_avg.area.gii
Estimated during DPABI Statistical Analysis (no PALM)

fsaverage5_lh_white_avg.area.gii
fsaverage5_lh_cortex.label.gii

Two hemispheres, then 0.025
Use DPABISurf Docker

Call DPABI StandAlone:

```
$ {MCRPath} /opt/DPABIG/DPABI_StandAlone/vni_DPABI_Standalone.sh
```

The R-fMRI Maps Project

Further Help

Reading and Writing functions

```
Reading:
[Data, VoxelSize, FileList, Header] = y_ReadAll('XX.func.gii');
Data  - 10242*230 single
Header – GIfTI Structure

Processing:
MeanData = mean(Data,2);

Writing:
y_Write(MeanData, Header, 'MeanData.gii');
```
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Thanks for your attention!