Diffusion MRI Reconstruction

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Brainhack School 2020 Project

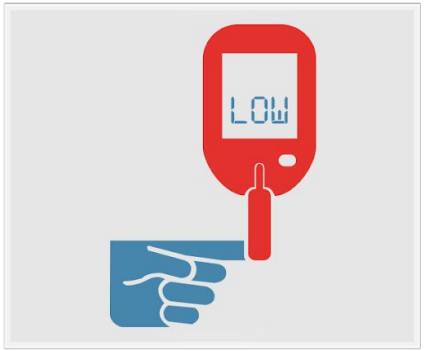
Project Background

1. dMRI: an high resolution while imaging lesions in vivo tissues
2. dMRI limitations: quality of data acquisition, quality of image reconstruction, quality of post analysis
3. dMRI reconstruction:

- Open-source tools: qMRLab
- What behind these tools?

PROBLEMS!

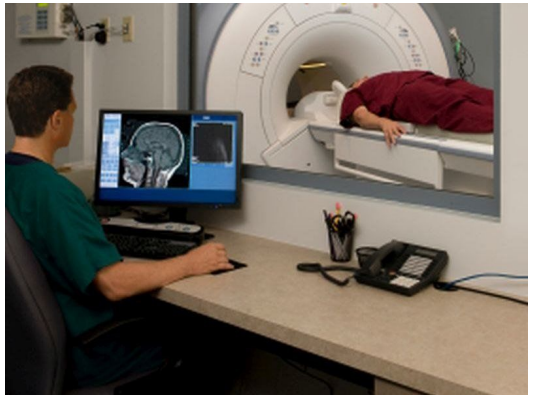
Low blood sugar leads to brain structures changing!



Goals

1. Get preprocessed diffusion MR images from raw data
2. Reconstruct diffusion tensor images from the preprocessed data;
3. By using machine learning, try to classify two hemispherical brains from preprocessed diffusion images

Diffusion MRI: a good method to imaging this changes



Tools Used

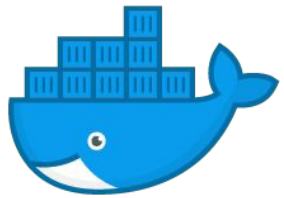
Coding:

Project organization and version control:

Visualization

GitHub

DIPY



Nipype:
Neuroimaging in Python
Pipelines and Interfaces

matplotlib

Datasets

Requirement: epi data with two opposite phase-encoding directions

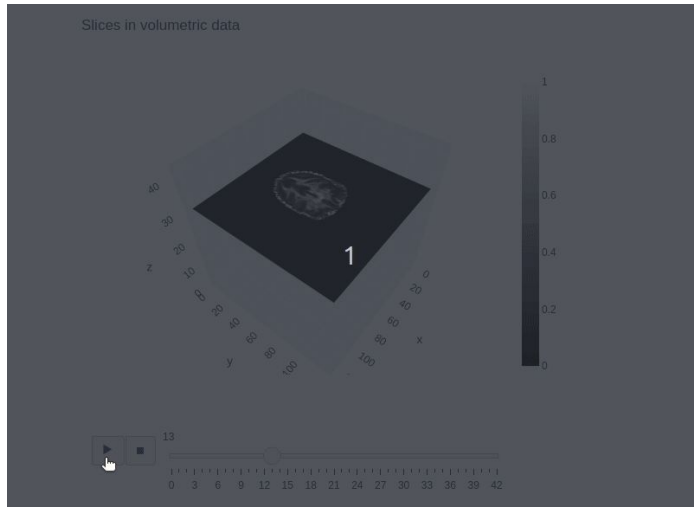
Developing Human Connectome Project

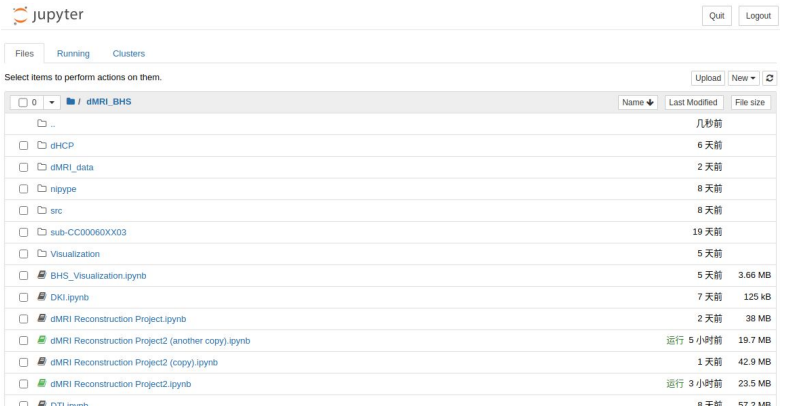
over 800 neonatal scans and over 250 fetal scans

to reconstruct diffusion Images

Deliverables

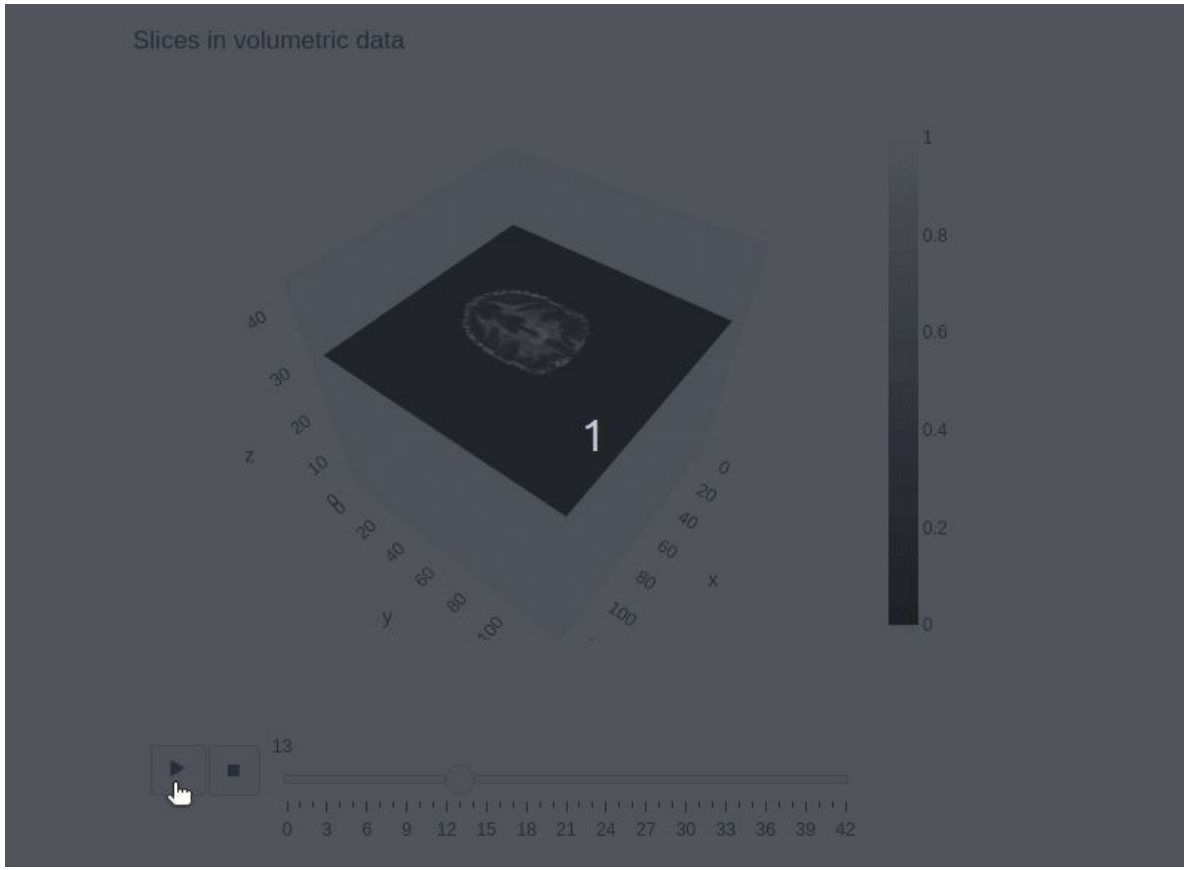
1. Data Visualization
2. Open-source dMRI reconstruction code
3. Markdown files to describe reconstruction details
4. Brain data statistics analysis example
5. Project report
6. Report google slides



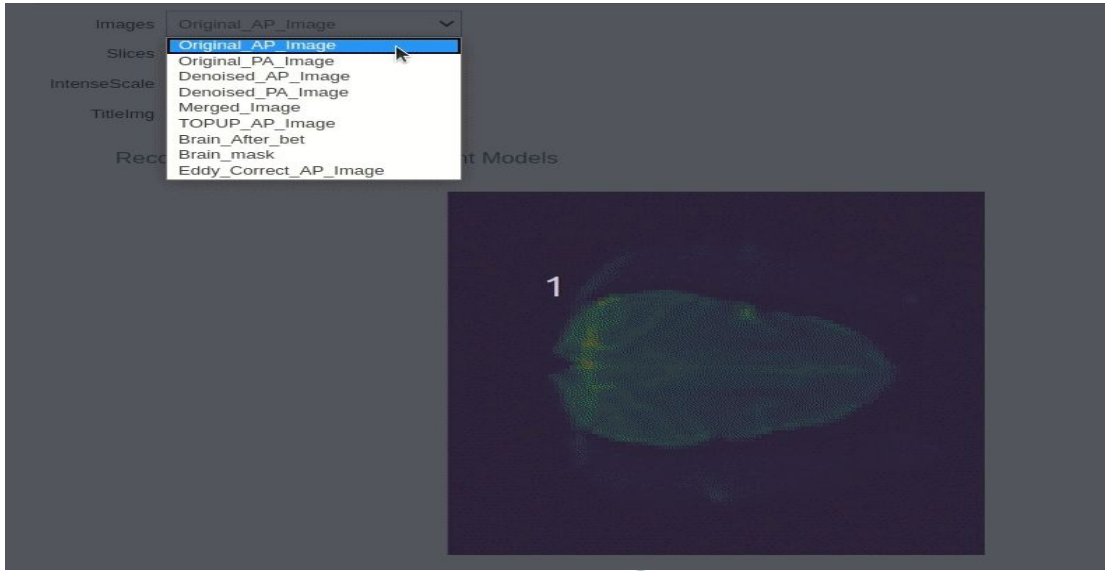


Data Visualization

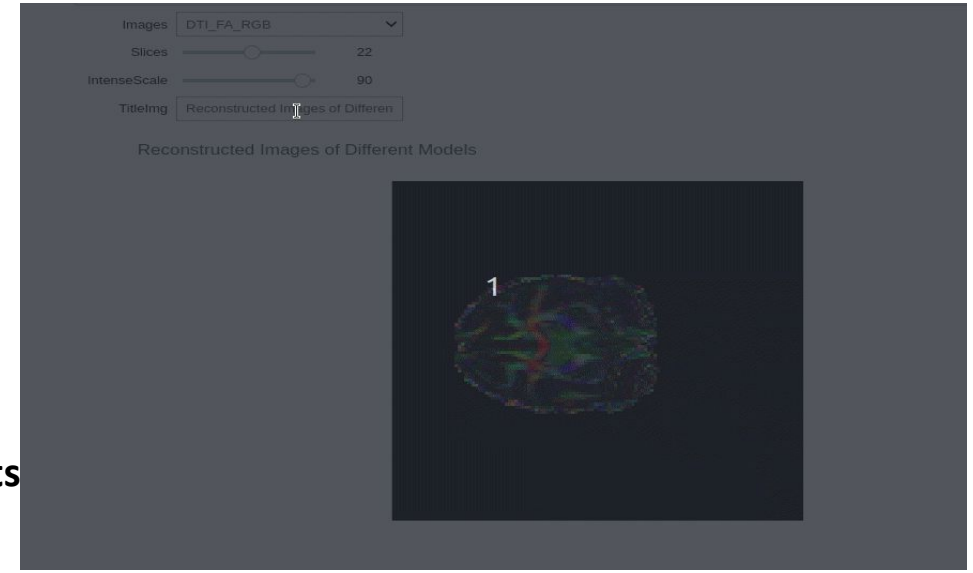
3D volume slices image



Interactive widgets use to show preprocess results



Interactive widgets use to show reconstruction results



Skills learnt

Developing Human Connectome Project

python™

DIPY

matplotlib

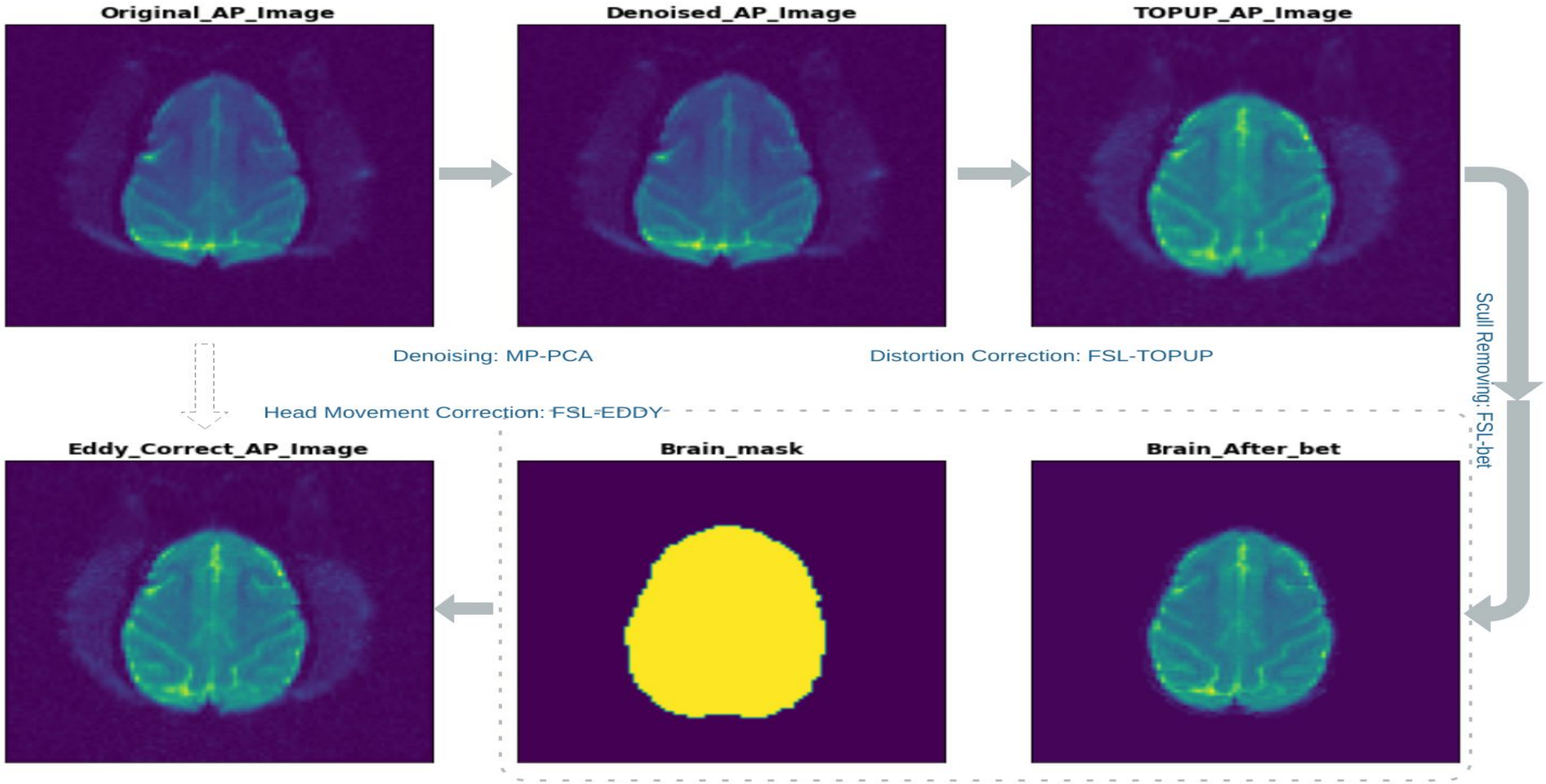
plotly

GitHub

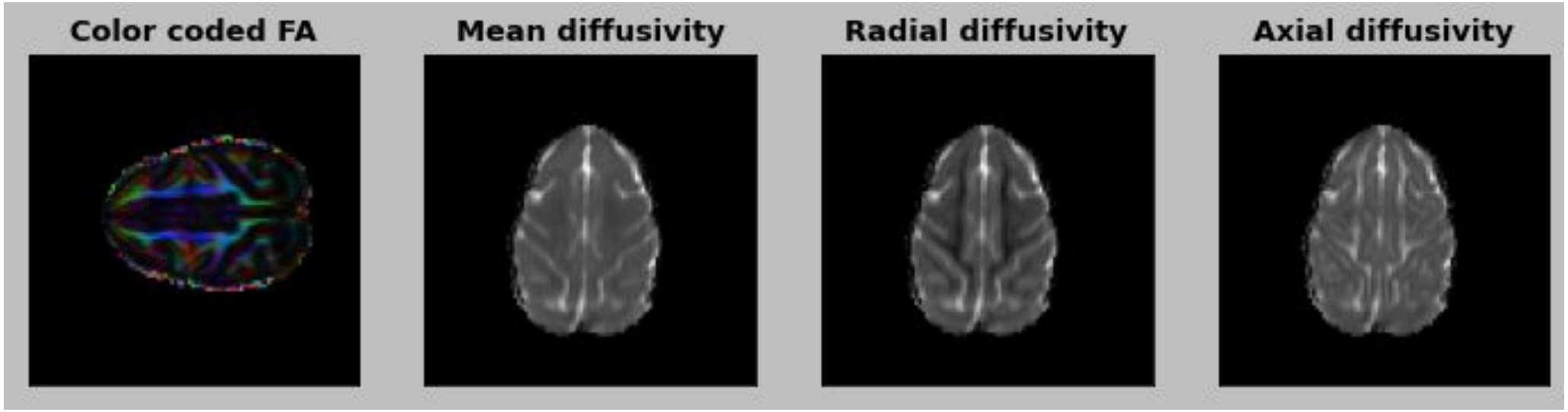
docker

jupyter

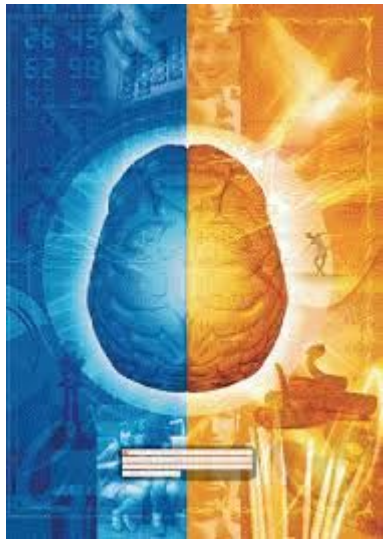
Results 1


Original_AP_Image
Denoised_AP_Image
TOPUP_AP_Image
Denoising: MP-PCA
Distortion Correction: FSL-TOPUP
Scull Removing: FSL-bet
Head Movement Correction: FSL-EDDY
Eddy_Correct_AP_Image
Brain_mask
Brain_After_bet

Results 2



Results 3



	precision	recall	f1-score	support
0.0	0.91	0.91	0.91	11
5.0	0.92	0.92	0.92	13
accuracy			0.92	24
macro avg	0.92	0.92	0.92	24
weighted avg	0.92	0.92	0.92	24

What To Do Next

- Combine different processing methods into this project
- Look deep into DTI model fitting
- Try to replace it by a new model created by myself

Thanks