



# ADVANCED FUNCTIONAL BRAIN IMG.

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## Assignment 2: Preprocessing and GLM Analysis of fMRI data using FSL

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**Aim:** The goal of this assignment is to get you acquainted with:

1. Preprocessing of fmri data using feat-fsl
2. First level GLM analysis of a single subject using feat-fsl
3. Registration using flirt-fsl
4. Cluster the files using cluster command and report areas that get activated.

**Task:** In this assignment, you will have to preprocess and run GLS analysis on a single subject undergoing a working memory task (n-back). This data was obtained from the OpenfMRI database. Its accession number is ds000115. The data for sub001 has been made available to you for analysis. The data is available for a single run for three different tasks. The data is available at [cerebrum.cse.iitd.ac.in:/mnt/project1/COL786/Spring17/Assign2](http://cerebrum.cse.iitd.ac.in:/mnt/project1/COL786/Spring17/Assign2)

For this assignment, we will follow the steps followed in the paper. The details have been mentioned below in brief. For more information, you can refer the paper.

#### fMRI Scan details:

Scanner type: 3T Tim TRIO Scanner

TR: 2500ms

Voxel Size: 4x4x4

Working memory task data were acquired from each participant in three BOLD runs, each consisting of two blocks of 0-back, 1-back, or 2-back working memory task. Each run consisted of 137 images (105 of them acquired during task performance), for a total of 411 images (315 acquired during task performance) and 17.1 min of scanning (13.1 min of task performance).

#### Task Details: (N-Back task)

All subjects performed one run of each of three levels of an “*N*-back” working memory task in which their task was to respond for each letter shown whether it was the same as a pre-specified letter (e.g., “X”; 0-back), the same as the immediately preceding letter (1-back), or the same as the letter shown two trials previously (2-back).

Each of the memory loads was performed for two task blocks within the same run and the order of runs was counterbalanced across participants. The task followed a mixed state-item design. Each block started with a cue shown for 2.5 s indicating the *N*-back condition, followed by letters presented one at a time for 2.5 s each. The delay between items was variable with the following proportion of delays 1 TR: 5%, 2 TR: 31%, and 3 TR: 64%. Each task block contained 21 trials and lasted for a total of 105 s. Each run started with 25 s of fixation, and each task block was followed by a 45 s fixation block.

## Data Preprocessing Steps:

Basic imaging data preprocessing included:

1. Compensation for slice-dependent time shifts;
2. Removal of first five images from each run during which BOLD signal was allowed to reach steady state;
3. Elimination of odd/even slice intensity differences due to interpolated acquisition;
4. Realignment of data within and across runs to compensate for rigid body motion.
5. Intensity normalization to a whole brain mode value of 1000;
6. Registration of the 3D structural volume (T1) using a 12-parameter affine transform; and
7. Co-registration of the 3D fMRI volume to the structural image and transformation to atlas space using a single affine 12-parameter transform.

## Further preprocessing steps include:

1. Spatial smoothing using a gaussian kernel with three voxels FWHM.
2. High-pass filtering with 0.009 Hz cutoff frequency.
3. Removal of nuisance signal that included six rigid body motion correction parameters, ventricle, white matter, and whole brain signals, as well as their first derivatives.

The details of the experiment protocol are given at:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3358772/>

## Contrasts to be generated:

1. nback-target
2. nback-nontarget
3. nback-error

( Refer to models/condition\_key.txt in the metadata folder)

The model files for the experiment are provided with the dataset. Once you have generated the contrasts, register the contrasts to the MNI image and using flirt tool (command line or GUI based)

## Submission files:

1. zstat files for all the contrasts. (Name them as zstat\_<task00x>\_<contrastName>.nii.gz )
2. Registered zstat files for all the contrast. (Name them as zstat\_<task00x>\_<contrastName>\_reg.nii.gz where x is the task number.)
3. Files containing clusters and areas that represent the cluster. Use an atlas to name the areas. List the top 5-6 areas only and not all the clusters. Name these files as cluster\_<task00x>\_<contrastName>.txt.
4. Add all the files in a folder and create a zip file for the same. The name of the folder and zip file should be yourName\_entryNumber\_assignment2.zip

Note that you have to submit these files for all tasks.

## Data Hierarchy:

anat: Contains the anatomical files for the subject.

BOLD: Contains the functional data for the three tasks.

models: Contains the models that need to be used an EV.


Metadata folder includes information about the complete dataset i.e. TR, demographics, model information, etc.

## References:

1. <https://wiki.biac.duke.edu/lib/exe/fetch.php?media=biac:fslcourse.pdf>

2. <https://wiki.biac.duke.edu/biac:fsl>
3. <https://fsl.fmrib.ox.ac.uk/fsl/fslwiki/FEAT/UserGuide>
4. <https://openfmri.org/dataset/ds000115/>
5. <https://fsl.fmrib.ox.ac.uk/fsl/fslwiki/Cluster>

## Submission status

Submission status	Submitted for grading
Grading status	Not graded
Due date	Tuesday, 20 February 2018, 11:55 PM
Time remaining	201 days 1 hour
Last modified	Monday, 20 February 2017, 11:53 PM
File submissions	 Deepak_2014EE30506.docx
Submission comments	► Comments (0)

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