

## FSL FEAT: Abridged Protocol

Belyk August 2013

### **Analysis of fMRI data in FSL FEAT**

Convert data to NIFTI: This stage will change file formats to NIFTI which is universal and easy to handle.

- Download mricron suite if not done already
- Open dcm2nii application within mricron suite
  - File-> Dicom to NIFTI (browse for folder containing DICOM files)
- Repeat for all anatomical and functional scans.

Startup: This stage starts fsl

- Arrange data in some sensible way.
- Open Terminal and navigate to a convenient place in the file hierarchy

```
>cd Documents/MyProject/data
```

- run FSL

```
>fsl
```

BET Brain extractions: This stage will process the anatomical scans and remove skull and dura

- Click BET brain extraction. This will open a new window.
- Input image = anat.nii
- Output image is automatically filled.
- Click '*Advanced options*'
  - Check output brain-extracted image
  - Check binary brain mask image
  - Fractional intensity threshold = 0.25
  - Threshold gradient = 0.25
- Check results. Modify either of the latter parameters and try again if result was not satisfactory.
- Repeat for all anatomical scans.
- Close window

First level analysis with FEAT: This stage will perform first level fixed effects analyses on all subjects. Highly recommend using the batch function and checking individual results afterwards. NOTE: First level outputs are registered to native space only. Transformation matrices for registration to standard space are computed at this stage, but not applied until second level mixed effects analysis. Running this step takes about 1-2 hours/scan.

- From dropdown menu select '*First-level analysis*' and '*Full analysis*'
- Data tab

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- Number of inputs = number of scans to batch process
- Click select 4D data->in each line browse for raw functional data in .nii
- Set TR, total volumes and volumes to delete. Ignore high pass filter for now.
- Pre-stats tab
  - Set desired preprocessing parameters.
  - Recommend BET, FWHM = 8mm. intensity normalization, Highpass
- Stats tab
  - Standard motion parameters in dropdown box
  - Click model setup wizard. This will open a new window.
    - Select the type of design and the duration of rest and task epochs.
    - Default high pass filter = 1/task cycle duration
- Post-stats tab
  - Select a threshold. Voxel = FDR. Cluster = Cluster based thresholding (less conservative).
  - This decision will not affect the higher-level analysis
- Registration tab
  - Select main structural images->Browse for anat\_brain.nii created by BET in earlier processing.
    - If batch processing select the appropriate anatomical to match each functional image to be processed. The anatomical scan list must have one to one correspondence with the functional scan list.
    - Leave Normal search and BBR.
  - standard space->Browse for standard space template with brain removed. Check Non-linear and leave warp at default 10mm.
- Analysis outputs to foldered labeled with extension .feat
  - Check reg/example\_func2standard.png to assess coregistration. If it's bad try again with 3DOF registration to highres and 12DOF registration to the template brain.
  - rendered\_thresh\_zstat.nii is the thresholded image.
  - rendered\_zstat.png shows axial slices
  - There are no tables here. They need to be calculated via script later.

Higher level analysis with FEAT: This level takes the output images from the previous step for random effects testing. You'll need to run this for each contrast (ie., each vs. rest and each high-level contrast). This step runs for about 10 minutes/contrast

- From dropdown menu select '*Higher-level analysis*' and '*Stats+Post-stats*'
- Data tab
  - Set number of inputs to the number of scans required
  - Select FEAT dorectproes->browse for output folders (.feat)

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- If .feat contains several contrasts (cope1,cope2...) these can be selected or deselected with the numbered radioboxes.
- Set output directory (.gfeat)
- Stats tab
  - Mixed effects: FLAME1
  - Click full model setup wizard (see FSL users guide for contrasts) <http://fsl.fmrib.ox.ac.uk/fsl/fslwiki/FEAT/UserGuide>
  - For a within subject design, leave the group column as '1'
  - Columns are conditions, rows are input images
  - Set one 'EV' per condition in the design.
  - For each EV set the relevant input images to 1, otherwise 0
  - In the contrast tab, set the number of contrasts (including vs. rest)
  - Set contrast vectors (e.g., [1 0] for EV1 > Rest or [1 -1] for EV1 > EV2)
  - Click 'View Design' to see a summary, then 'Done'
  - Note: With careful planning this can all be done in one step. Load all the .feat files as input, specify all the conditions and all the contrasts together. This would mean using the same threshold for each condition though.
- Post-Stats tab
  - Set thresholds as before
  - Use standard space template as background image for group data
- FSL will output 1 image for each contrast specified in the stats tab. These images are numbered in the order of the contrasts with no relevant names. Keep notes about which contrasts are which.