Introduction

This manual is edited to help researchers interested in using magnetic resonance imaging (MRI) data in MEG source modeling. We will specifically use the following software packages.

I. FreeSurfer
   An open source software suite for processing and analyzing (human) brain MRI images. For more information, please check https://surfer.nmr.mgh.harvard.edu/

fMRI data pre-processing basically involves the following steps:

- Unpack DICOM files into the file format allowing us for subsequent processing
- Motion correction
- Slice-timing correction
- Spatial smoothing

Environment setup

- **Login**
  1. Open a SSH session
  2. Login to server

```
%ssh 140.119.165.24 -l username[1] -Y

(%ssh -o TCPKeepAlive=no -o ServerAliveInterval=15
140.119.165.24 -l username –Y)
```

  3. Goto your working directory

```
> cd
/space/maki5/1/users/fhlin/ini_vm_nccu/10102012_ChangCI/epi
_data
```

  4. Prepare environment

```
> source /space/maki/1/pubsw/bme-dev-env-dev.csh
```

[1] Here I use “user_name” as the example.

Unpack DICOM files

- **Scan EPI sessions**

  The first step is to check how many EPI "sessions" in the data stored in the folder `VM_EPI`.

  ```
  > unpacksdcmdir -src VM_EPI -targ . -scanonly ./info
  ```

  By the end of screen output, you may find the following:

  ```
  Done scanning Wed Feb 19 16:47:01 CST 2014
  -----------------------------------------
    4         ep2d_bold_MGH  ok   64  64  30 120
  10102012_CHANGCI.MR.FHLIN_FMRI.0004.0001.2012.10.10.19
  .21.11.750000.5743858.IMA
  ```

  It indicates there is only ONE (1) session in this data. And the EPI session has session number 4.

- **Perform unpacking**

  Now ONE (1) file is needed to specify which run(s) is going to be unpacked. Here I created a file called unpack.rule. The content of the file is:

  ```
  > cat unpack.rule
  4    bold nii  f.nii
  ```

  It specifies that run 4 should be unpacked inside the folder BOLD with nii[2] file format. The output file should be bold/004/f.nii.

  Now perform the unpacking with this configuration rile.

  ```
  > unpacksdcmdir -src VM_EPI -targ . -cfg ./unpack.rule
  ```

  If things run smoothly, you would see the output screen:

  ```
  StartTime: Wed Feb 19 16:51:22 CST 2014
  EndTime:   Wed Feb 19 16:51:35 CST 2014
  unpacksdcmdir Done
  ```

  Double-check if files are there as expected:

  ```
  > ls bold/004
  ```

[2] Nii is the file name extension for the NifTI file format, a common file format storing neuroimaging data. Please see http://nifti.nimh.nih.gov/nifti-1/ for details.

```
flf  f.nii  f.nii-infodump.dat
```

It specifies that run 4 should be unpacked inside the folder BOLD with nii file format. The output file should be bold/004/f.nii.

Pre-processing steps

Two files are needed to specify all folders containing unpacked EPI data. Here I created `sessid` and `sessdir` two texts files for this purpose:

```
>pwd
/autofs/space/maki5_001/users/fhlin/ini_vm_nccu/101020
12_ChangCI/epi_data

> ls
bold  dicomdir.sumfile   info  log  sessdir  sessid
unpack.log     unpack.rule  VM_EPI

>cat sessid
epi_data

cat sessdir
/space/maki5/1/users/fhlin/ini_vm_nccu/10102012_ChangC
I
```

- **Make analysis/pre-processing template**

```
> mktemplate-sess -sf sessid -df sessdir
```

- **Motion correction**

All files inside each folder within 'bold' will be motion corrected.

```
> mc-sess -sf sessid -df sessdir -per-run
```

Check the output files:

```
ls bold/004
flf  fmcpr.mat.aff12.1D  fmcpr.mcdat  fmcpr.nii.gz
fmcpr.nii.gz.mclog  f.nii  f.nii-infodump.dat
mcdat2extreg.log  mcprextreg  template.log
template.nii.gz
```

The file `fmcpr.nii.gz` contains the motion-corrected EPI data in zipped nii format.

- **Slice timing correction**

  Slice timing correction is going to apply to files with file stem 'fmcpr'. The output file after slice timing correction has the file stem 'fmcprstc'.

  ```
  > stc-sess -sf sessid -df sessdir -i fmcpr -o fmcprstc
  ```

  Check the output files:

  ```
  > ls bold/004
  flf  fmcpr.mat.aff12.1D  fmcpr.mcdat  fmcpr.nii.gz
  fmcpr.nii.gz.mclog  fmcprstc.nii.gz
  fmcprstc.nii.gz.log  f.nii  f.nii-infodump.dat
  mcdat2extreg.log  mcprextreg  template.log
  template.nii.gz
  ```

  The file `fmcprstc.nii.gz` contains the motion-corrected AND slice timing corrected EPI data in zipped nii format.

- **Spatial smoothing**

  Spatial smoothing is going to apply to files with file stem 'fmcprstc' using a Gaussian smooth kernel with full-width-half-maximum (FWHM) of 10 mm. The output file after slice timing correction has the file stem 'fmcprstcs'.

  ```
  > spatialsmooth-sess -sf sessid -df sessdir -i
  fmcprstc -o fmcprstcs -fwhm 10 -outfmt nii -no-mask
  ```

  Check the output files:

  ```
  > ls bold/004
  flf           fmcpr.mcdat   fmcpr.nii.gz.mclog
  fmcprstc.nii.gz.log      fmcprstcs.nii  f.nii-
  infodump.dat  mcprextreg template.nii.gz
  fmcpr.mat.aff12.1D  fmcpr.nii.gz  fmcprstc.nii.gz
  fmcprstc.nii.gz.log.bak  f.nii
  mcdat2extreg.log      template.log
  ```

  The file `fmcprstc.nii` contains the motion-corrected, slice timing corrected, AND spatially smoothed EPI data in nii format.