Tutorial

Preprocessing Checks/
Research question and GLM
SPM main menu

- Functions to preprocess fMRI data.
  - e.g. Smooth
  - e.g. Coregister
SPM main menu

• Other useful tools.
• e.g. Display
• e.g. Check Reg
• e.g. ImCalc
Reorientation

• First step before preprocessing
• Set origin to anterior commissure:

http://imaging.mrc-cbu.cam.ac.uk/imaging/FindingCommissures
Reorientation

- Display structural image
- Set fixation cross on the anterior commissure
- Click on «Set Origin»
- Click on «Reorient» and select images to reorient.
- Repeat for functional images (remember to select all functional images within a session)
Preprocessing checks

Guide to image prefixes:

• a: slice-timing corrected
• r: resliced
• m: bias corrected (modulated)
• w: normalised (warped)
• s: smoothed

• c1 etc: tissue maps
• y_: warp fields
Preprocessing checks

• Check Reg
  • Display one preprocessed functional image and one structural image
  • Check whether and where the two images differ.
  • Right click on the structural image and select «Contour/Display onto/all but current»
  • Right click on the structural image and select «Contour/Options/Number of lines» → enter 2
Image realignment

Check Movement
Create plot:

load rp_afmri01.txt
load rp_afmri02.txt
figure('Color', [1 1 1]);
subplot(2,1,1);plot(rp_afmri01(:,1:3)); hold all; title('translation'); legend(['x';'y';'z']); ylabel('mm')
subplot(2,1,2);plot(rp_afmri01(:,4:6)); hold all; title('rotation'); legend({'pitch'}; {'roll'}; {'yaw'}))
xlabel('images'); ylabel('degrees')

figure('Color', [1 1 1]);
subplot(2,1,1);plot(rp_afmri02(:,1:3)); hold all; title('translation'); legend(['x';'y';'z']); ylabel('mm')
subplot(2,1,2);plot(rp_afmri02(:,4:6)); hold all; title('rotation'); legend({'pitch'}; {'roll'}; {'yaw'}))
xlabel('images'); ylabel('degrees')
SPM main menu

• SPM Batch Editor
Correct differences in image acquisition time between slices. Slice-time corrected files are prepended with an 'a'.

Note: The sliceorder arg that specifies slice acquisition order is a vector of N numbers, where N is the number of slices per volume. Each number refers to
Image time-series → Realignmen → Normalisation → Template → Kernel → Smoothing → General linear model → Design matrix → Parameter estimates → Statistical inference

Statistical parametric map (SPM) → Gaussian field theory

$p < 0.05$
SPM main menu

- Modeling data, performing statistics on the fMRI data.
Task

Fixation

Press right

Press left
Design

• First run: Block design – same direction of arrow shown in blocks of 15 seconds with null blocks included.
• Second run: Event-related design – direction of arrow changed every 3 seconds with null trials included.
Behavioral data

Behavior analysis (Errors etc.)

All behavioral data (raw data)

Regressors for DCM

Regressors for all 4 conditions

Regressors (left arrow vs. right arrow)

Regressors (left press vs. right press)

Wedge regressors with arrow modulation

Wedge regressors (event) and motor regressors (events)

Regressors (TL-BR wedge vs. TR-BL wedge)
Conditions in LRArrowRegs01/02
Conditions in LRPressRegs01/02

RightPress

LeftPress

RightPress

LeftPress
Conditions in WedgeRegs01/02

TopRight-BottomLeft

TopLeft-BottomRight

TopRight-BottomLeft

TopLeft-BottomRight
Conditions in IndividualRegs01/02

TR-BL: Arrow Right

TL-BR: Arrow Right

TR-BL: Arrow Left

TL-BR: Arrow Left
Task

Using the function «teach_check_behav»
• plot data in BehavRun01 and BehavRun02
• plot data in BehaviorSummary01 and BehaviorSummary02
Task

What questions can we answer with this data set?
• Formulate research question
• Derive hypotheses
• How would your GLM look like?

Design matrix
Preparation

• If you still have the files from the preprocessing ready on your computer, you do not need to do anything.

• If not you can do the following:
  • For Sub01 copy the raw functional scans from scandata to functional, and the raw structural scan from scandata to structural
  • Open MATLAB, add path to SPM12, go to the folder where you have saved the function “teach_prepro_subject.m” and type: `teach_prepro_subject('path/to/Sub01', 1);`
GLM – General information

• Scanning parameters: TR = 2.2 s; slice order: ascending; number of slices = 32

• Behavioral parameters:
  • In the file Behavior Summary there are:
    • tLeftStim and tRightStim → time (after scanstart) of presentation of left or right arrow.
    • tLeftPress and tRightPress → time (after scanstart) of left or right button presses
GLM – Specify first level
GLM – Set up design

Choose directory
Choose seconds
TR = 2.2 seconds
Then specify «Data & Design»
GLM – Set up design

Specify design using timing from e.g. stimulus presentation.

Include movement

Don’t forget 2nd condition! Repeat for second run!