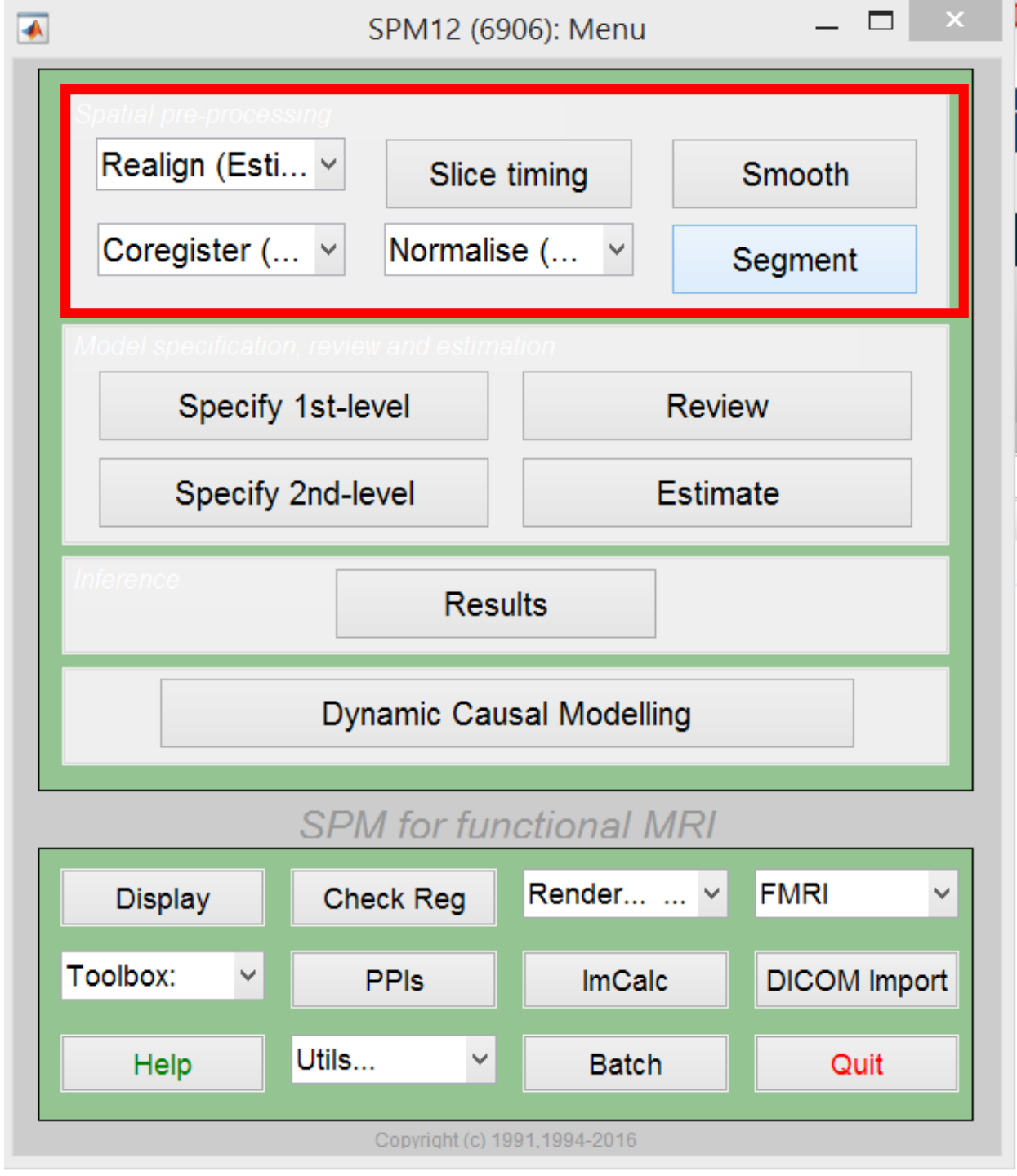
Tutorial

Preprocessing Checks/

Research question and GLM

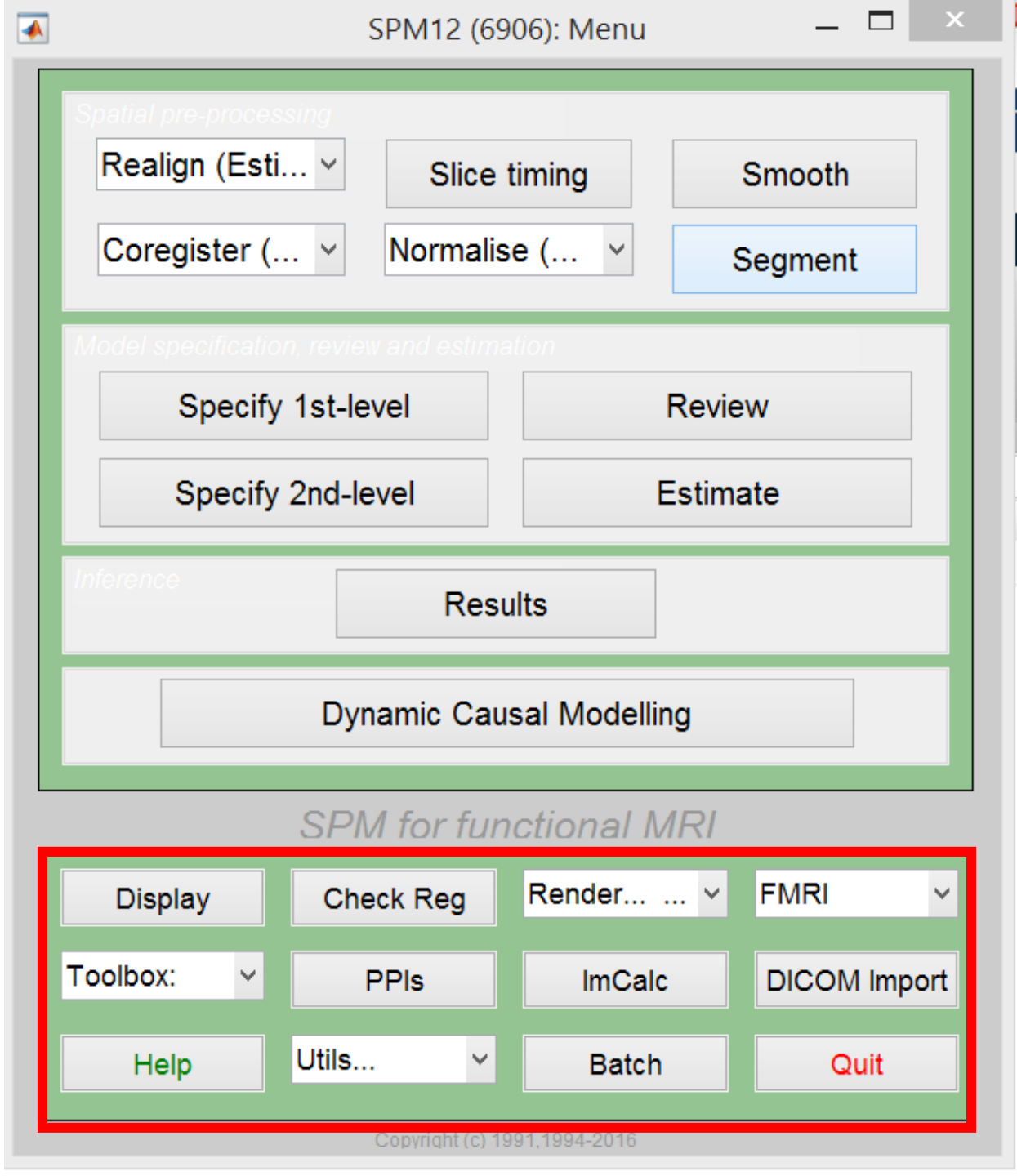
SPM main menu

- Functions to preprocess fMRI data.
- e.g. Smooth
- e.g. Coregister



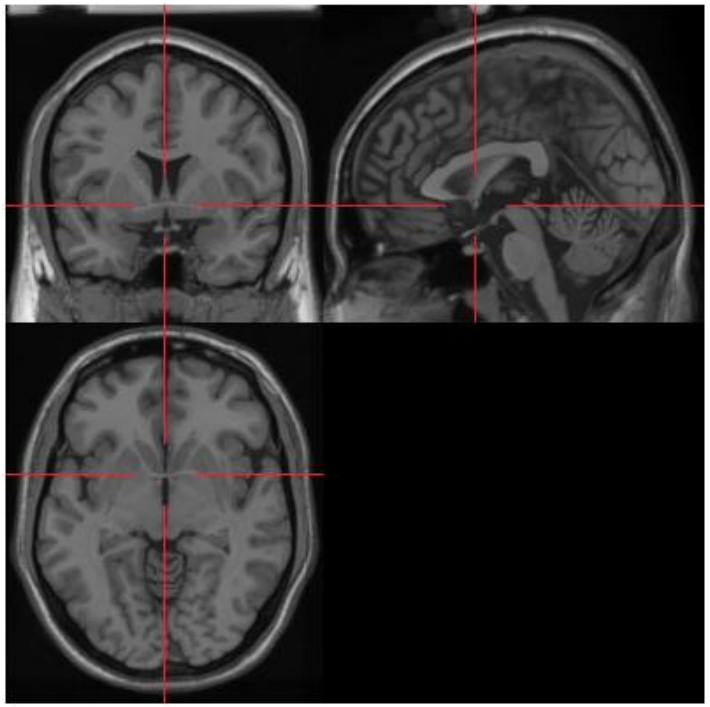
SPM main menu

- Other useful tools.
- e.g. Display
- e.g. Check Reg
- e.g. ImCalc

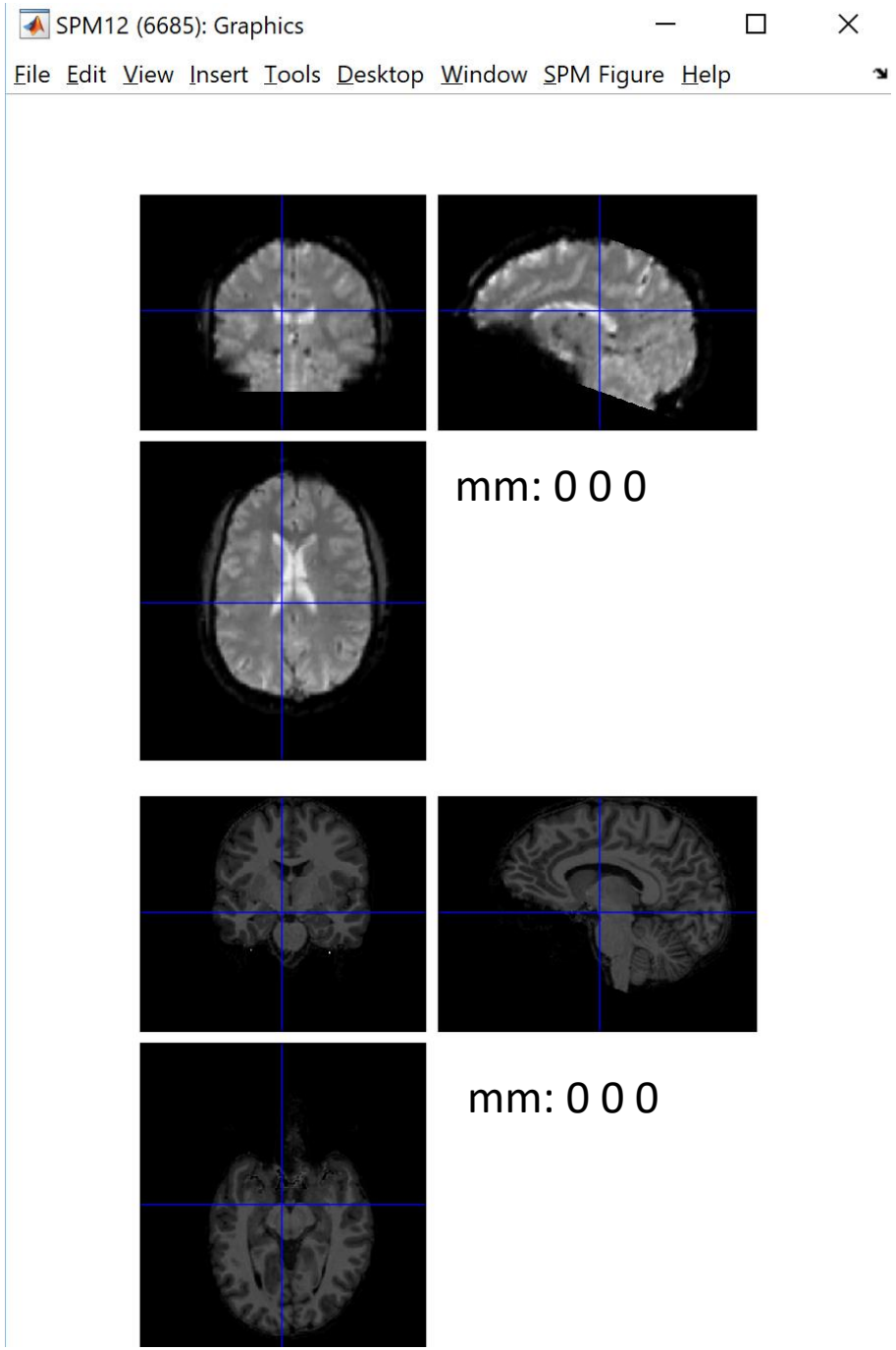


Reorientation

- Fist step before preprocessing
- Set origin to anterior commissure:

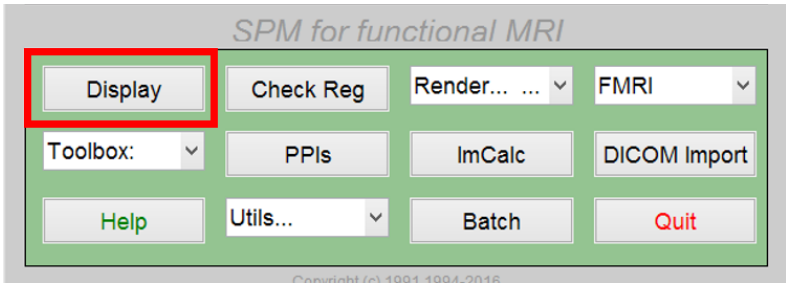


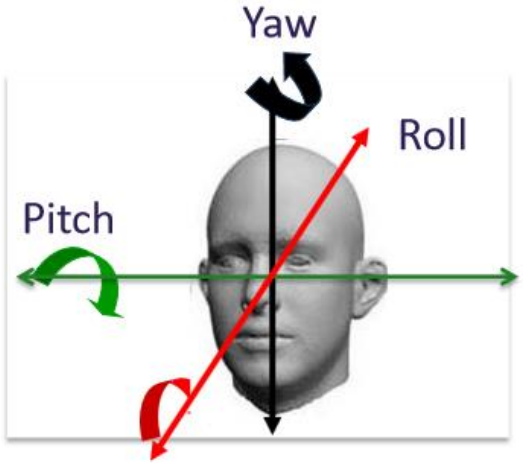
http://imaging.mrc-cbu.cam.ac.uk/imaging/FindingCommissures

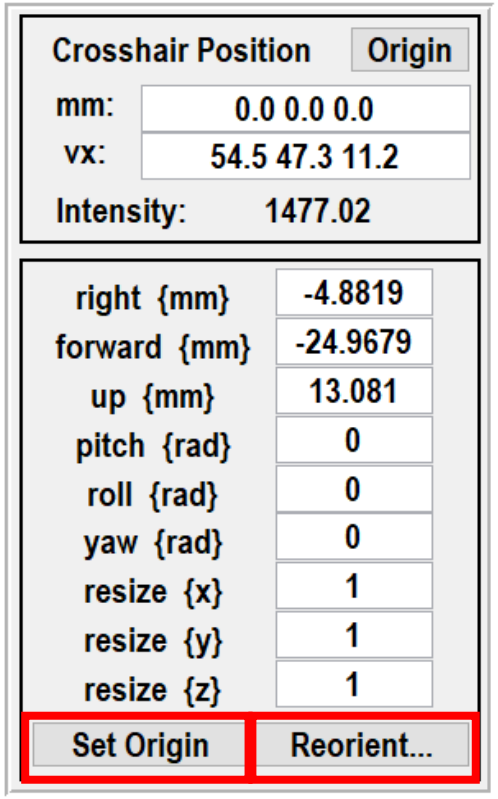


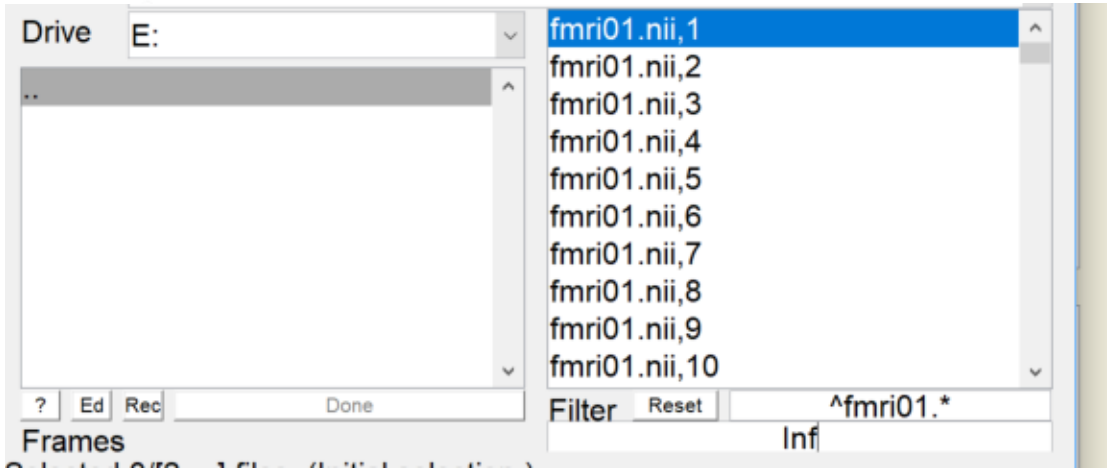
Reorientation

- 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

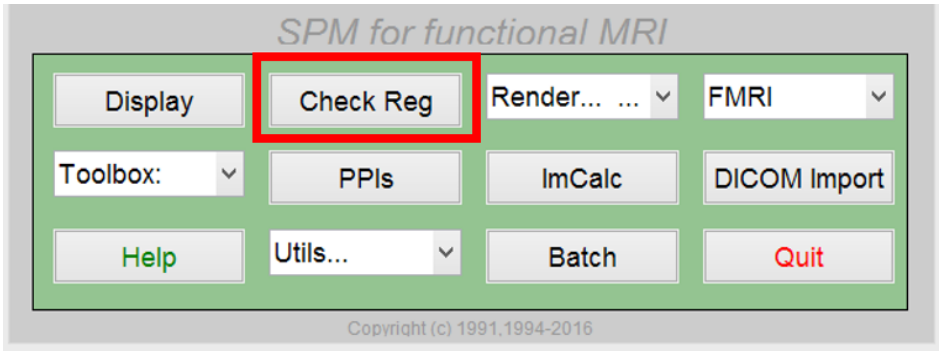
Guide to image prefixes:

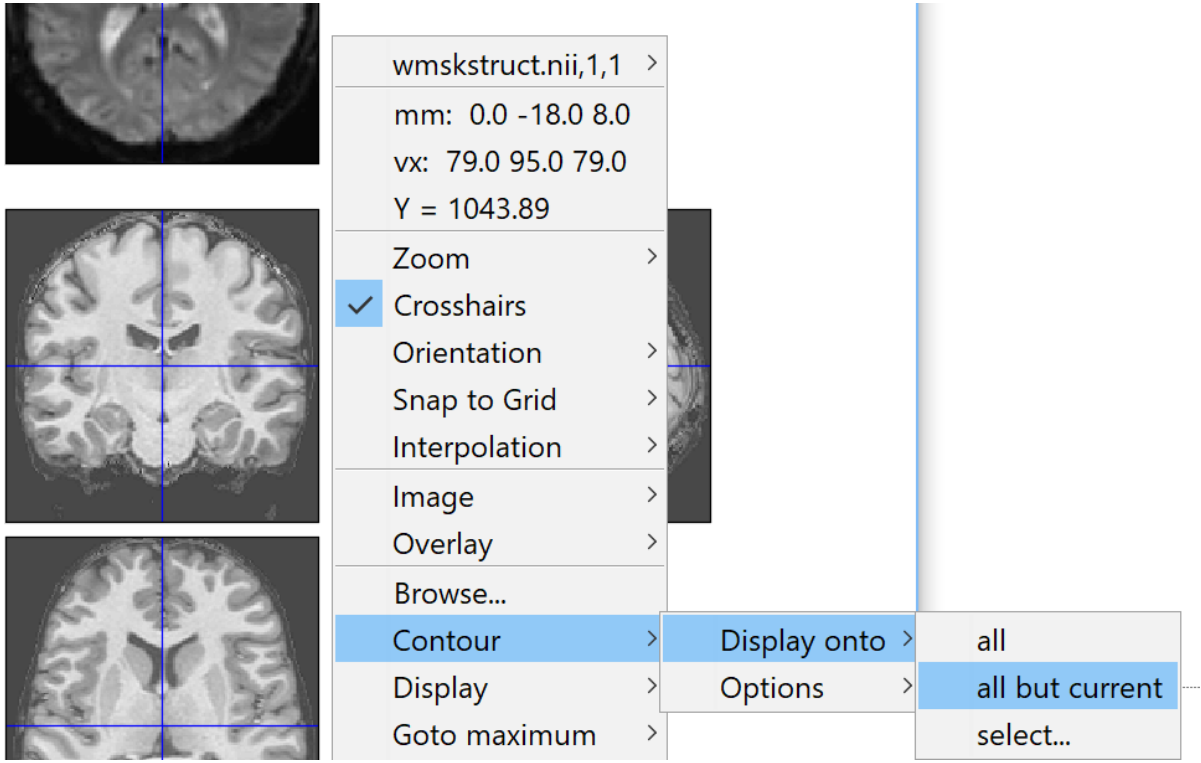
- a: slice-timing corrected
- r: resliced
- m: bias corrected (modulated)
- w: normalised (warped)
- s: smoothed

- 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

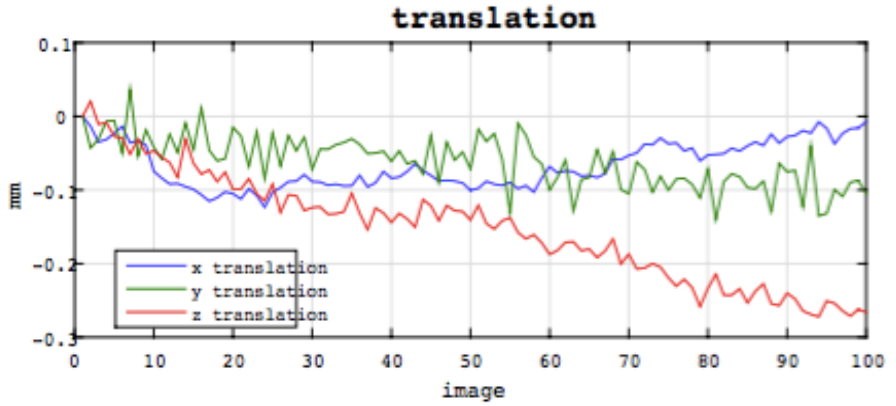


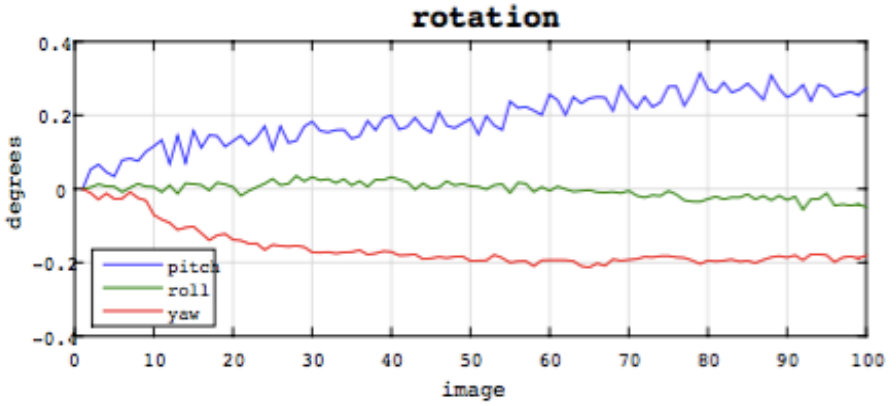


Check Movement

Image realignment

```
1   /Users/kasperla/Dropbox/Conferences/SPMZurich15/PracticalsPhysIOPreproces
2   /Users/kasperla/Dropbox/Conferences/SPMZurich15/PracticalsPhysIOPreproces
3   /Users/kasperla/Dropbox/Conferences/SPMZurich15/PracticalsPhysIOPreproces
4   /Users/kasperla/Dropbox/Conferences/SPMZurich15/PracticalsPhysIOPreproces
5   /Users/kasperla/Dropbox/Conferences/SPMZurich15/PracticalsPhysIOPreproces
6   /Users/kasperla/Dropbox/Conferences/SPMZurich15/PracticalsPhysIOPreproces
7   /Users/kasperla/Dropbox/Conferences/SPMZurich15/PracticalsPhysIOPreproces
8   /Users/kasperla/Dropbox/Conferences/SPMZurich15/PracticalsPhysIOPreproces
9   /Users/kasperla/Dropbox/Conferences/SPMZurich15/PracticalsPhysIOPreproces
10  /Users/kasperla/Dropbox/Conferences/SPMZurich15/PracticalsPhysIOPreproces
11  /Users/kasperla/Dropbox/Conferences/SPMZurich15/PracticalsPhysIOPreproces
12  /Users/kasperla/Dropbox/Conferences/SPMZurich15/PracticalsPhysIOPreproces
.............. etc
```





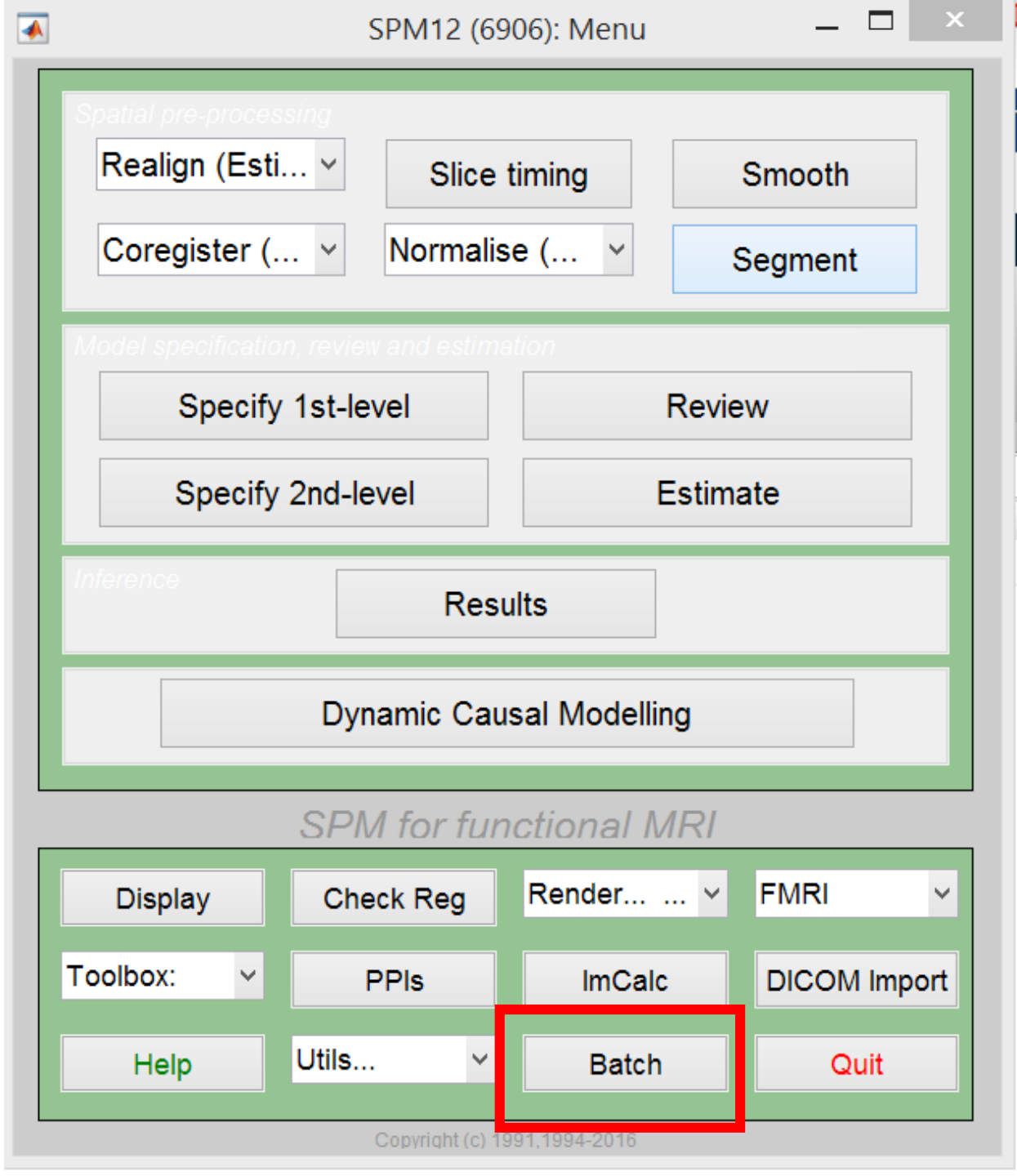
Create plot:

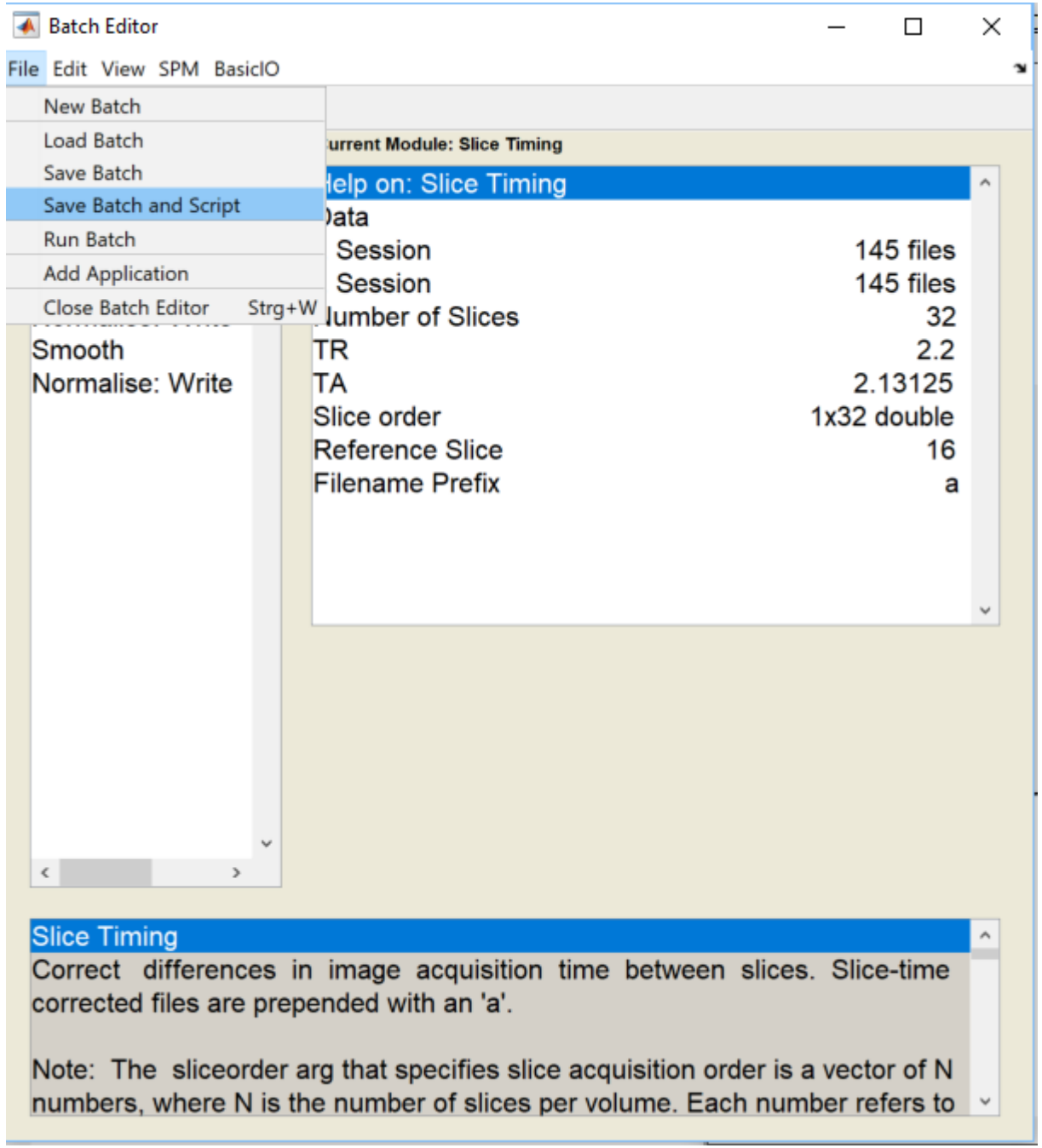
```
load rp_afmri01.txt
load rp_afmri02.txt
figure('Color', [1 1 1]);
subplot(2,1,1);plot(rp_afmri01(:,1:3)); hold all;title('translation'); legend(['x';'y';'z']); ylabel('mm')
subplot(2,1,2);plot(rp_afmri01(:,4:6)); hold all;title('rotation'); legend([{'pitch'}; {'roll'}; {'yaw'}])
xlabel('images');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




Batch Editor
File Edit View SPM BasicIO
New Batch
Load Batch
Save Batch
Save Batch and Script
Run Batch
Add Application
Close Batch Editor Strg+W
urrent Module: Slice Timing
elp on: Slice Timing
ata
Session 145 files
Session 145 files
lumber of Slices 32
TR 2.2
TA 2.13125
Slice order 1x32 double
Reference Slice 16
Filename Prefix a
Smooth
Normalise: Write
Slice Timing
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

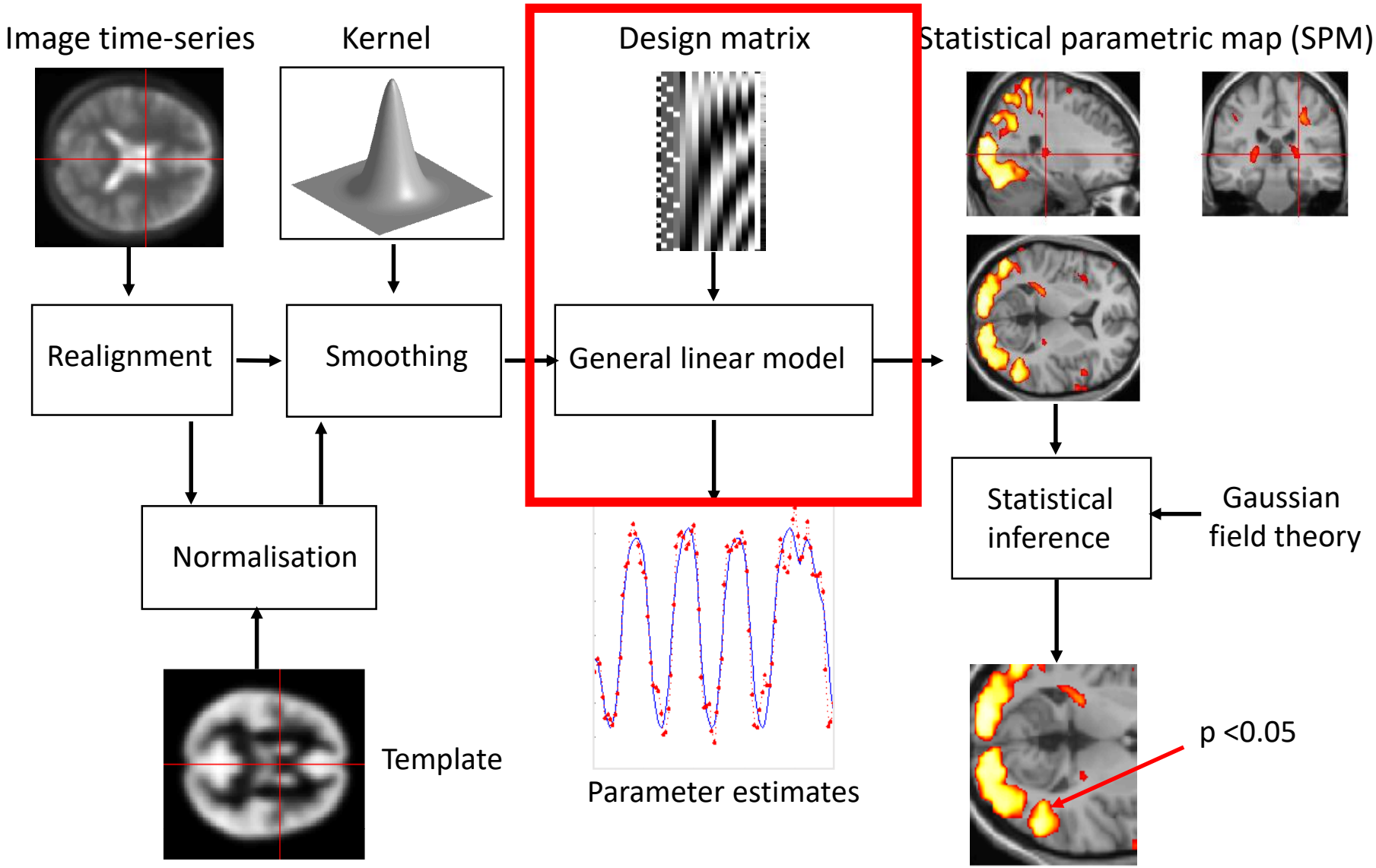
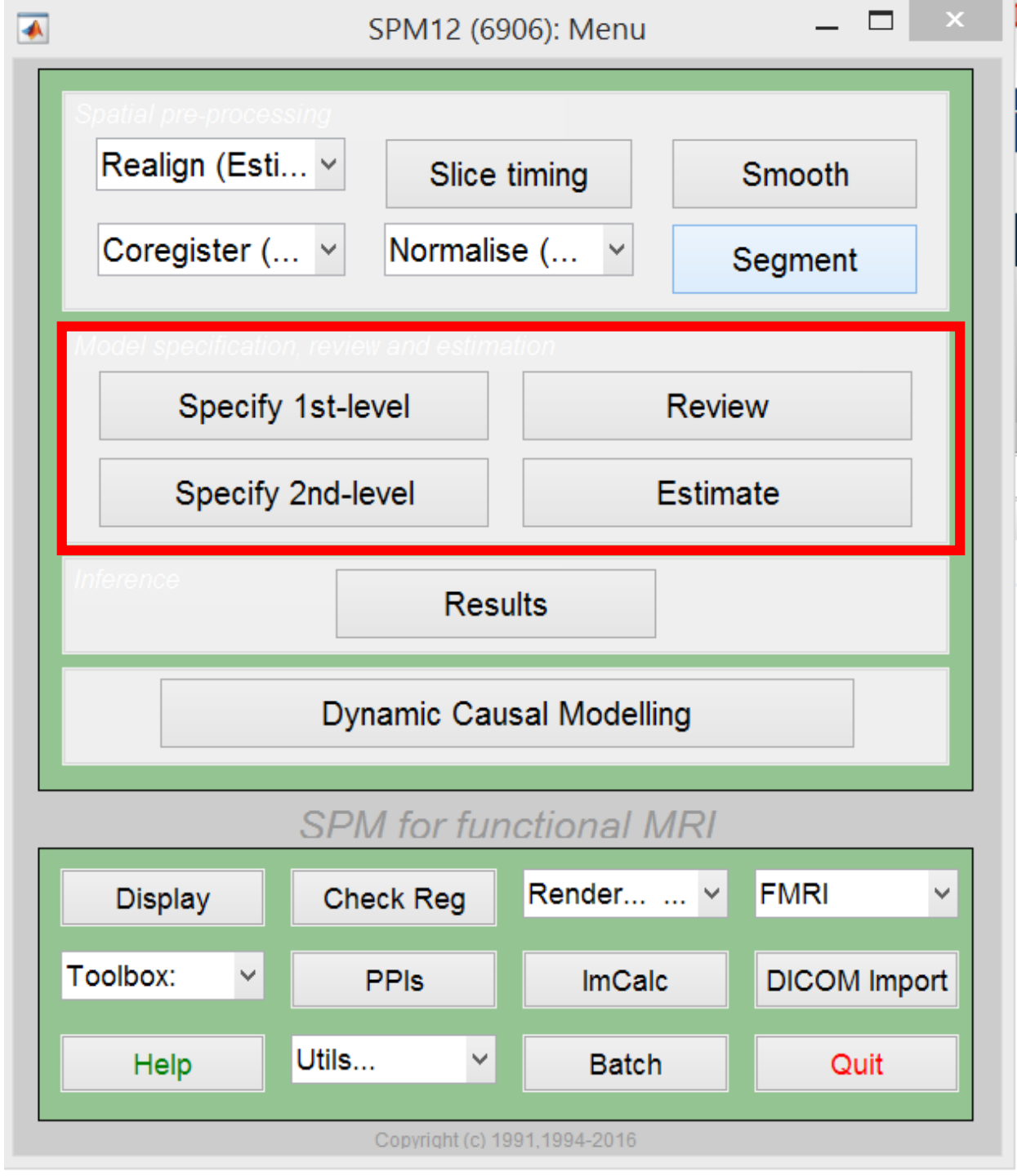


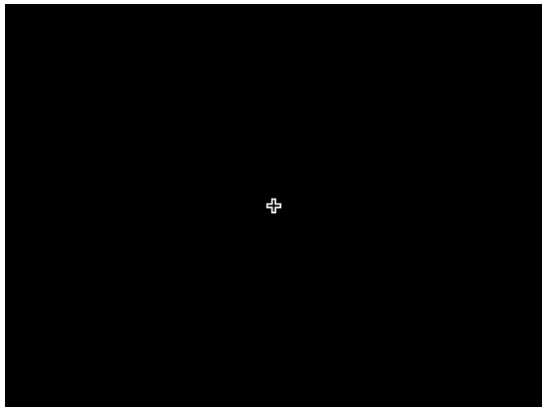
Image time-series
Kernel
Design matrix
Statistical parametric map (SPM)
Realignment
Smoothing
General linear model
Normalisation
Statistical inference
Gaussian field theory
Template
Parameter estimates
p <0.05

SPM main menu

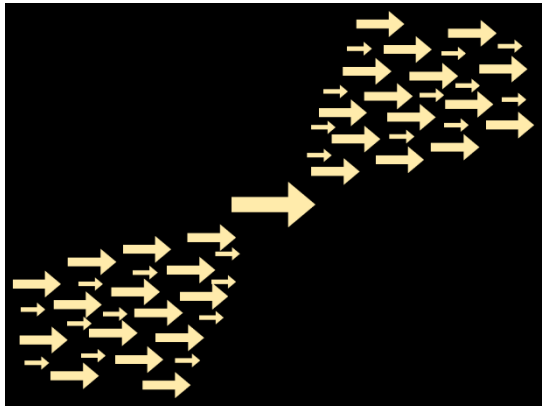
- Modeling data, performing statistics on the fMRI data.

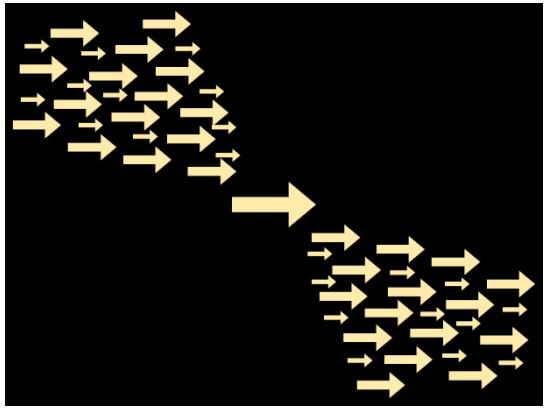


Task

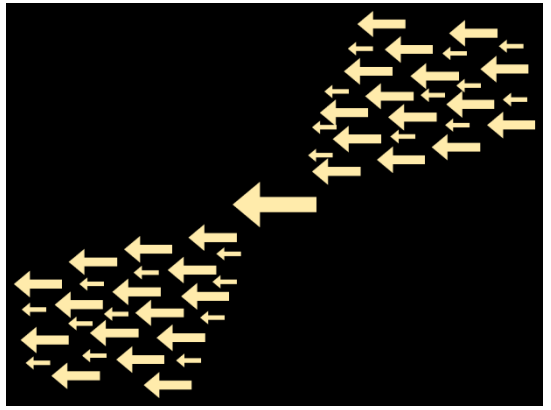


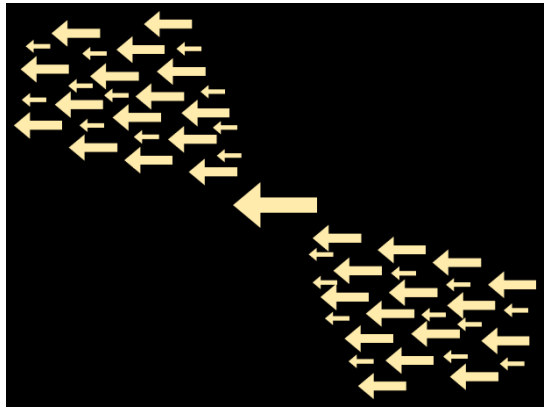
Fixation





Press right



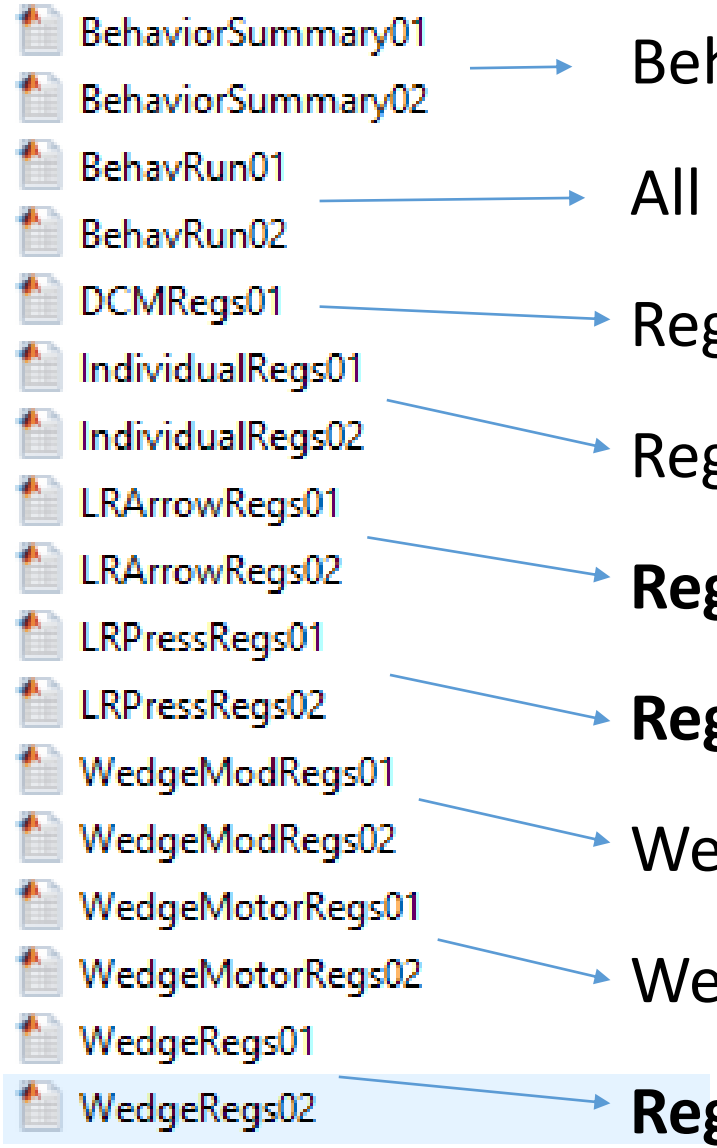


Press left

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)

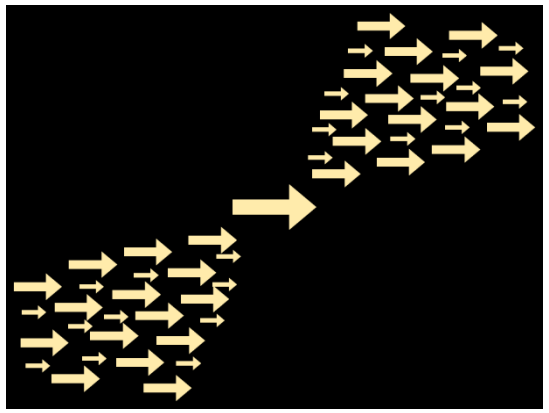
Regressors (left press vs. right press)

Wedge regressors with arrow modulation

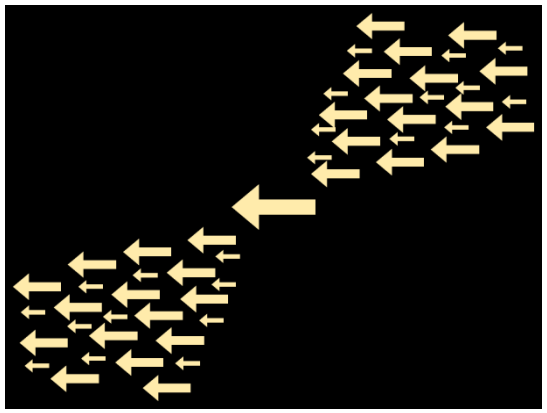
Wedge regressors (event) and motor regressors (events)

Regressors (TL-BR wedge vs. TR-BL wedge)

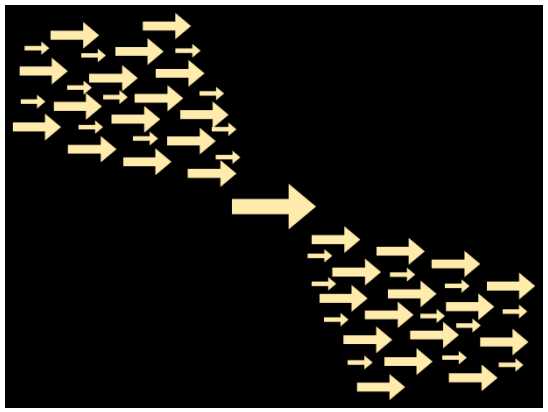
Conditions in LRArrowRegs01/02



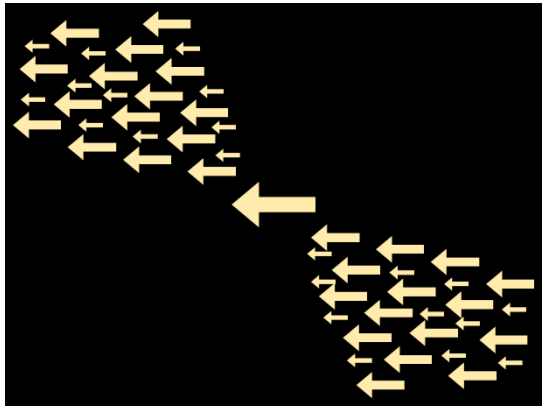
RightArrow



LeftArrow

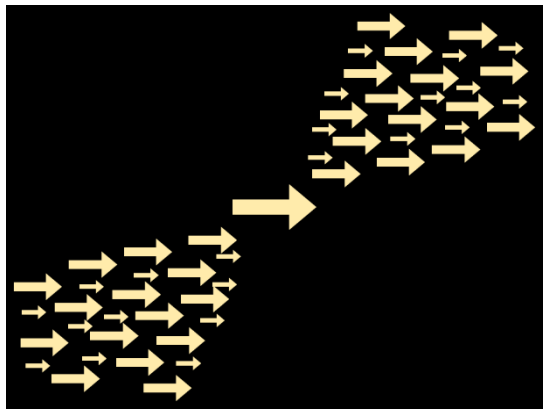


RightArrow

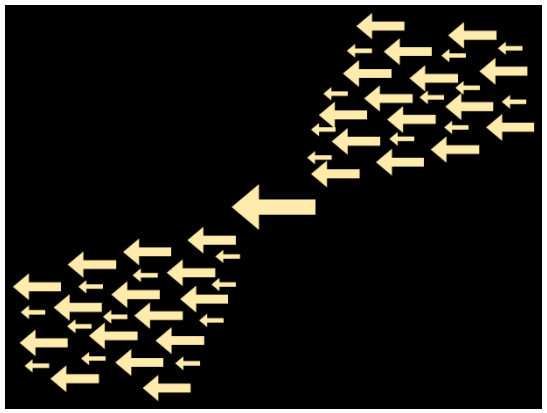


LeftArrow

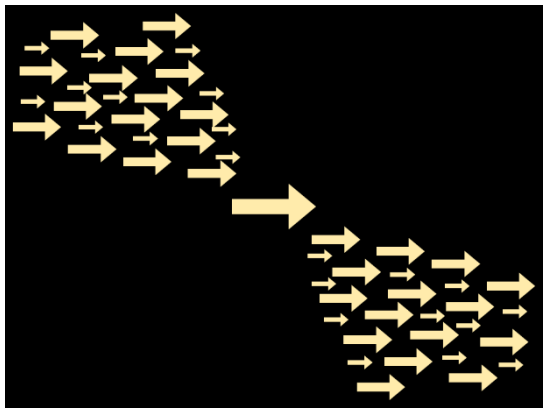
Conditions in LRPressRegs01/02



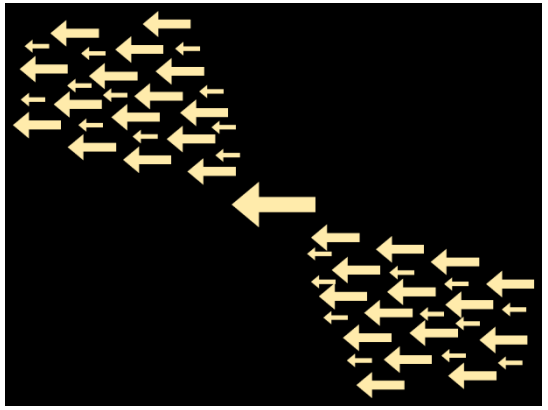
RightPress



LeftPress

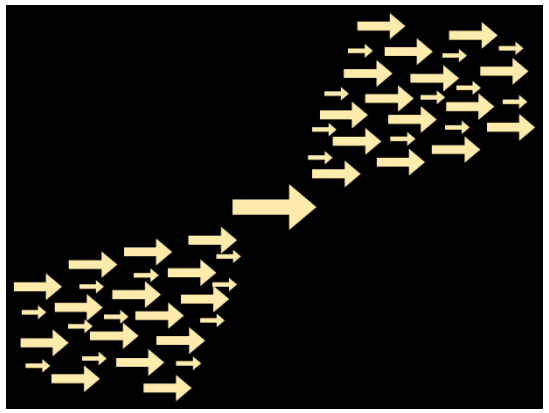


RightPress

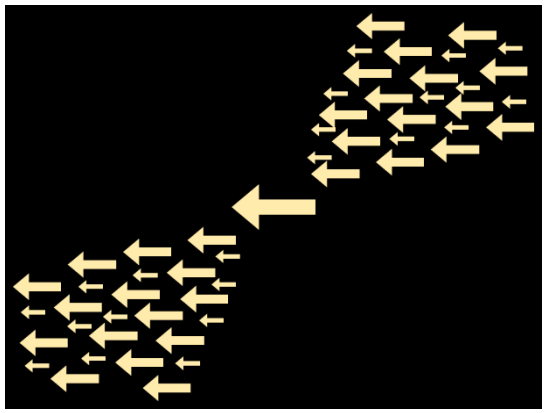


LeftPress

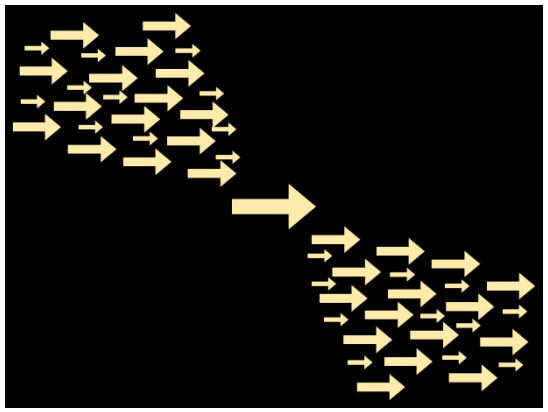
Conditions in WedgeRegs01/02



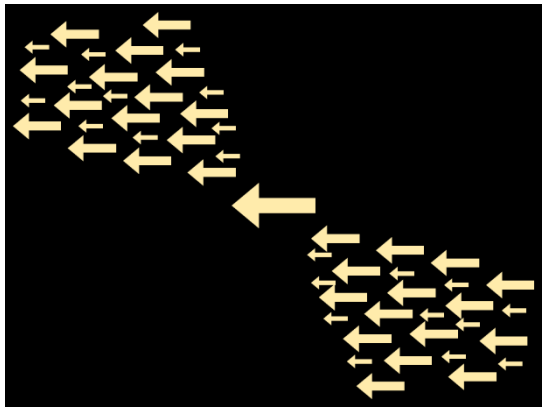
TopRight-BottomLeft



TopRight-BottomLeft

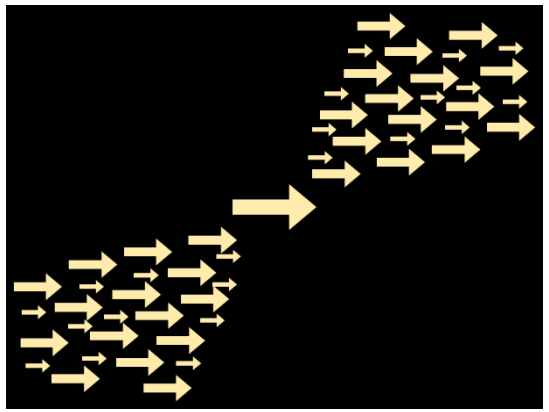


TopLeft-BottomRight

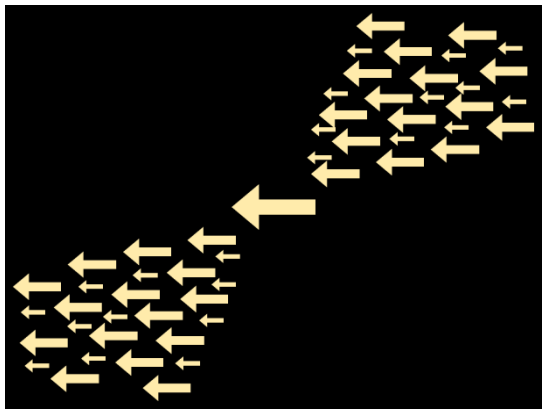


TopLeft-BottomRight

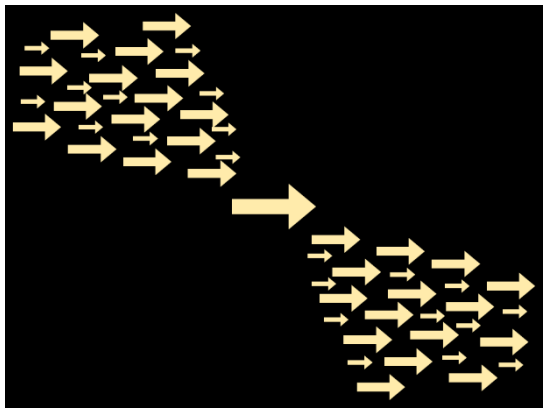
Conditions in IndividualRegs01/02



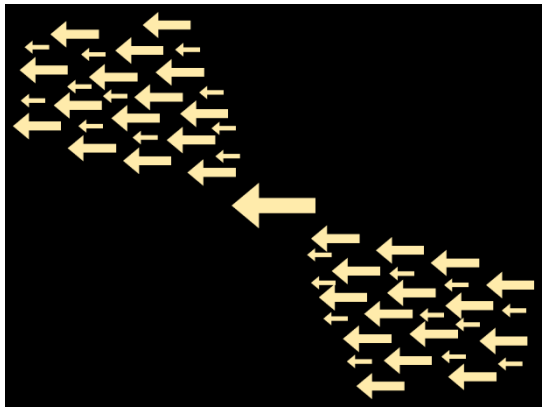
TR-BL: Arrow Right



TR-BL: Arrow Left



TL-BR: Arrow Right



TL-BR: Arrow Left

Task

Using the function «teach_check_behav»

- plot data in BehavRun01 and BehavRun02
- plot data in BehaviorSummary01 and BehaviorSummary02

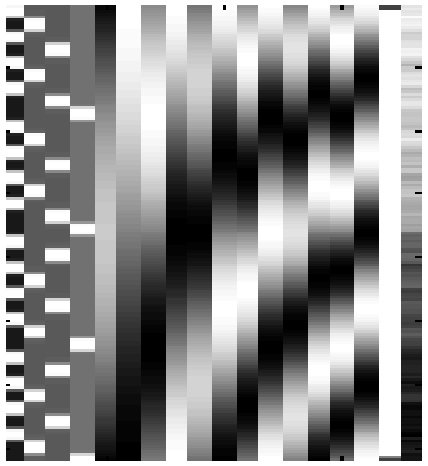
Task

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:

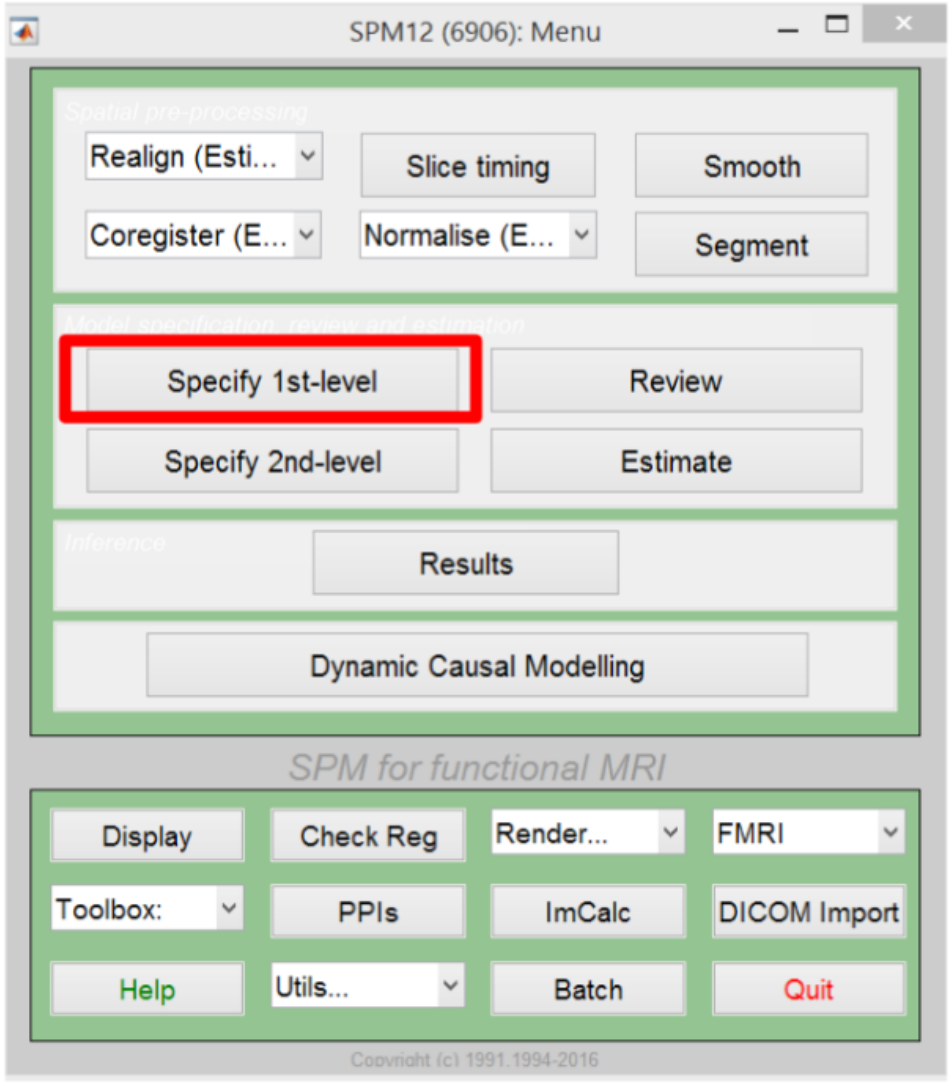
```
teach_prepro_subject('path/to/Sub01', 1);
```

GLM – General information

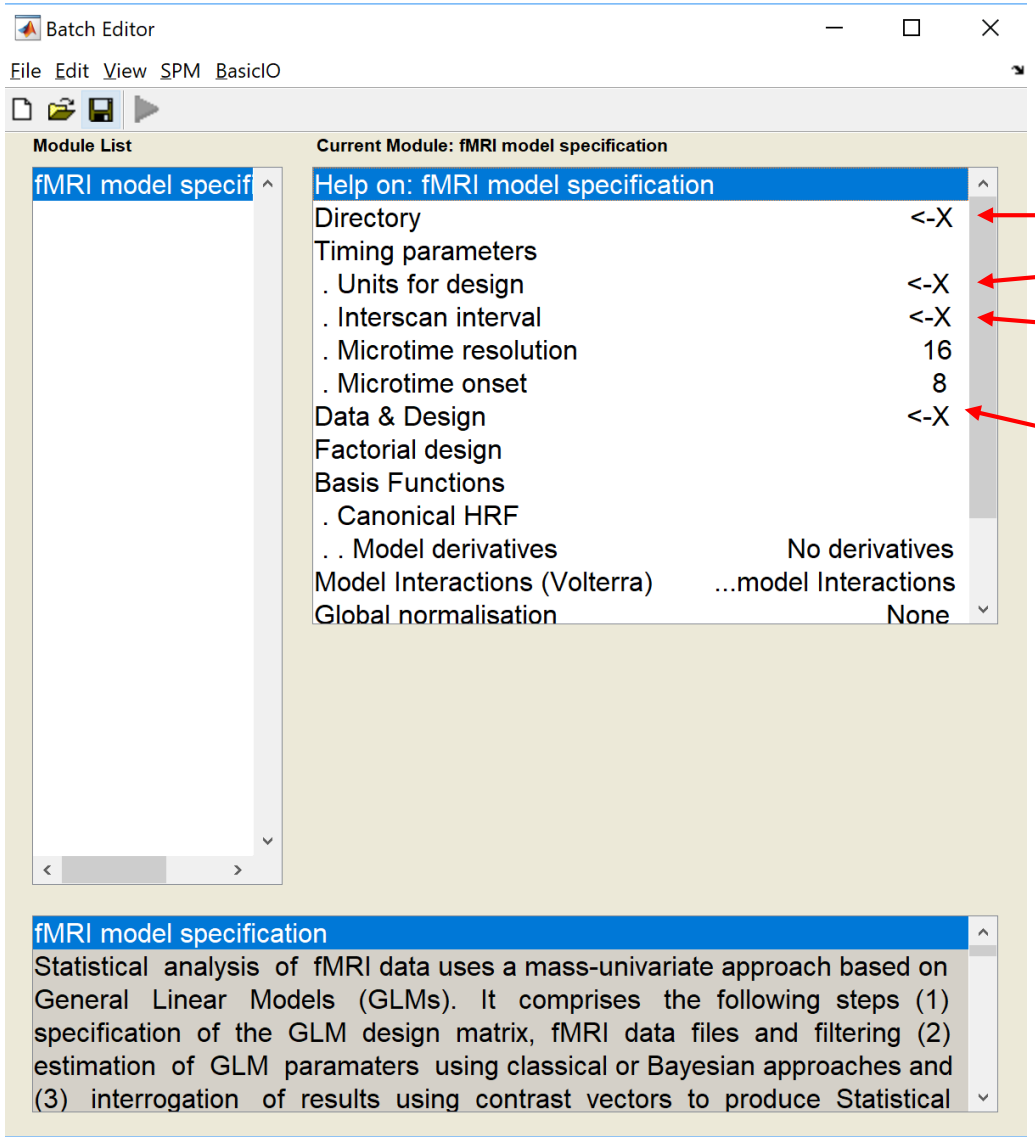
- Scanning parameters:TR = 2.2 s; slice order: ascending; number of slices = 32

- 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



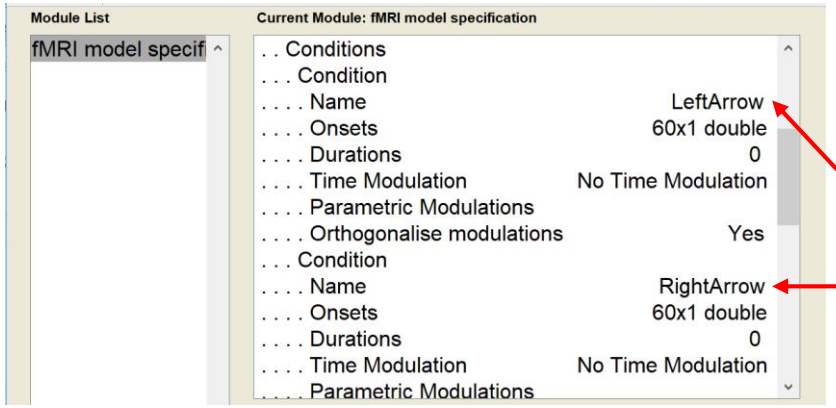
Choose directory

Choose seconds

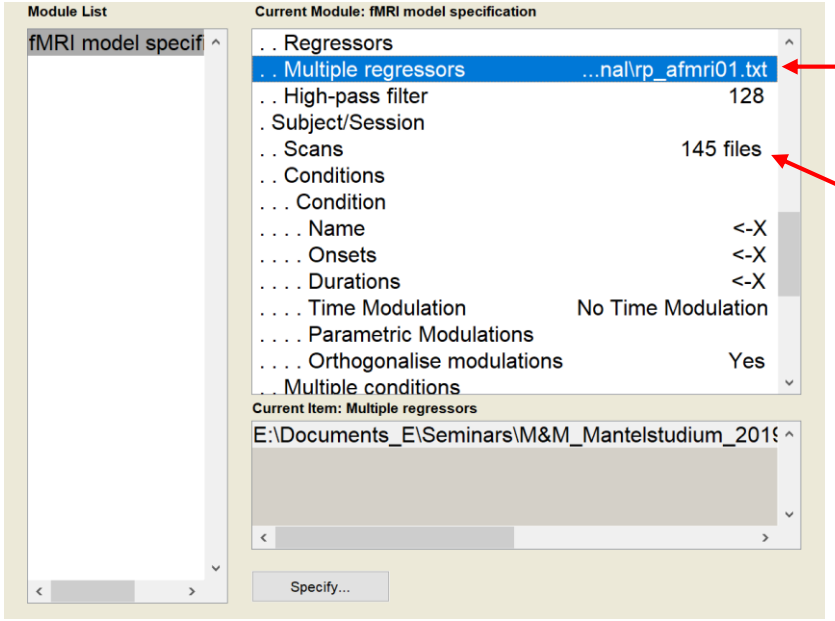
TR = 2.2 seconds

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!