Homework #4

Data Analysis in Event-related Design

Zhu's Intro. fMRI

Due date: April 17, 2013

1. (10 points) With the "deconv.s" as an example in the event-related design study (the "Flanker study"), in one or two sentences, please explain what AFNI program "3dDeconvolve" does. Then explain how I got the following files or numbers: "reg_cat_TSall+orig", the "2" in "-polort", the "9" in "-num_stimts", the content of "concat.1D ", what is the "2" in "TSall_analy.1D[2]", the "0" and "6" in "-stim_minlag 3 0 -stim_maxlag 3 6", "mask800+orig", "-tout", the "3" in "-num_glt 3", "-gltsym 'SYM: +ICong[0..6] -Cong[0..6]', and "-iresp 2 IRF_ICong".

   Hint:
   3dDeconvolve –help
   "3dDeconvolve" resolves IRFs and performs relevant statistical analysis.

   Additional hints:
   The "2" in "-polort": model the system to correct baseline, linear trend and quadratic trend of the image signal at each voxel.
   The "2" in "TSall_analy.1D[2]": the 3rd stimulus type.
   The "0" and "6" in "-stim_minlag 3 0 -stim_maxlag 3 6": Modeling IRF for the "Neutral" condition starting at time point zero, and ending at time point 6 (6 x 2.5 sec = 15 sec). The IRF is assumed to return to baseline after 15 sec.
   "-gltsym 'SYM: +ICong[0..6] -Cong[0..6]': The contrast of "ICong – Cong" conditions. "ICong[0..6]" means adding Points 0 to 6 of the ICong IRF.
   "-iresp 2 IRF_ICong": Output the ICong IRF.

2. (5 points) How % signal change is calculated in event-related design?

   % signal change is estimated as: [(Sum of all points of IRF)/baseline] x 100%, more specifically,

$$\%SignalChange \approx \frac{\sum_{m=0}^{p} h_m}{baseline\_signal} \times 100\%$$

3. (15 points) For the subjects in the flanker study, I have assumed that the homodynamic responses would come back to the baseline after 15 sec. In one subject, I found that the homodynamic responses should be modeled a bit longer. It looks like 20 sec will be good. Could you modify the script and analyze this dataset with this new model?

The dataset is /fmri/PI/training/Class_Intro_fMRI/ZhuFlanker/zhu_E12708.tar.gz.

Please copy this dataset to your directory and analyze it.

Please attach the section of your scripts with the modifications. Show me the homodynamic response curves for the Incongruent and Congruent conditions at a voxel of the brain where significant differential activation is found. Attach the plots for the curves and the differential activation maps. Pleas also let me know the directory where you analyze the data.

Hint:

Run the following for auto Talairach transformation:

@auto_tlrc -base TT_icbm452+tlrc -input T1Volume+orig

You change the model of the hemodynamic responses. For a TR of 2.5 sec, 20 sec is time point 8. For the "3dDeconvolve" command, you need to replace the "6" with "8" for all "-stim_maxlag" in the following codes:

```
    -stim_file 1 'TSall_analy.1D[0]' -stim_label 1 'Cong' -stim_minlag 1 0 -
stim_maxlag 1 6 \
      -stim_file 2 'TSall_analy.1D[1]' -stim_label 2 'ICong' -stim_minlag 2 0 -
stim_maxlag 2 6 \
      -stim_file 3 'TSall_analy.1D[2]' -stim_label 3 'Neutral' -stim_minlag 3 0 -
stim_maxlag 3 6 \
```

Correspondingly, replace the "6" with "8" in the following:

```
      -gltsym 'SYM: +Cong[0..6] -Neutral[0..6]' -glt_label 1 'Cong-Neutral' \
      -gltsym 'SYM: +ICong[0..6] -Neutral[0..6]' -glt_label 2 'ICong-Neutral' \
      -gltsym 'SYM: +ICong[0..6] -Cong[0..6]' -glt_label 3 'ICong-Cong' \
```

If you analyze the data in the same directory that you analyzed before, change the names for the IRF "iresp" files and the deconvolution "bucket" file.

4. (20 points) Please include the above subject to the group analysis that you did in the lab exercise. Re-run the group analysis. Please attach your script and representative pictures showing the differential activation between the Incongruent and Congruent conditions, and their activations versus baseline at this same anatomical location.

   Hints:

Copy “PerSigChan.s” to the “/E12708/Afni_analy” directory. Open “afni” at this directory with “T1Volume” as “Underlay” and “deconv_TS” as “Overlay”. Update the “PerSigChan.s” for this subject according to the “deconv_TS”. All numbers inside the “[ ]” should be checked and/or updated. Then run “PerSigChan.s” to generate all the % signal change “*_per_sig_ch” files.

Do Talairach Transformation.

Then run “PerSigChan.s” to generate all the % signal change “*_per_sig_ch” files.

Copy all the *_per_sig_ch+tlrc.* files to the “FLY_group_ANOVA2” directory with a new subject name.

In the “FLY_group_ANOVA2” directory, set up the “3dANOVA2” command to include this new subject (the 9th subject). You can also create a new script with the “3dANOVA2” command. The “8” of the ‘-blevels” should be “9” now. Add

```
-dset 1 9 FLY_new_Cong_per_sig_ch+tlrc \
-dset 2 9 FLY_new_ICong_per_sig_ch+tlrc \
-dset 3 9 FLY_new_Neutral_per_sig_ch+tlrc \
```

Update the name of the “bucket” file also.

Run the 3dANOVA2 script.

You can then run “afni” to display the activation maps (“T1Volume” as the underlay, and the bucket name as the overlay).