Functional Brain Imaging Systems

Computer Assignment #2   Due: 17/3/00
Analysis of functional MR images (A single subject study)

I- Questions
1- What is the purpose of temporal filtering (as a preprocessing step) in fMRI analysis? Which kinds of filters are applied to fMRI data?
2- What are the limitations of MRI scanner for doing an auditory experiment? Do you know any technique to overcome this?
3- How we can measure the hemodynamic response function with a temporal resolution more than the repetition time (TR) of our MRI pulse sequence?
4- Briefly discuss the limits of spatial resolution in fMRI.

II-- Data Analysis

In this part you will perform a (partially) complete analysis of fMRI data with spm/fsl. To complete this part of homework you need SPM or fsl. If you are familiar with linux you may select fsl as your analysis framework, otherwise spm works better for you. Try to download and install the latest version of these softwares, if you don't already have them. Tutorial (step by step) instructions for working with fsl and spm are provided in their websites.

Data specifications and location You may find the specification and main data at
http://nbml.ir/FA/scientific-tournament/558184
Choose the data of one run from all 15 runs according to the last digit (least significant digit=first digit from right) of your student ID. If it is zero choose run 10.
The raw data EPI data is put in dicom format.
i) Remove several (as required) first EPI volumes for the reason of intensity stability.
ii) Do the motion correction and report the estimated motion parameters (in 6 directions) in your report.
iii) Do the spatial filtering with FWHM of 5 mm. You do this step for validating the final results that you will get based on GRF.
iv) Remove the trends through high pass filtering (state the cut-off frequency you used in your report).
v) Set up your model (design matrix) with five exploratory variables corresponding to scene, object, scrambled, body and face. Model the noise with an AR process (both softwares have this capability). Use suggested HRF by the software to be convolved with the stimulation pattern. Print the resulted design matrix which is visualized by the software.

vi) Set up four t-statistics to detect the activation areas corresponding to the below items.
a) Some regions of the brain which are activated during the scene and not activated during scrambled.
b) Some regions of the brain which are activated during the object and not activated during scrambled.
c) Some regions of the brain which are activated during the body and not activated during scrambled.
d) Some regions of the brain which are activated during the face and not activated during scrambled.
vii) Let the software does the statistical analysis and obtain the T statistical maps of the previous

items. Obtain the activated areas of above items for a threshold of 0.01 for corrected (for FEW) p-values. State the correction you select. Overlay the activated areas on the structural (T1-weighted) image. Then print proper slices (which point to activated parts of the brain) for all above items, and include them in your report. (please montage the output file in word file to save space)