HST.583 Functional Magnetic Resonance Imaging: Data Acquisition and Analysis
Fall 2008

Laboratory 1: Introduction to fMRI Data Analysis

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Instructions

Get fMRI data from internet

1. First log on to the iMac using your MIT server login and password.
2. Click on Safari in the dock at the bottom of the screen (looks like a compass); this is Mac OS X's internet browser.
3. Type in *www.neurolens.org* into the address field.
4. Click on "Tutorials" from top links.
5. Right click on "Data and PDF document (29 megs)" under Tutorial 1, and choose "Download linked files as ..."
6. Click on "Desktop" under "Places" on left pane; then click the "Save" button to save *Tutorial1.zip* onto your Mac desktop.
7. Click on *Tutorial1.zip* which will decompress into the *Tutorial1* folder.

Run Neurolens fMRI Analysis Software

1. Click on Spotlight which is the little magnifying glass in the top right corner of your screen, a blue text field bar will open.
2. Type in "Neurolens"
3. Click on the Neurolens Icon which should be the "Top Hit". This will open Neurolens; you will see it in the dock.
4. Right-click on the Neurolens icon in the dock, and choose "Keep in Dock". This will keep the icon in the dock even after it quits.

Open tutorial document

1. We will be using a *modified* document for this tutorial, NOT the one that came with *Tutorial1.zip*!
2. Click the *Tutorial* folder. A new finder window will open up
3. Click on "MacData" under "Places" in left-hand plane
4. Click on afs.course => other => HST.583
5. Double-click on "Tutorial1New.pdf"; this will open up the tutorial in a new window
6. Keep this window on your desktop; you can refer to it to complete the lab 1 exercises.

Load and analyze real fMRI data

1. Start following the instructions listed on page 5 of the tutorial, under *Exercise 1: Loading the DICOM files*. As a short-cut, you can just drag the *DICOM* sub-folder in the *Tutorial1* folder onto the Neurolens icon in the dock. This will load the data.
2. Continue through to exercise 4
3. Answer the lab questions on subsequent page.
4. BONUS (if you have time): complete exercises 5 and 6.

Laboratory 1: Questions

Use Neurolens, the tutorial document, and your textbook to help answer all questions! Feel free to answer using graphical explanations (i.e. a sketch!)

1. Take a look at the -log(p) map you generated in exercise 4. Voxels whose time course match the model with statistical significance are non-zero (i.e. either yellow or blue, not green). There are two such regions located side-by-side near the posterior section (i.e. towards the rear) of the brain; this area is known as the visual cortex.
   a. Do these regions appear to be in the right places based on how the visual fields map to the visual cortex? Explain.
   b. One of these regions is yellow (I.e. positive), and one is blue (i.e. negative). Why is this the case? Does the negative patch indicate a region of *de*activation as opposed to activation?
   c. There are also blue and yellow patches in other areas of the brain. Command-click on some of these voxels to see the corresponding time-course and model fit in the original data window. Do you think we have located new functional areas outside the visual cortex that respond to visual stimulation?

2. Why was spatial smoothing done when analyzing the fMRI data? Could we *not* smooth the data before model fitting? What would be benefits and drawbacks of this more direct approach?

3. In this exercise, we performed model-fitting in one operation, implementing the two design regressors as well as the polynomial drift terms. Some researchers remove polynomial drift terms to first create a drift-corrected data set. They then perform their model-fitting using the design regressors on this drift-corrected set. Is this a better/ worse/ equivalent approach? Explain.

4. Run the Linear Modeling Action once more. After entering the design matrix, and specifying the contrasts, click on the “Ouputs” tab. Unclick -log(p) and choose “Standard error for effect” check boxes. Change the “Treshold” level to zero. Click “Run”. The standard error for effect window should pop-up.
   a. Choose the standard error window; move from the inferior to superior (lower to higher) slices of the brain using the mouse pointer or the scroll-wheel. Notice that the orbits (eyes) are considerably brighter (i.e. positive) than most of the brain tissue. Why would this be the case?
   b. Qualitatively, what is the standard error map telling you? For optimal detection, what would we like to see in this map? Explain.

5. List three ways to increase activation detection sensitivity in fMRI and elaborate on why the methods would work. Answers can be from an experimental design, acquisition, or data analysis point-of-view.