University of Washington
Computer Science and Engineering
Winter 2007

CSE 490 I: Design in Neurobotics

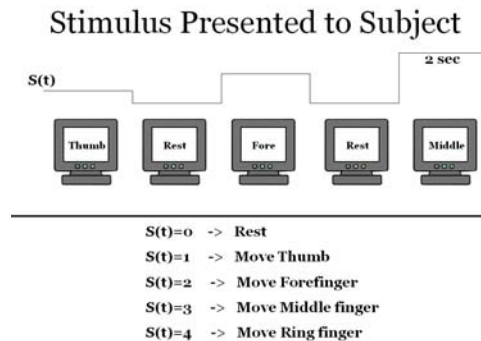Problem Set 5   Due: 10:30am on 2/16/2007

For the next two assignments, you will be using the real brain signals collected through electrocorticographic (ECoG) as was demonstrated by Kai Miller in his lectures.

You should first download all the data and MATLAB routines/demo you will use for this assignment. The files are large (each subject is 60 – 80 Mb and there are 5 subjects) so make sure you are prepared to spend some time downloading it.

Each subject data contains 3 relevant variables: stimulus information, finger position information, and signals from the brain surface. Review the lecture notes as needed to understand/remember them.

Stimulus S(t) presented to subject: It is what the subject saw on the computer screen as the command for their action.

Stimulus Presented to Subject

$S(t)=0$ -> Rest
$S(t)=1$ -> Move Thumb
$S(t)=2$ -> Move Forefinger
$S(t)=3$ -> Move Middle finger
$S(t)=4$ -> Move Ring finger

Finger position ($d1(t)$ --- $d5(t)$): This is the actual movement of fingers recorded from a dataglove (same glove as what you use in the lab). NOTE: YOU WILL NOT USE THIS DATA FOR THIS ASSIGNMENT (BUT YOU WILL USE IT IN THE NEXT ASSIGNMENT)

Use Behavioral Data from Glove
(finger displacement as a function of time)
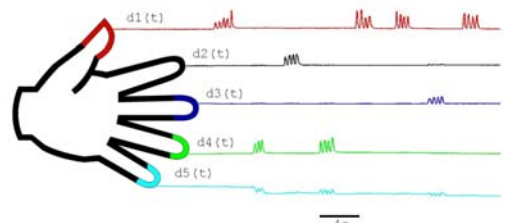
Signals from the brain surface: This is the signals from ECoG channels.

data(time,channel)
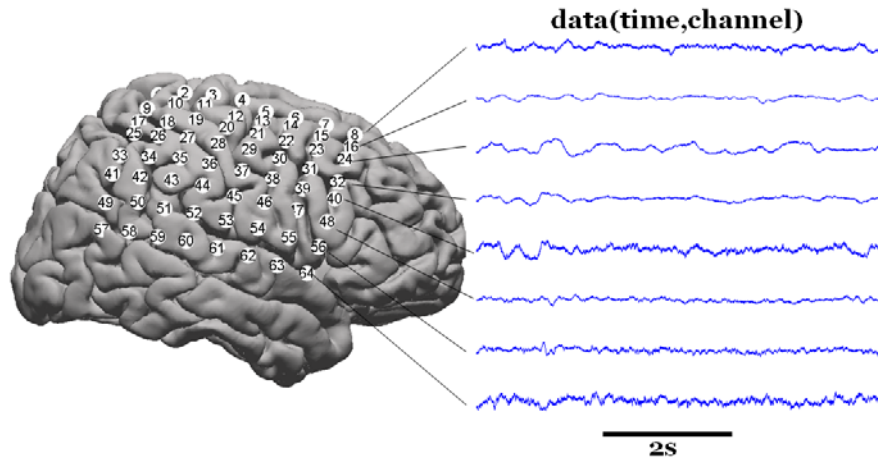
Your assignments are to (1) find the best frequency band in the ECoG signal based on what you learned in class and based on your data analysis, and (2) identify the channels that are correlated with the thumb movement (based on the stimulus (S(t)) the most.

Next week, you will find out the correlations between the dataglove data and all finger movements.

1. Your first job is to find the best frequency band to analyze the ECoG signals for hand movement. You can use any strategies you'd like to find the frequency range and the size of the band. For this assignment, only use the stimulus (S(t)) and not the dataglove data. You should report

(a) Your favorite frequency range and the size of the band, and
(b) The technique you used to find them. In this explanation, make sure to touch on the following issues: the effect of the frequency choice, the effect of the band width, the reasons/choice of the power calculation window, etc.

Hint: an exhaustive search is not recommended because the data size is so large and there are many range/width you can pick (and it doesn't show your ability to use the prior knowledge already learned in class). You should make a good guess based on what was covered in the lecture, and explore the "reasonable" range close to that. You will get rewarded for your technique, not for finding the absolute optimal frequency band.

2. Using the frequency band you identified above, identify one channel per subject that correlate to the thumb movement stimulus the most. You should report

(a) The channels you identified, and
(b) The technique you used to find them. In the explanation, make sure to touch on the following issues: the pruning process (i.e. going from, say, 3 candidates to one channel), if any of the adjacent channels were more correlated (and if so why), how well it is correlated, etc.