NBIO 303 Problem Set 1: Due 1/31/2014

Attached you will find two short matlab codes[1] . If you type generateNoisyData, you will be able to run an experiment giving you a 300 ms spike train in response to your input. Think of the input as the direction in which you are have deflected the cockroach spine, measured in degrees, and use values between 0 and 90. You can ask for as many repetitions as you like. The data will be in the variable "spiketrain" and will consist of a matrix of trials, each of which has millisecond timebins which are either zero if there was no spike in that bin, or one if there was.

1. Use MATLAB plotting routines to examine the responses you've received, and describe them in as much detail as you can. To get started, some suggestions are:

   imagesc(spiketrain). This will make a "raster plot" (albeit with colors that you could improve) … "dots" at the time of each spike, with each row being a trial and each column being a time point.

   Using the "sum" command to figure out the total spike count over each trial.

   Using the "mean" command to figure out the average spike rate as a function of time averaged over trials (the PSTH).

   Using "mean" and "std" commands to figure out the mean and standard deviation of the total spike count from trial to trial.

   (Once you have done this from your observations, look into the code to make sure you understand why the m-file works to generate this output, and what is assumed about the noise in the system. For now don't look inside the function defining the tuning curve.)

2. Take one of your inputs to be 50. Explore how discriminable responses to stimuli close to 50 are, given the spiking output. How does that compare with a similar difference in input starting from 20?
   Start by plotting the normalized histograms, or distributions, of the spike counts in response to 50 and in response to 50 + x, where you choose x. How might you quantify how discriminable these are?

   A hint: to think about what this means, make sure you are taking the "organism's point of view:" that is, you have only the spikes that occurred on a single trial, and you must make the best possible inference as to whether one stimulus ("50") vs another ("50+x") occurred.

---

[1] One is a function, and one is an m-file. The function is used to evaluate something where all you want to have access to is the output, given the input. The m-file will leave everything defined in it accessible in the workspace.

3. Map out the tuning curve, with error bars. Do you notice anything about these error bars?

4. Can you change the tuning curve so that the neural system gives a more discriminable response near the input value 20? Demonstrate this with data.