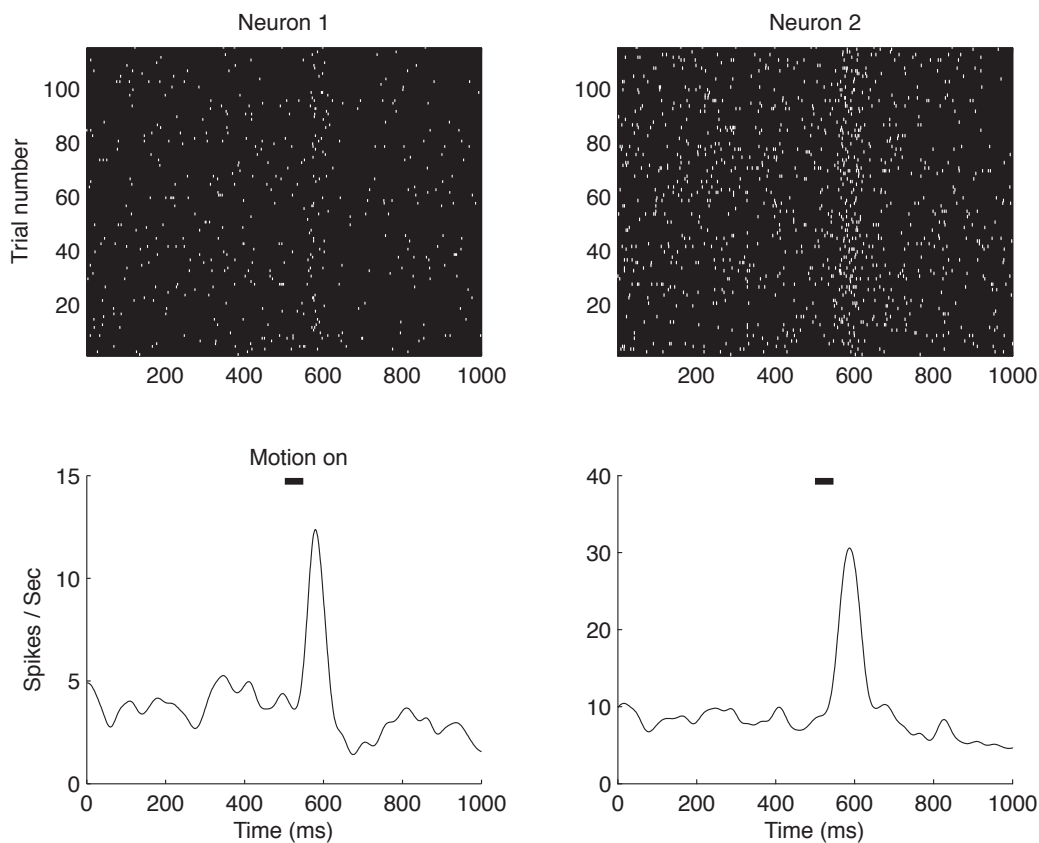


Introduction to Computational Neuroscience

Decoding and ROC analysis

In this lab you will analyze the responses of two MT neurons that were simultaneously recorded from a monkey performing a motion detection task. The goal of the lab is to apply ROC analysis to decode the neural response. Specifically, you will perform neurometric and detect probability analyses.

The details of this experiment were presented in class. Briefly, a monkey was trained to release a lever when two random dot stimuli moved coherently, which occurred at a random time. Each patch overlapped one of the neuron's RFs and the coherent motion was always in the neuron's preferred direction.



1) **Load the data.** Loading the file *decodingLabData.mat* creates the variables *neuron1*, *neuron2* and *responseTimes*.

Neuron1 and *neuron2* are matrices of the neural responses where each row is a trial and each column is 1 ms. The data is aligned to the motion stimulus which begins at 500 ms and lasts for 50 ms. Each bin is either 1 or 0 corresponding to whether an action potential was recorded.

The variable *responseTime* is a vector of the time the lever was released for each trial. The time **reported is relative to the onset of the motion stimulus**. A value of NaN indicates the monkey failed to release the lever.

2) **Check the data.** Run the script *labHandOutFigure.m* to generate the figure above. This script and its functions will help illustrate how to access the data.

3) **ROC Neurometric Analysis.** Determine how well each neuron informs an ideal observer that the motion stimulus has occurred on a trial-by-trial basis. To accomplish this, compare the neural responses in a 100 ms window before the onset of the motion stimulus with the neural responses 40 to 140 ms after the motion stimulus.

- a) For each neuron, create two histograms of the number of spikes occurring during each 100 ms window. Show both histograms on the same plot and include this plot with your report.
- b) Write a Matlab function to determine the ROC Neurometric score for each neuron. This function takes as its input two list of numbers and returns the area under the ROC curve.
- c) Discuss what the ROC score means and whether either neuron reliably signaled the occurrence of the motion pulse?

4) **ROC Detect Probability.** Determine if the activity of either neuron was correlated with the animal's detection of the motion stimulus. Use the neural response from 40 to 140 ms after the motion stimulus to compute a Detect Probability using ROC analysis. To accomplish this, take the following steps.

- a) For each neuron, create two histograms of the number of spikes occurring during the 100 ms window corresponding to correct and failed trials. Show both histograms on the same plot and include this plot with your report.
- b) Use your ROC function to determine the ROC Detect Probability score for each neuron.
- c) Discuss what the ROC score means and whether either neuron's response to the motion pulse was correlated with the animal's behavior?
- d) Propose a different analysis one might perform on this data to examine if the neural response was correlated with the animal's perception of the motion stimulus?