Signal & Data Analysis in Neuroscience
Bar Ilan, Spring 2020 Due: April 30 10:00 AM.

Assignment 03

1) Cross-correlation

Neuron A is a regular neuron, alternating between ISIs of 100 and 200 ms (e.g. spike at 100, 300, 400, 600, 700, 900, etc.) The neuron excites a Poisson neuron B leading to an increase in its firing rate from a baseline of 10 spikes/s to 20spikes/s, for a period of 20ms, following a delay 4 ms.

a) Draw the autocorrelation functions of A & B in the range of ±500ms, normalize to rate.

b) Draw the cross-correlation of (A,B) in the range of ±500ms, normalize to rate.

* Explain critical points in X and Y axes.

* Analytical solution, no Matlab please.

2) Common input Cross-correlations analysis

Two neurons (A&B) receive a common inhibitory input from a third neuron (C). What is the expected shape of the cross-correlations A&B, A&C, B&C?

For each cross-correlation:

a) Explain if there is a peak or a trough, and whether it's around zero or off zero.

b) Write a Matlab simulation after you've thought of the answer.

c) Sketch / Plot the cross correlation.

3) PSTH

The spike times and stimulation times (in seconds) are given in file Q3data.m using the variables spikeTime and stimTime respectively.

a) What is the mean neuronal firing rate during the period prior to stimulation?

b) What is the stimulation rate?

c) How does the stimulation affect the mean firing rate?

d) How does the neuron respond to the stimulation? (define your time window).