Assignment 2: Dr. Chacron

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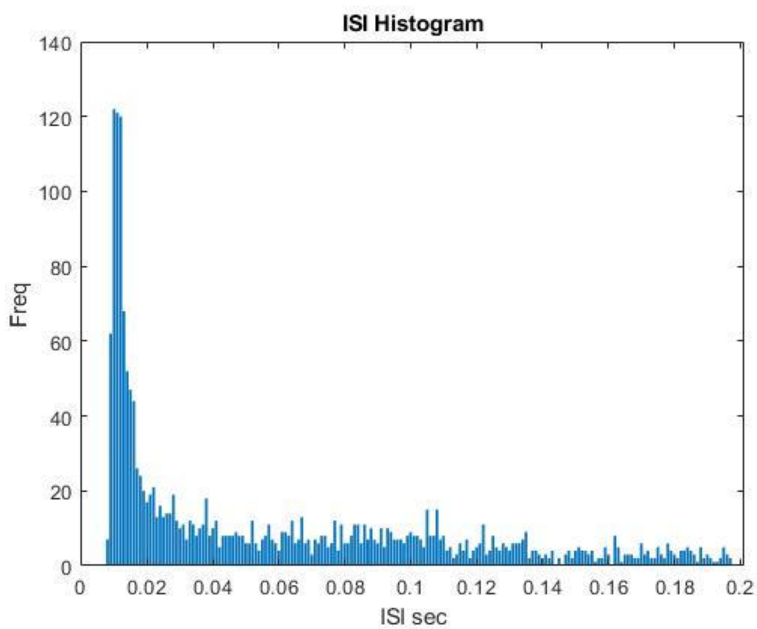
Part I) Spike train statistics

A) Making a binary representation of a spike train

1) Sampling frequency is $= \frac{1}{v_m(\text{i})-v_m(\text{i-1})}$ = 1.0417e+04 = 10417Hz (1/a time step)
2) A threshold of -30 was chosen. This results in 2026 spikes where the timepoints where **V_m(idx) > threshold** & **V_m(idx-1) < threshold** is satisfied
3) Nothing to report for this question/task.

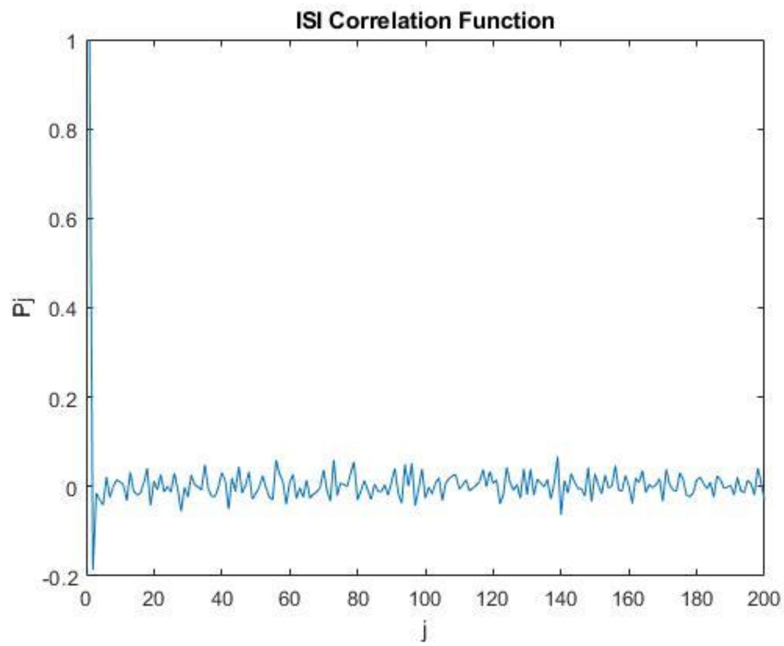
B) Interspike Interval Statistics

1) Nothing to report for this question/task
2) Plot is shown below:



3) MATLAB computes the CV to be 1.0416. This value indicates that the neuron activity is slightly more variable than the Poisson process (1.0416 > 1).

4) Plot is shown below:

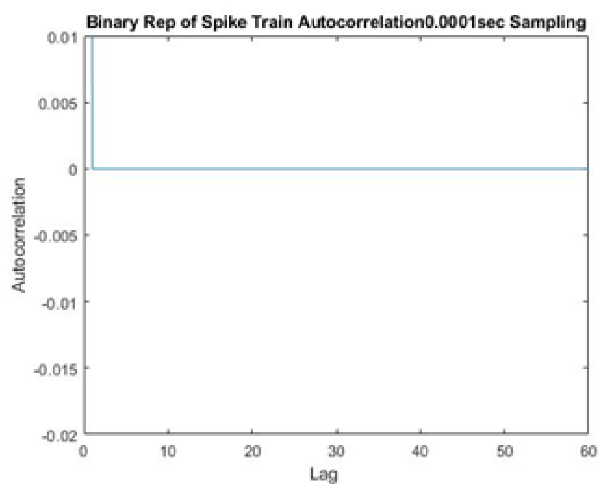


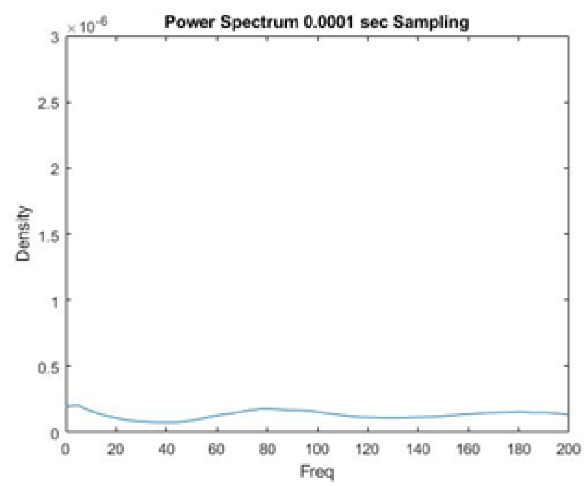
The ISI correlation coefficients have stochastic changes centering around 0.

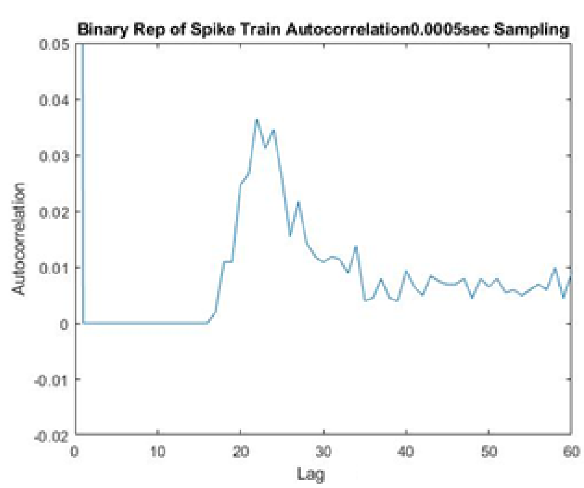
This implies that the spike train **IS NOT** a renewal process

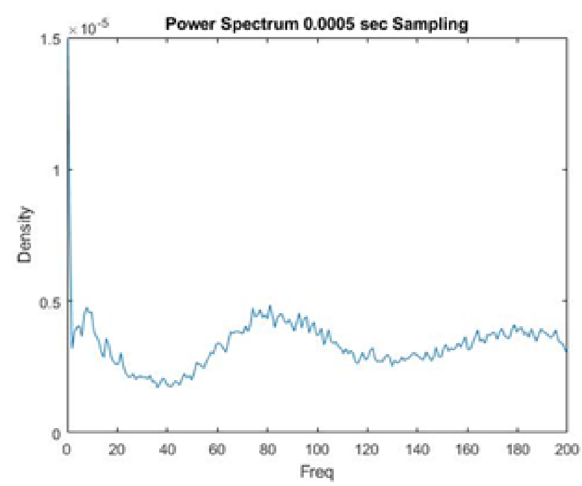
C) Autocorrelation function and Power spectrum

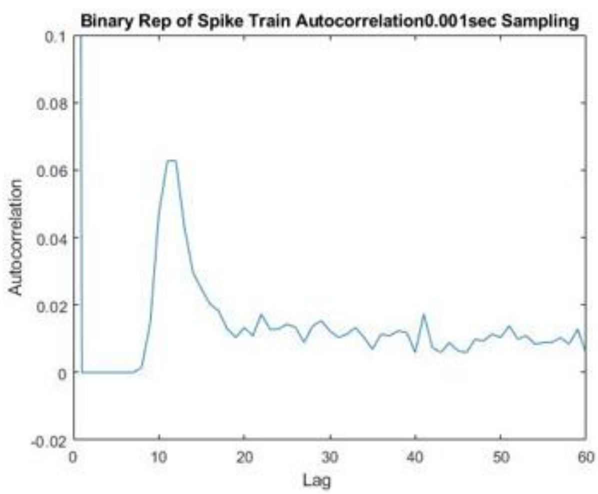
1) and 2) The following are the generated autocorrelation and power spectrum graphs

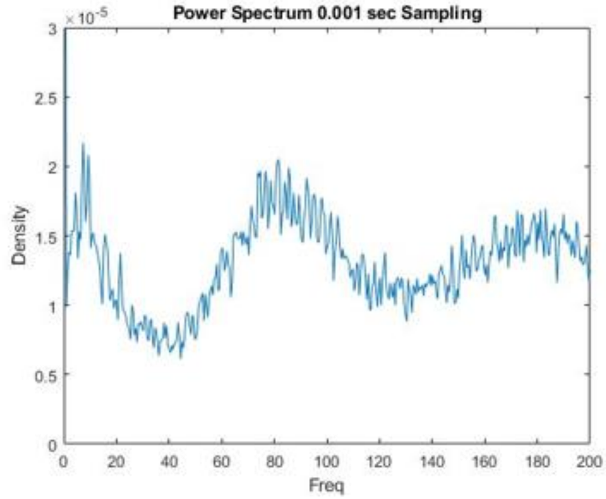










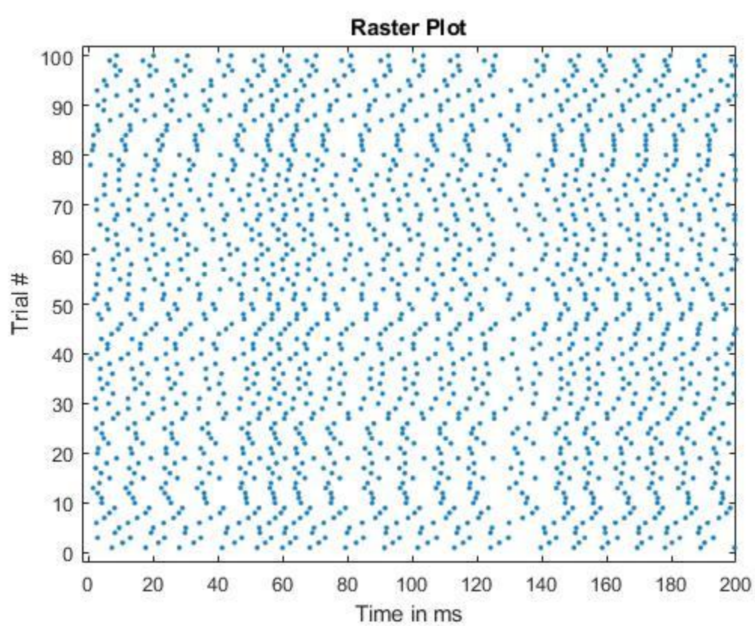


Looking at the generated graphs, the absolute refractory period appears to be about ~0.008 seconds. The "peaks" observed in the autocorrelation graphs indicate possible doublets as packets of action potentials. Changing the sampling frequency changes the amount of noise observed in the function, as well as the overall amplitude of the values. The firing rate would be ~10 Hz (approximate location of first peak observed). A power spectrum obtained from a Poisson process would appear to be a constant value $\pm$ white noise. In comparison, the power spectra obtained are cyclic in appearance.

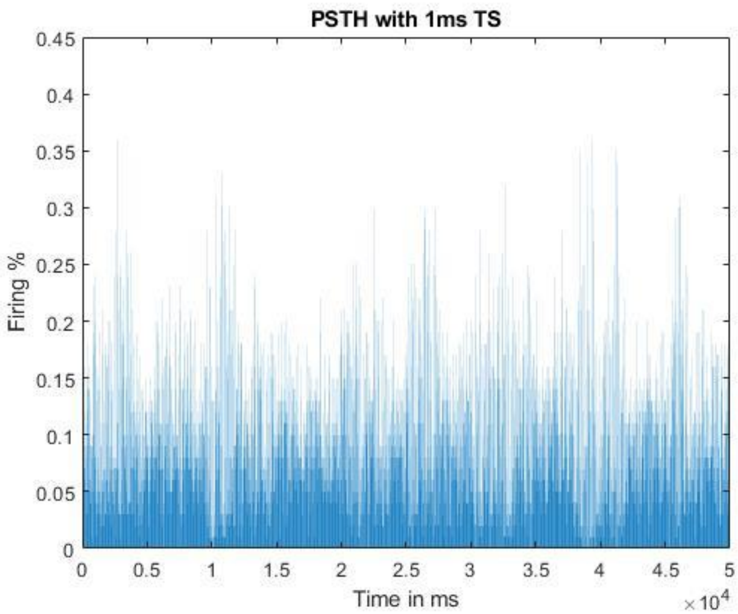
Part II) Measures of Neural Encoding

A) Raster plots and PSTH

1) Below is the Raster plot.



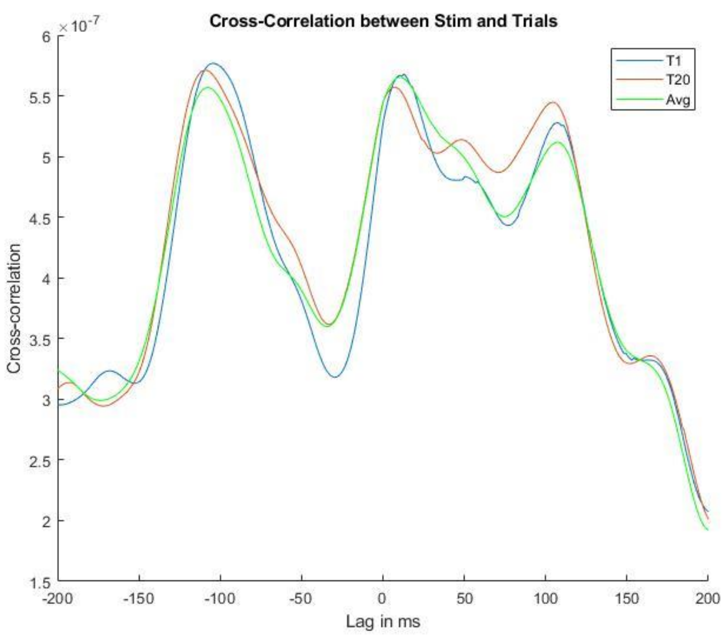
2) Below is the PSTH



All the times that the graph would plot

B) Cross-correlation function and transfer function

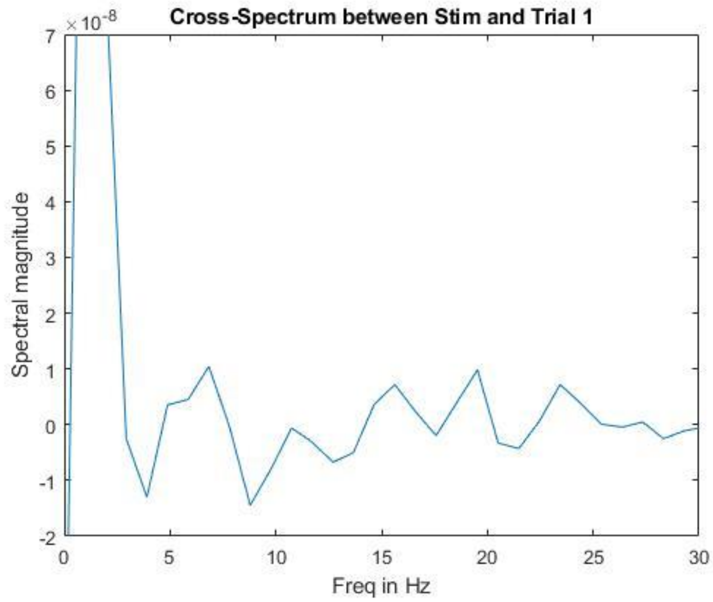
1) Below are the Cross-Correlation Functions



Visually, the cross-correlation functions between T1, T2, and the overall average are all similar.

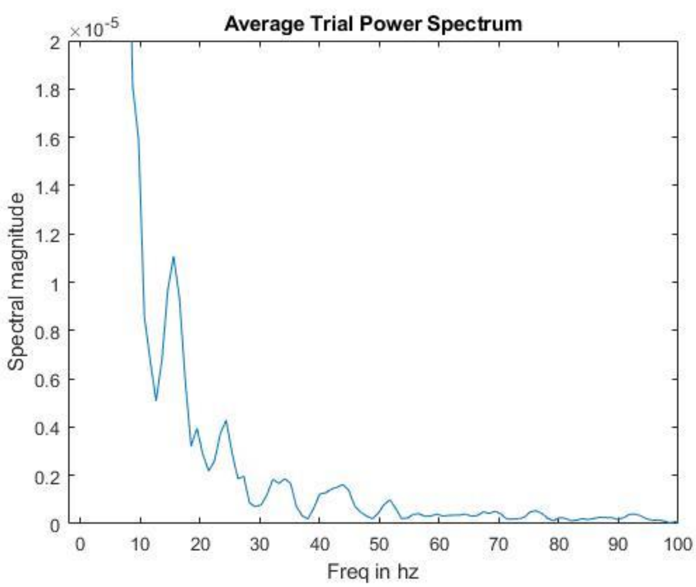
- This suggest that the relationship between stimulus and neuron response is consistent across trials.

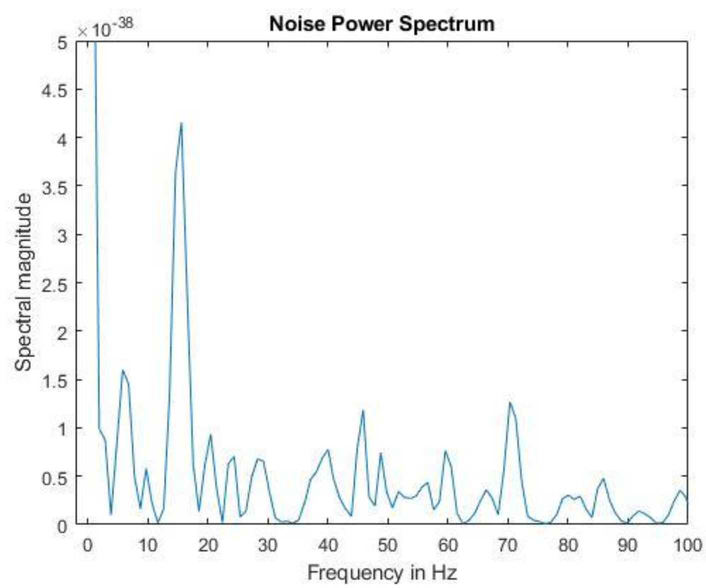
2) Below is the Cross-Spectrum graph



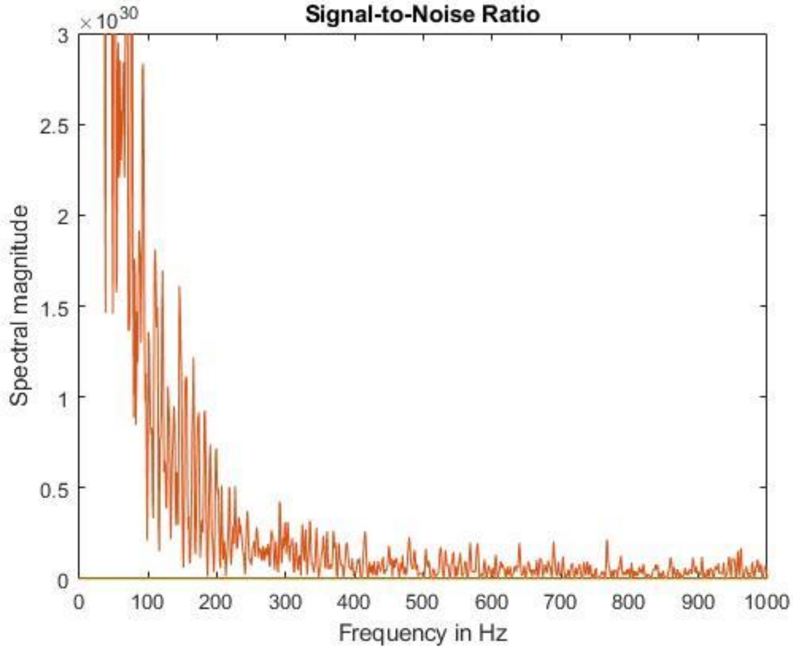
C) Signal-to-noise Ratio

1) Was not too sure if I had done this properly because the numbers seem way off, so instead I am explaining my process:
First, obtained average trial power spectrum and the noise, defined by: $noise = response - \langle response \rangle$





Then from that just plotted (Frequency, SNR = ATPS/NPS)



Which does not seem right < 100 Hz as the value exponentially increases as it approaches 0