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Assignment 02

1) See file ass_1.py + ass02ex01.png.

Code explanation: - We got input of spikes of stochastic point process.
total of 10,685 sec. (we add 1sec for fig)
- then we created a figure with 3 subfigs:
Pre-a) "Neuron Chaviv" spike train in msec resolv.
Avg sp/sec -> 0.000335 so we said 0.001 //

Fano Factor (FF) / Coefficient of Variation ((Cv)):

a) for 1 sec window (1000 msec = T):
FF = 0.33
Cv = 0.15
} Very noisy, seems like a regular neuron. (Cv -> 0)

b) for 25 msec window:
FF = 0.62
Cv = 1.27
} Relatively not regular neuron. (Cv -> 1) close to poisson (Homo..) but no (Poi -> C.v < 1) because RP.

Cv is a measure of micro order (low resv.)
FF is a measure of macro order. (High resv.)
"Everything is relative" (A.E)

c) for poisson spike train (homogeneous) both order indicators (Fano Factor and Coef. of Var.) should be close to 1, yet it's not sufficient.
In our case, using a relatively small win size the "Neuron Chaviv" has similarities with poisson process (homogeneous) but both indicators aren't 1 so No!
Cv is high with small window size, but low with high window size -> the bigger the window, the more regular the neuron seems!
smaller window -> less order -> not regular

r(t) = 55 sp/sec
r(t)_tref < r(t)

2) See file ass_2.py + ass02ex02.png.

Norm:

a) TIH - count of No. of spikes per bin
b) Survivor function -
c) Hazard func - In poi (constant) plot = p. here not rf, rc
d) Autocorrelation - but noisy in long times. Symetric. Normalized.

ref = refractory Period
rec = recovery Period
4 ms
7 ms

We took 90 seconds, and stimulated a poisson neuron with 55 msec five rate (on arg). We added 2 periods which affected the Hazard + Surv. In the autocorr we got ears that represents the ref and rec periods. (in Hazard suposed to be constant because in poisson independent prop.)

3) non-homo Poi

$r(t) = \begin{cases} 1 & \text{mod}(t,50) < 25 \\ 0 & \text{else} \end{cases}$

0.1 sp/msec

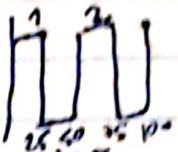
t=25 r(t)=100

25<t<50 r(t)=0

t=0 25 50 100

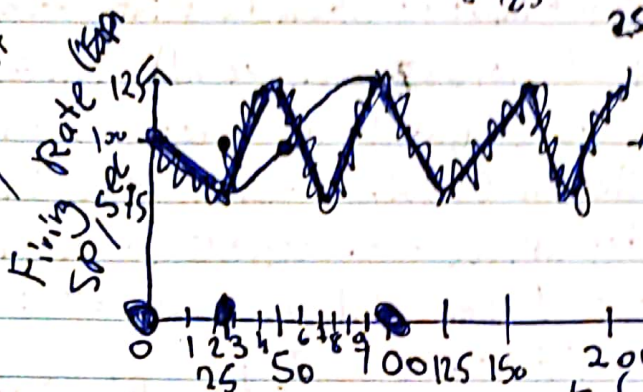
t=1 26 51 101

t=25 25 50 100



a)

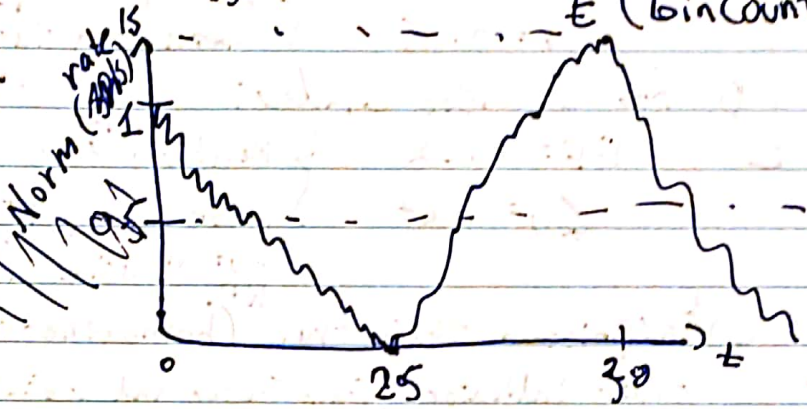
Symetric so redundant



fits the next spike and it is the autocorr for this neuron-like oscillator due to the constant rithem...

b)

Symetric so redundant.



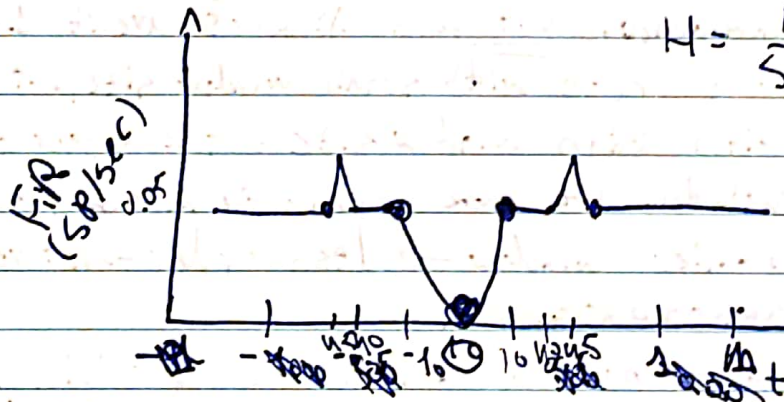
$\frac{25}{125-75} = \frac{125-75}{100} = \frac{50}{100} = \frac{1}{2}$

4) a) Hazard → Autocorr

reflects the independence of t(0) in r(t+1) $P_{(0)} = 0.05$ (independent)

this means, the 15 first sec have $P_{(0)} = 0.18$, and after 40 sec $H = 0.15$

$H = \frac{ISI(t)}{Surv_{(t)}} = \frac{ISI(t)}{1-CDF_{(t)}} = \frac{ISI(t)}{1-\sum ISI(t)}$



Poi - (4) $\frac{P}{1+P \cdot J}$

Osca - (3) P

Elev - (2) $(1-\varepsilon a)\,P$

Ref - (1) P

0

b) The neuron is a combination:

$r(t) = \begin{cases} (4) \approx Poi \cdot P_{(i)} = 0.05 & 10 < t < 40,\ t > 45 \\ (3)\ Osca & 40 < t < 45 \\ (1)\ 0\ or\ P & \\ (2)\ exp & 0 < t < 10 \end{cases}$

Bursty

Regular → Poi → Reg → Poi

Start with exp, then constant (t<40), then rithmic, then constant

(t<10) Poi like (t<45)