CNS2025: Homework 4

Due: 2025-10-01 23:59

Exercise 1

Use `numpy.load()` to get data from the file hw04-data.npz. The data file contains arrays of input frames of stimulus current (`i`), frame-based spike train (`s`), and time step per frame (`dt`). Please calculate the spike-triggered average (STA) of the input for time shifts from -3ms to 2ms.

Unlike most of the examples shown in the lecture, the STA calculated from this data is non-zero for positive time shift. What may have been the reason causing this seemingly noncausal result?

Exercise 2

Download the MATLAB data file c1p8.mat, which is from the website of our textbook. This file contains the spiking information of a blowfly H1 neuron when the fly was exposed to a near-white-noise visual motion input stimulus. Please calculate the STA of the measurement for the window from -300ms to 100ms.

As given by the authors, the sampling rate of the data was 500 Hz giving a time per frame of Δt = 2 ms. You can load the ".mat" file into python with, for example, the following code snippet:

```
from scipy.io import loadmat
dat = loadmat('c1p8.mat') # This gives a `dict`
stimulus_inputs = dat['stim'][:,0]
spike_train = dat['rho'][:,0]
```

Exercise 3

Perform and plot the STA on the resulting `spike_train` obtained from the linear-nonlinear model in the last "Linear-nonlinear model" section of the provide `code04.ipynb` code file for a window from -0.3 s to 0.2 s. (Please use the seed `seed = 123` for generating the spike train. You should have 10000 frames of data for the input current and for the spike train.) Repeat this after each of the following steps:

1. Change the size of `input_currents` array to 10^8 for a better statistics. (You can change the second statement of the cell that constructs the input current to `noise = rng.normal(size=int(1e8))`) Repeat the calculation and plot of STA.
2. Now, change the last line of the cell to "`input_currents = noise`" so there is no correlation in the input current. (Keep the size of the array at 10^8 for good

statistics.) Repeat the calculation and plot of STA.

Draw the STA and the linear kernel `win_kernel` together or side-by-side for a comparison.
