6. Exercise Sheet – Brain-Inspired Computing (WS 15/16)

Due date 23.11.16.

Name(s): Group: Points: ___/___/___/___

6.1 Poisson process with absolute refractoriness (40 Points)

Derive and plot the power spectrum for a Poisson process with absolute refractoriness and compare it to the one of the Poisson process. Which one would you choose for transmitting a slow (i.e., low-frequency) signal and why?

6.2 Inhibitory rebound with AdEx (30 Points)

Run a `PyNN` simulation (with `NEST`) to observe post-inhibitory rebound. The AdEx model is available as `EIF_cond_exp_isfa_ista`. First, think about which parameters influence the membrane in a way that is relevant for this phenomenon. Start from the default parameters and modify the relevant ones to get closer to the desired behaviour. Alternatively, you could also use a brute-force approach and sweep over an appropriate interval of parameter values to find the ones you need.

6.3 Power spectra (30 Points)

On the course website you find two example signal traces (named `signal_1.npy.gz` and `signal_2.npy.gz`). They were sampled with a $\mathrm{d}t$ of 1 ms and 0.1 ms respectively. After downloading, you can load them in the following way:

```
import gzip
import numpy as np

with gzip.GzipFile("signal_1.npy.gz") as f:
    signal_1 = np.load(f)

with gzip.GzipFile("signal_2.npy.gz") as f:
    signal_2 = np.load(f)
```

a) Plot the first 100 ms of each signal.

b) Plot the histogram over all values in the signal.

c) Construct your own autocorrelation function (without using any convolution-related `numpy` functions).

d) Plot the autocorrelation function of both signals.

e) Based on your autocorrelation function, devise a function that computes the power spectra of a signal. (Hint: You may read up on and use both `numpy.fft.rfft` as well as `numpy.fft.fftfreq`.)

f) Plot the power spectra of the two signals. Do both signals originate from the same source? Substantiate your answer.