

## Project #1

(Due on March 24, 2008, Monday)

Note:

Please use Matlab to complete this assignment and hand in your project report (PDF file) with executable computer codes (Matlab files).

### Part A: Sorting single-units from multi-units neural recordings

You are given two data files, each containing 1-hour long digitized neural recordings (see ReadMe.txt). The two data sets were simultaneously recorded from two separate locations in auditory cortex. These recordings contain spikes from multiple neurons as well as background noises. Please use two algorithms sort single-units from these data sets (Principal Component Analysis-PCA [1] and Wavelet Decomposition method [2]) to.

Question 1:

Determine how many single-units you can reliably sort from each data file.

Question 2:

Compare the accuracy of the two spike sorting methods (PCA vs. wavelet).

### Part B: Analyzing single-unit spike trains

Answer the following questions for each single-unit sorted from the two data files using the methods described in Johnson (1996) [3].

Question 1:

Is the spike train stationary? (Verify the stationarity with respect to inter-spike intervals by calculating short-term average with confidence intervals.) If not, are there any patterns of changes over time?

Question 2:

Is the spike train Poisson? If not, what is the best analytical approximation of its inter-spike interval distribution?

Question 3:

Compute *Fano factor* defined as  $F(T) = \text{Var}(N_T) / E(N_T)$ , where  $N_T$  is the spike count within time window  $[0, T]$ .

Question 4:

Compare results from each single-unit and discuss similarities and differences.

### **References:**

- [1] Lewicki M.S. A review of methods for spike sorting: the detection and classification of neural action potentials. *Network* 9(4): R53-78, 1998.
- [2] Quiroga RQ Nadasdy Z Ben-Shaul Y. Unsupervised spike detection and sorting with wavelets and superparamagnetic clustering. *Neural Comput.* 16:1661-1687, 2004. (Related codes available at: <http://www.vis.caltech.edu/~rodri/>)
- [3] Johnson DH. Point process models of single-neuron discharges. *J Comput Neurosci* 3: 275-299, 1996.