**Neural Data Analysis**

**Objectives:**

1. Plot the raw voltage data as a function of time.
2. Plot and visualise the waveform of extracellular action potentials recorded.
3. Set up threshold to detect the extracellular action potentials (Spikes).
4. Plot firing rate for different baseline and stimulus conditions to realise rate coding.
5. Plot the mean amplitude of action potential for different baseline and stimulus conditions.
6. Plot firing rate as a function of time to see the adaptation.

**TEMPLATE CODE-**

The recorded data is a .WAV file. To analyse this continuous signal, you will first need to digitize it using following command-

[voltageData, samplingRate]= **audioread**(‘*Name of the file that contains recorded data*.wav');

voltageData is the extracellular voltages measured in arbitrary units.

samplingRate= The frequency at which the voltage data is sampled.

Once you have voltage values and sampling rate, find the duration of the signal recorded and time points at which the each voltage value is sampled. Hint: Use ‘**length()**’ function to get the number of samples.

1)Plot the voltage values for the time points (atleast for 30 second interval) of your choice.

Hint: Use **find()** function to get the index of the data at the time of interest.

Ex :- >>x=[2 4 6 8 10]

>>find(x>4 & x<10)

>> 3 4 % gives the indices of the entries.

2) Now choose the appropriate time scale to visualize the waveform of action potential.

3) Spike detection algorithm

Now you have to identify the spikes out of background noise. Choose threshold value that is neither too high nor low and play around with different threshold values. You will get an idea about the threshold from the voltage graph plotted earlier.

Hint: Use the following command to get the peak voltage and index of those values.

**For Matlab version 2017 and higher**:

[peakVoltage peakIndex] = findpeaks(voltageData,’MinPeakHeight’,thresholdValue)

peakVoltage are the peak values which are above threshold.

peakIndex are the indices of the corresponding peakVoltage.

Find the time points at which the peak voltages occur.

**For Matlab 2015:**

peakIndex= findpeaks(voltageData,thresholdValue)

Note: For 2015 version findpeaks function gives only the indices and you will have to obtain the voltage values and corresponding time points.

Finally, the spike detection plot should have time series of voltage values with threshold and peak values marked. If the position of your markers match with the positions of action potentials then your spike detection algorithm is working fine.

**Question: What happens if you choose threshold too low or too high?**

4) Make a bar plot of the firing rates for different baseline and stimulus conditions:

Get the firing rate for each condition using the time stamps noted during the experiment.

Firing Rate = Number of spikes/time.

Use your spike detection algorithm to count the number of action potentials/spikes in the chosen interval and divide by the time period of this interval.

**Question: Comment on the result. What is happening to firing rate as you increase the stimulus strength?**

**Why is it called rate coding?**

**Why do you think the sensory system needs rate coding?**

5) Make a bar plot of the mean amplitude for different baseline and stimulus conditions.

Hint: Use mean() function to find the mean.

**Question: Describe the result. Is the mean amplitude same across baseline and stimulus condition? If yes, why? If not, why not?**

6) Plot firing rate as a function of time to see the adaptation.

Plot firing rate in different time bins (use bins of length 5 secs).

**Question: How is firing rate changing with time?**

**What do you understand about the sensory system from adaptation?**

**Submission-**

Submit a write up describing your observations. Add all the generated plots and comment on each of them. Answer the questions asked above.

Also, submit the Matlab code used to generate all the plots.

Send your submissions to

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