Sharif University of Technology

Advance Neuroscience

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Assignment 2

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In this assignment we are going to analyze the activity of a population of single units recorded with multi electrode array in Parietal cortex. The task (Figure 1) is designed to study the encoding of reward expected value in area 7a (Figure 2). This area encodes the spatial location of cue [**1**].

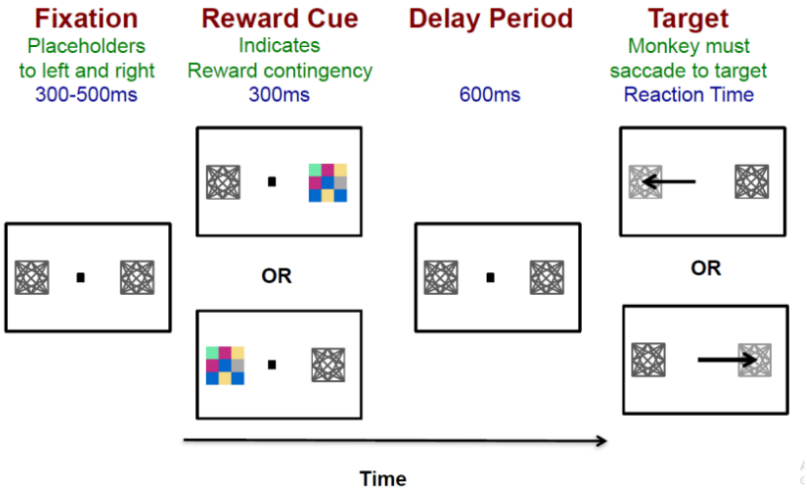


Figure 1: Task General Structure.

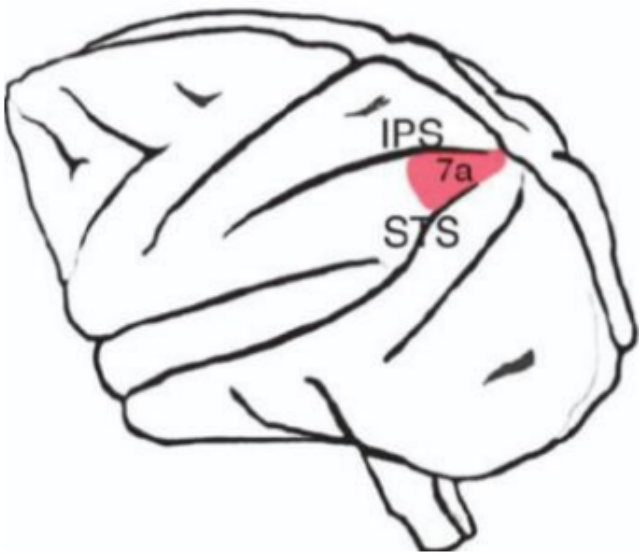


Figure 2: Anatomical location where the data is recorded.

1. As we can see the PSTH for different conditions in Figure 3, all of them act in the same way and they aren't separable. It seems that it might there is no information on PSTH in this area to separate the tasks. There is a change after Reward onset in rate but it happens in all 6 conditions.

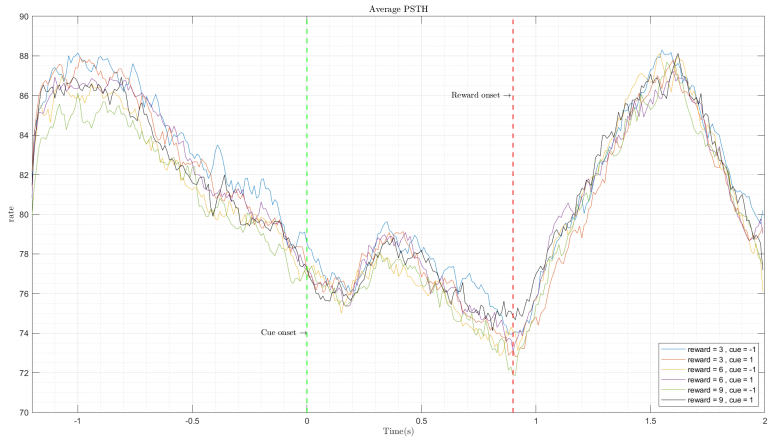
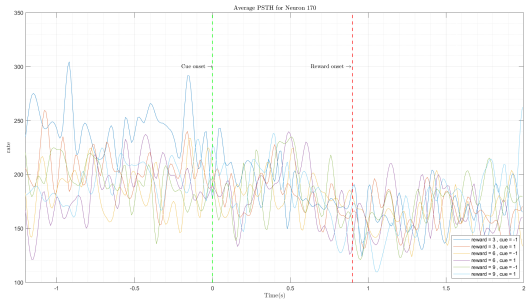
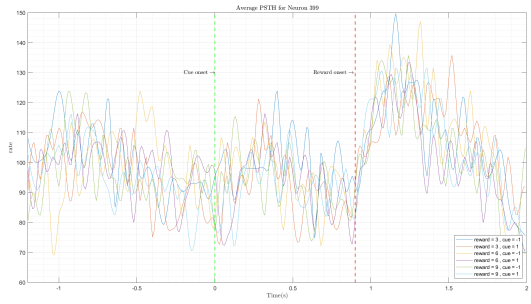


Figure 3: All 6 Conditions PSTH For all Neurons and all Trials.

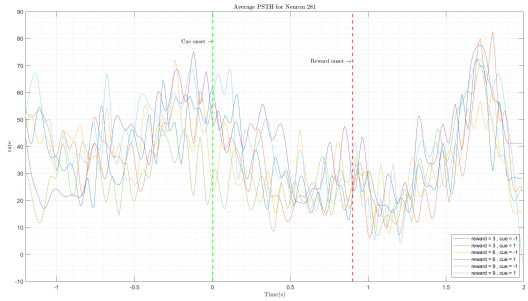
Also, we can see this in random neurons chosen in Figure 4 to see if there are any differences in their PSTHs. Some of them have changes in rate and some of them just like the same. But there are no differences in 6 conditions and neurons act in a same manner.



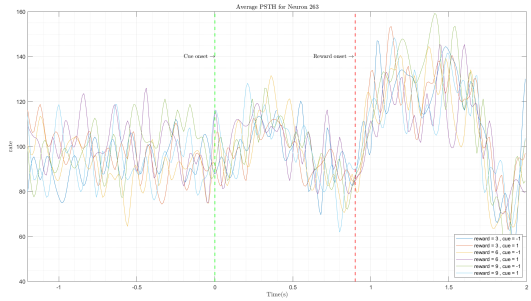
(a) Neuron Number = 170



(b) Neuron Number = 399



(c) Neuron Number = 281



(d) Neuron Number = 263

Figure 4: 4 Random Neurons PSTH in 6 Conditions

2. In this section, I am going to see which one of the Cue locations or Reward magnitude is better for linear regression of PSTH. As we can see in 5, the Reward Magnitude can be a good regressor for neural PSTH in different conditions.

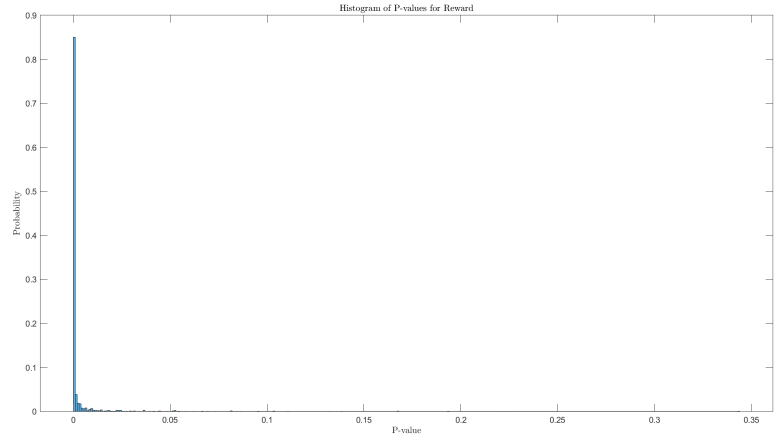


Figure 5: Histofram of Reward Magnitude Regressor P-Value.

The P-values for Cue Location was very big so they can not be a good regressor for PSTH in different conditions.

3. Here we are going to see if there is information in other aspects of the data. We can see two components of PCA of Neural activity in Figure 6. With PCA, I reduced the size of the data from 481x320 to 2x320 (481= Number of neurons, 320 = Number of time samples). We can see the oscillatory movement of different conditions after cue onset. It seems that the neurons have information in their population activity. Also, it seems that 6 conditions are separable at the end of the task. They have the same activity before cue onset and after that, they start their oscillation activity.

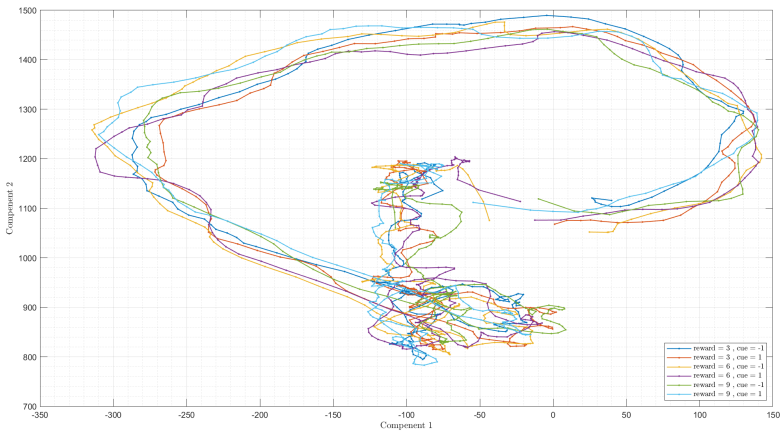


Figure 6: Two Components of PCA in Different Conditions vs Each Other.

4. It will come up to mind that the oscillation is in the data and there is no information over time. To test this hypothesis, I shuffled the data to see the result. As we can see in Figure 7, the shuffled data PCA components don't show the oscillation and we figure that there is information in the temporal and the ordered data.

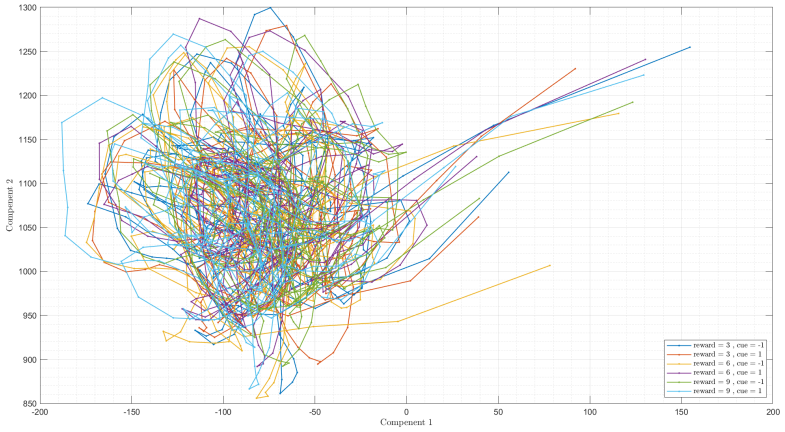


Figure 7: Shuffled Data Two Components of PCA in Different Conditions vs Each Other.

References

[1] Constantinidis, C. and Steinmetz, M.A., 2001. Neuronal responses in area 7a to multiple-stimulus displays: I. Neurons encode the location of the salient stimulus. Cerebral Cortex, 11(7), pp.581-591.