In the name of God

Sharif University

Electrical Engineering Department

Sharif Brain Center

Advanced Neuroscience Course

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Homework 2

Analysis of Population Response


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In this homework, we want to analyze the response of 481 neurons to the task. Also, we will analyze the population response.
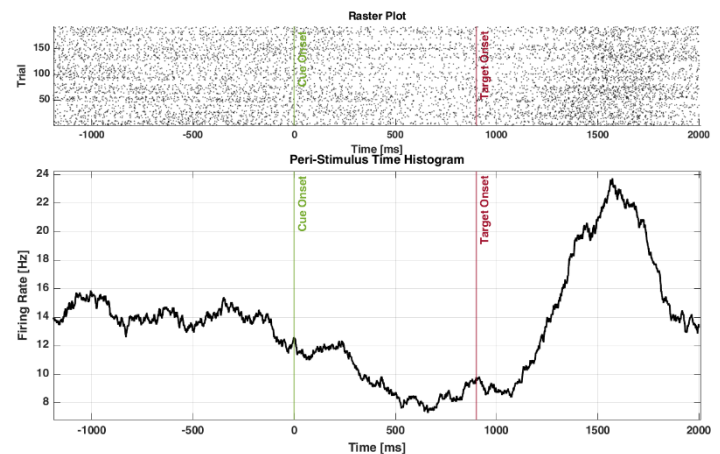
Part 1 (PSTH):

In the first plots below, you can see the Raster plot and PSTH of 4 randomly chosen neurons. As you can see there are many different response patterns, some will respond to target onset strongly (as we see later, these neurons encode target location very well), and even there is one that has inhibition after target onset.
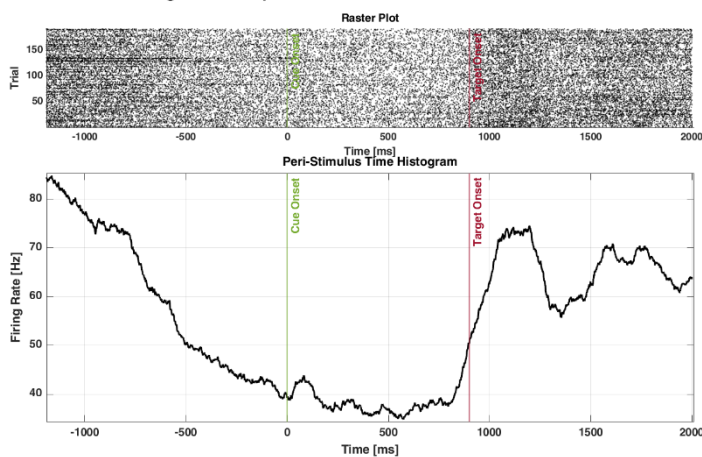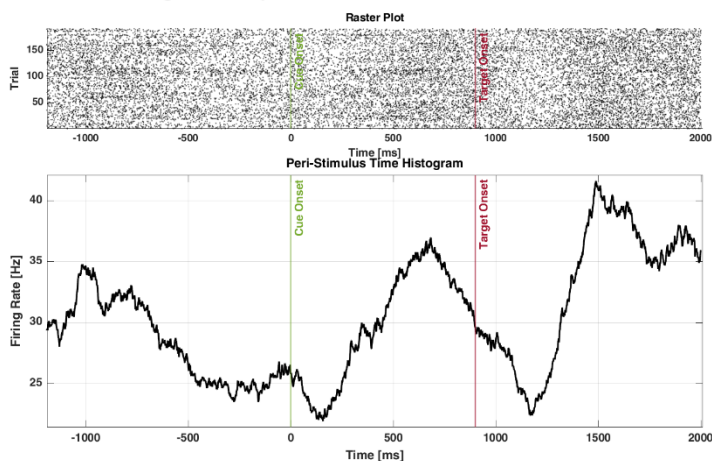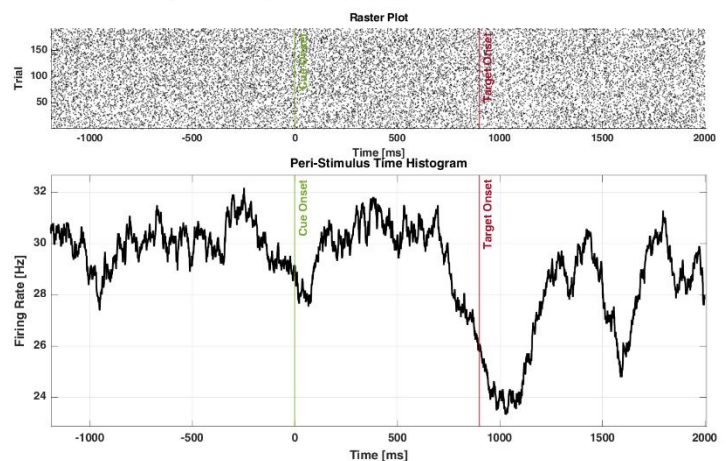
Then in the next plot, you can see the response of 9 randomly chosen neurons for each of 6 conditions. And also the mean response of them in black.
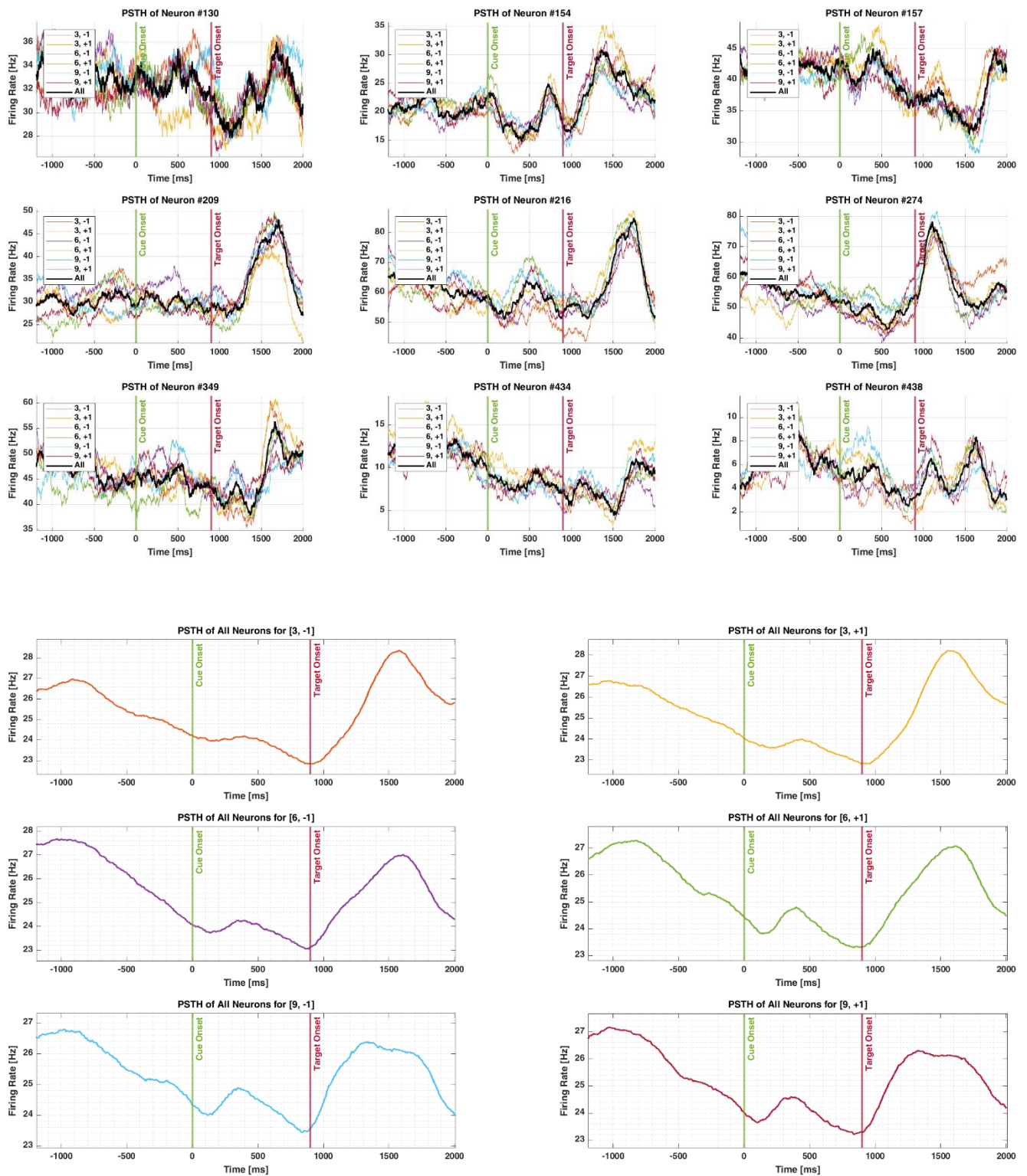
In the plot above you can see the mean PSTH for each condition. This is an important plot since you can see that REV has an obvious effect on the response after target onset.

To address the 2nd question of part 1 I plotted the mean response for each of the task parameters. As you can see the value of REV can be decoded from the duration of high response after target onset. The cue location is hard to be decoded from the shape of PSTH.
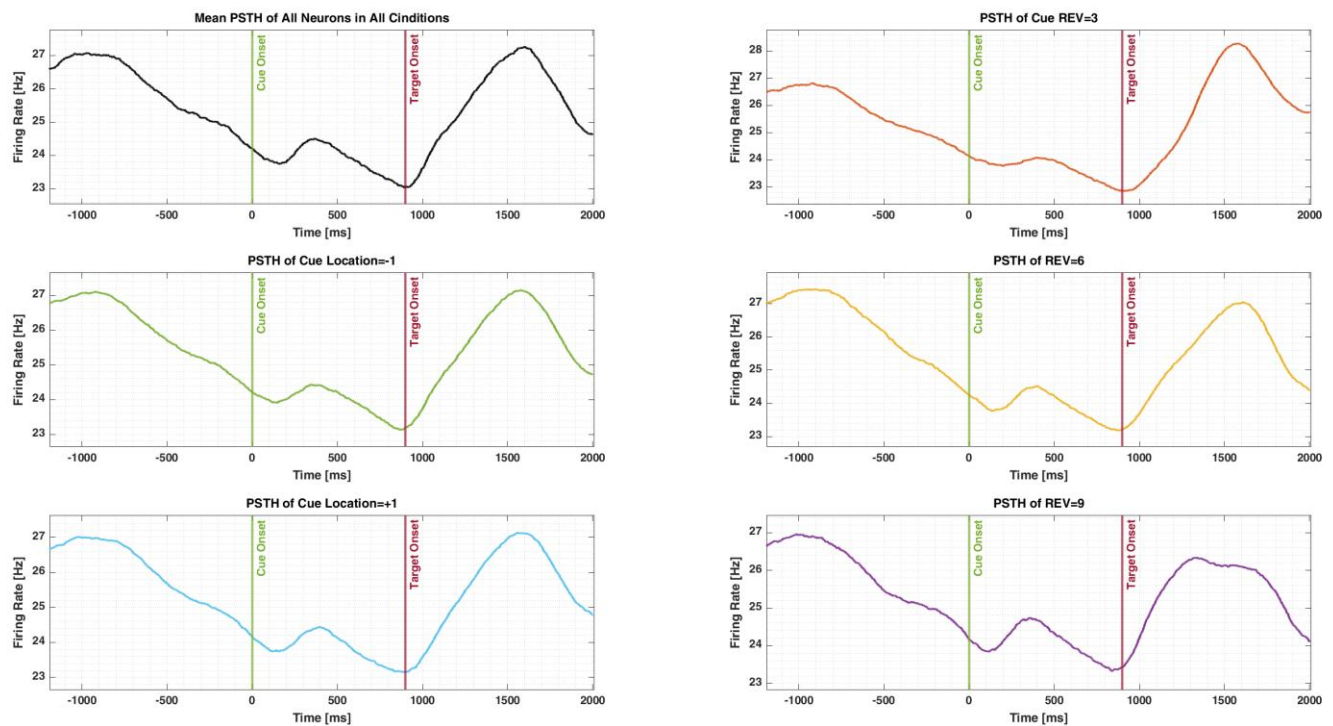

So it seems that we should have much more neurons with small p-values for REV than cue location, this means that REV can be decoded more easily from neural responses.

Part 2 (Single Unit Analysis using GLM):

Here we use GLM to predict task parameters. You can see the histogram of p-values for the prediction of REV, cue location, and both in the plot below. As you can see the best performance is for decoding REV. Decoding cue location has a bad performance and there are only 15 neurons that have a p-value<0.01 for this. These results are fully compatible with what we saw in the previous part. You can see all p-values in the `pVals` matrix in the directory.
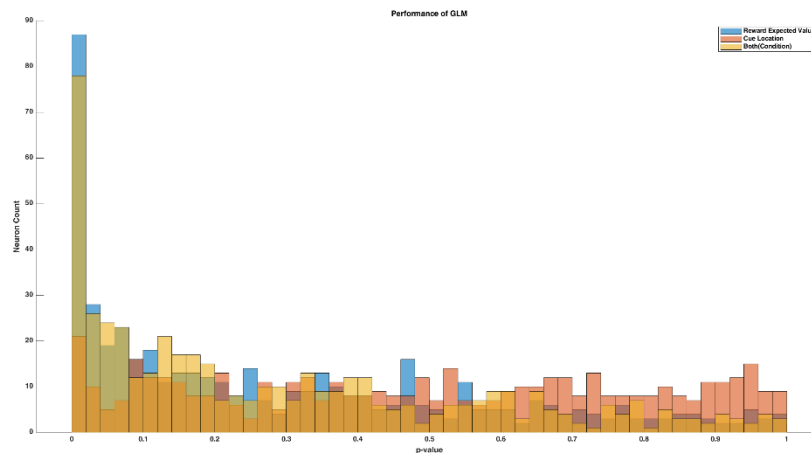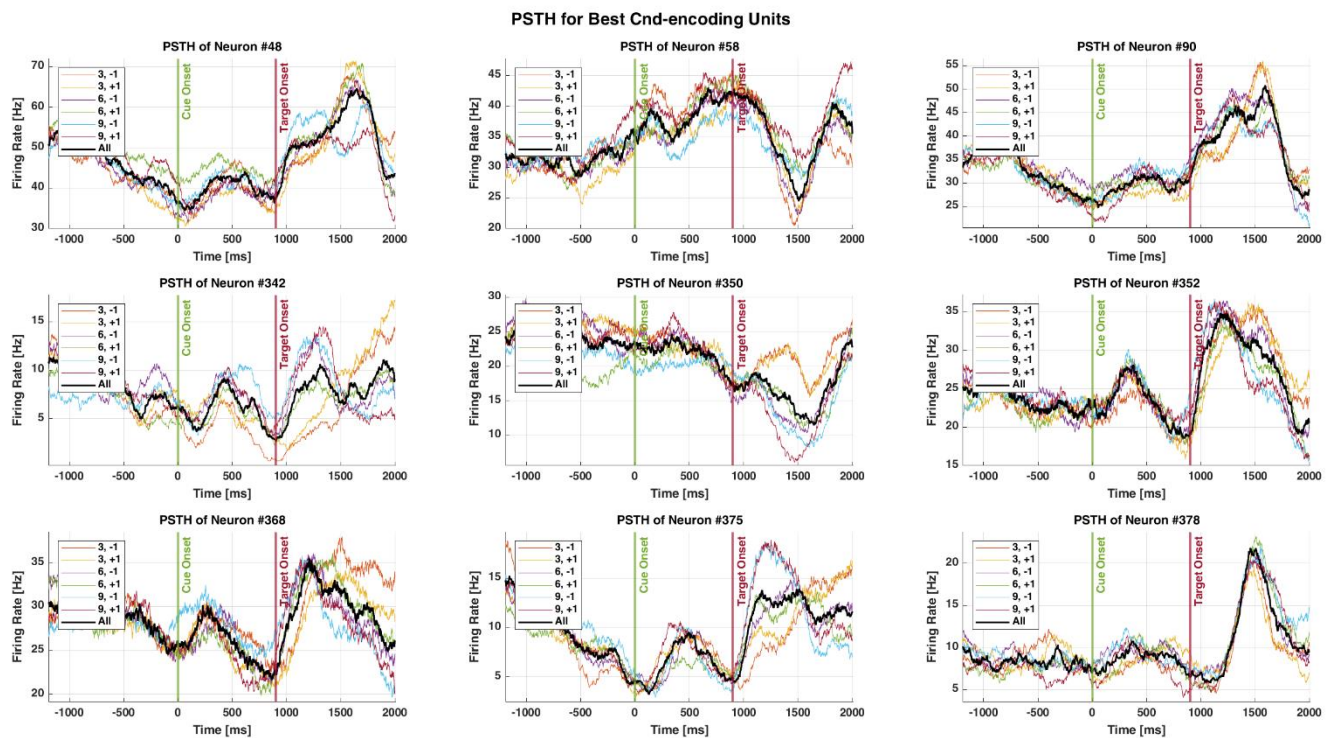

You can see PSTH of 9 neurons which have the best coding of REV.
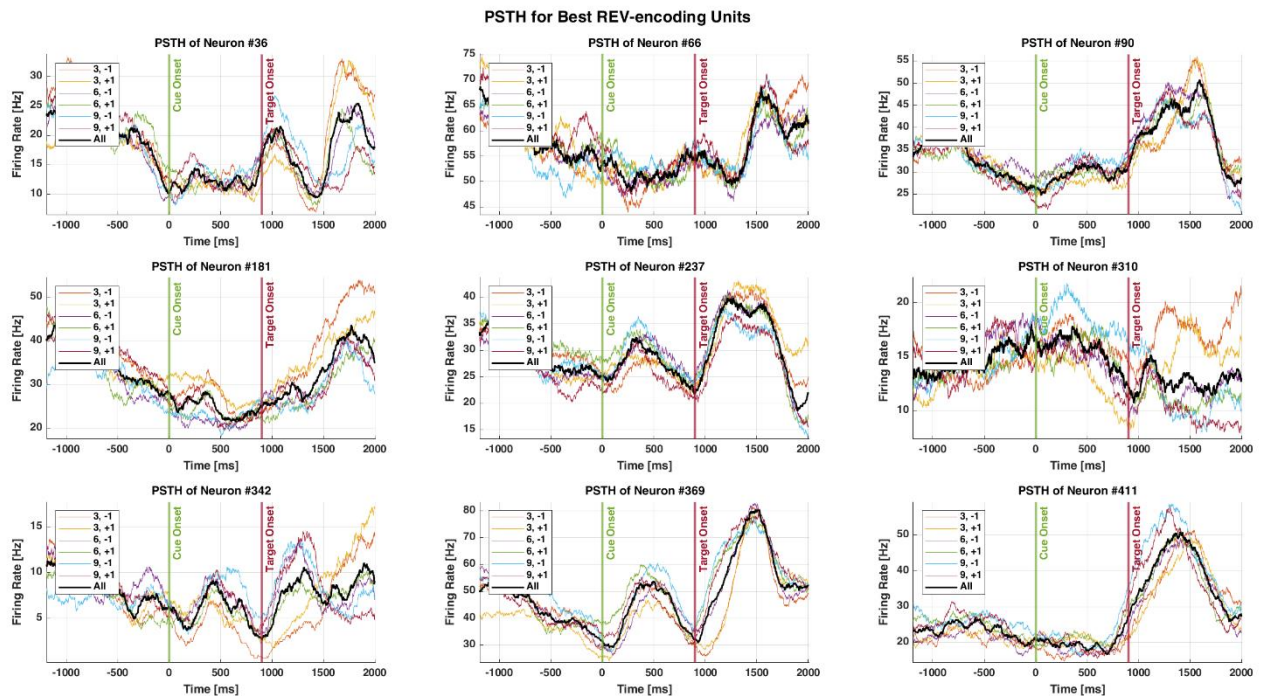
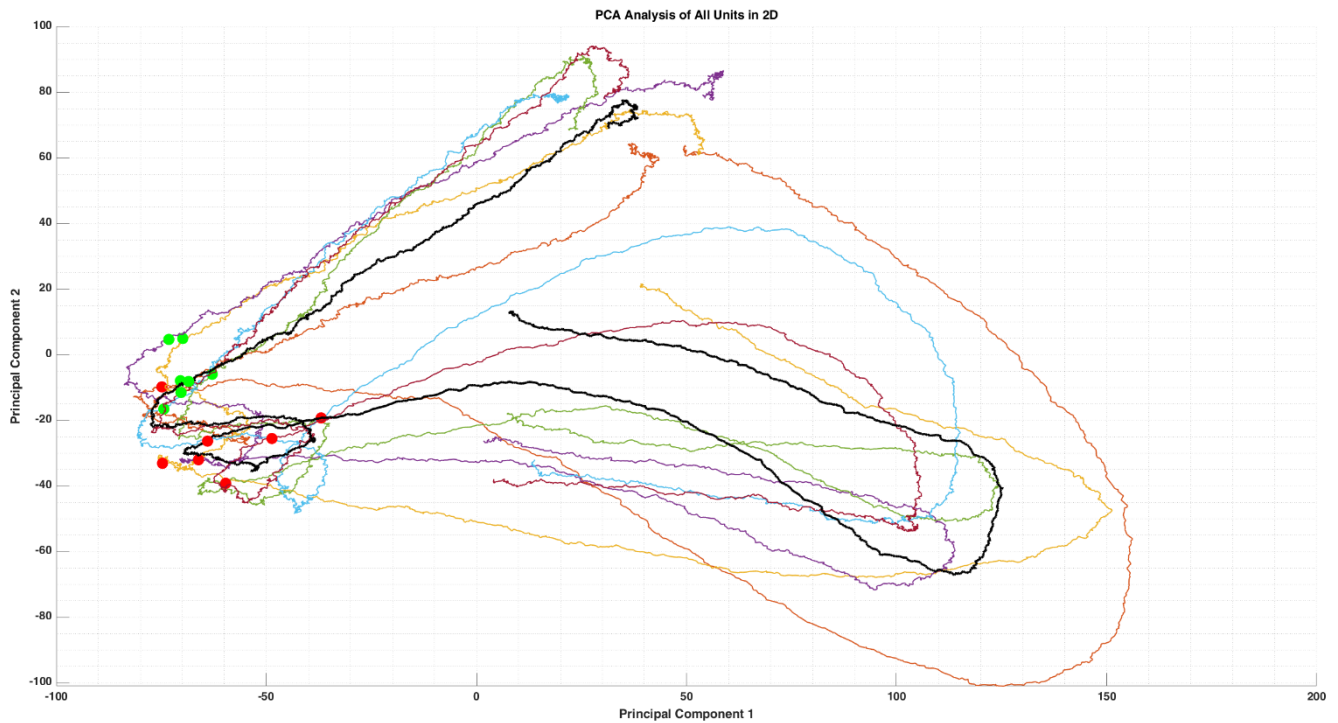Next is PSTH of 9 neurons which have the best coding of Location.

PSTH for Best Location-encoding Units
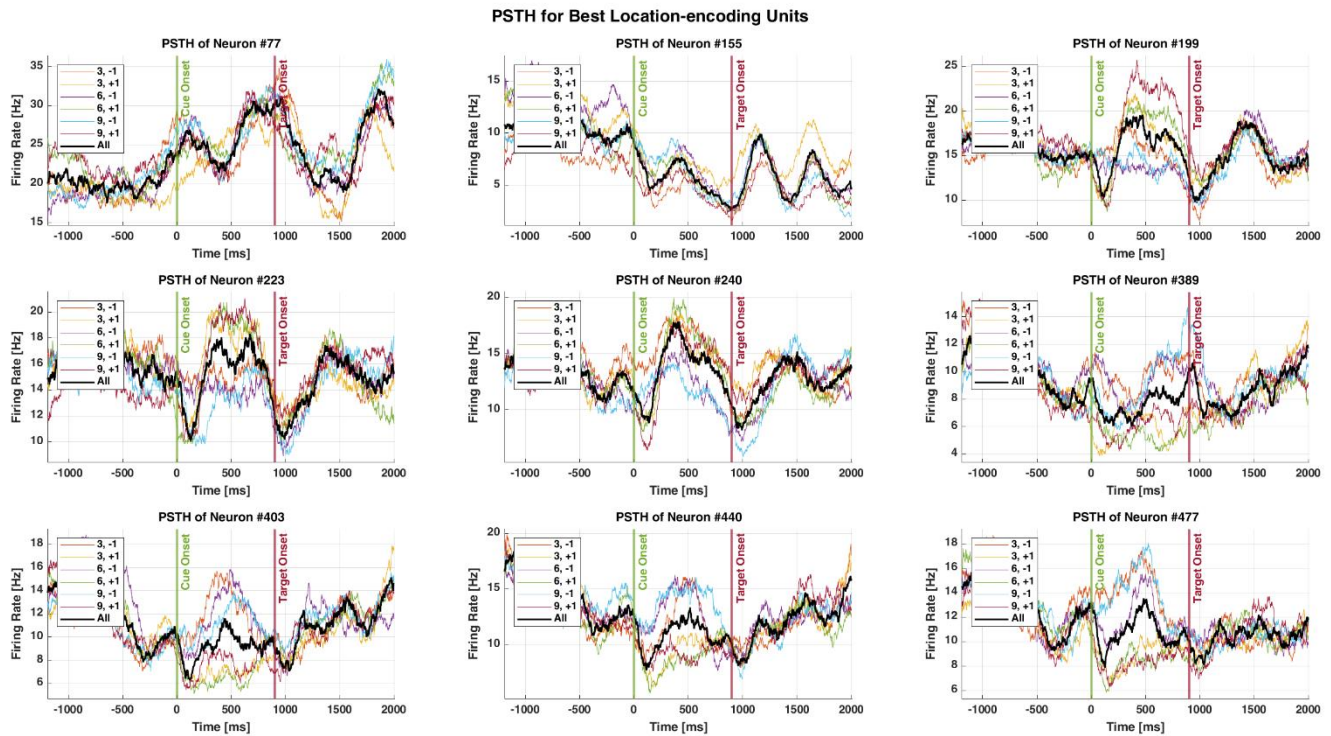
At last, you can see PSTH of 9 neurons which have the best coding of both.
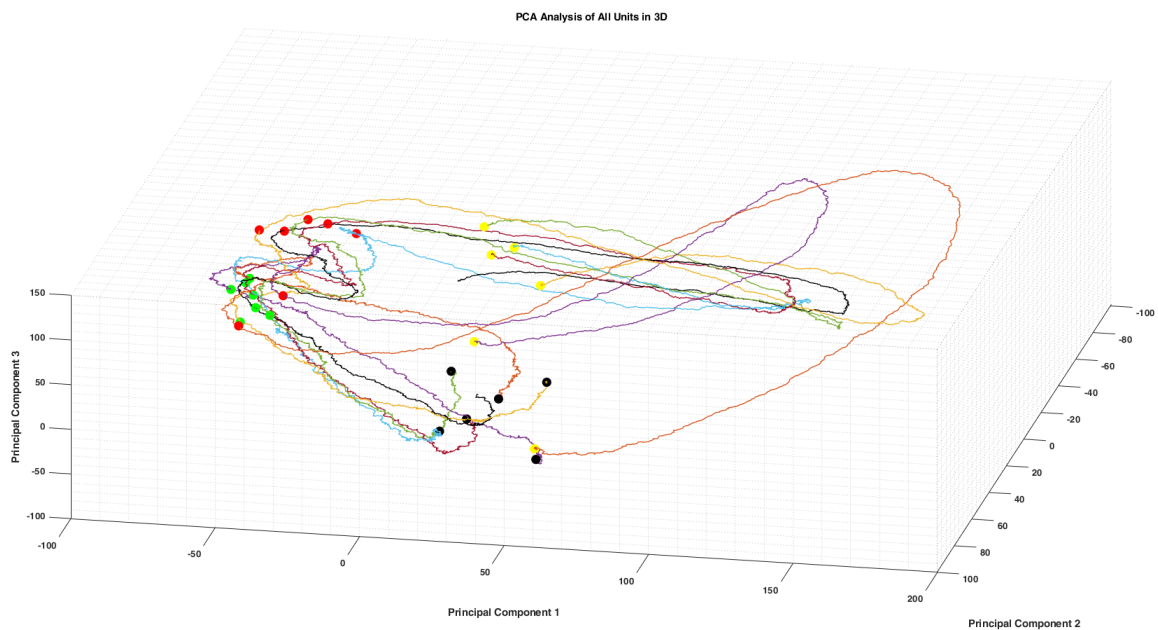

PSTH for Best Cnd-encoding Units

Part 3 (Dimensionality Reduction):

In this part, we want to reduce the dimension of our data to see the dynamic of its response better. We used PCA for this purpose.
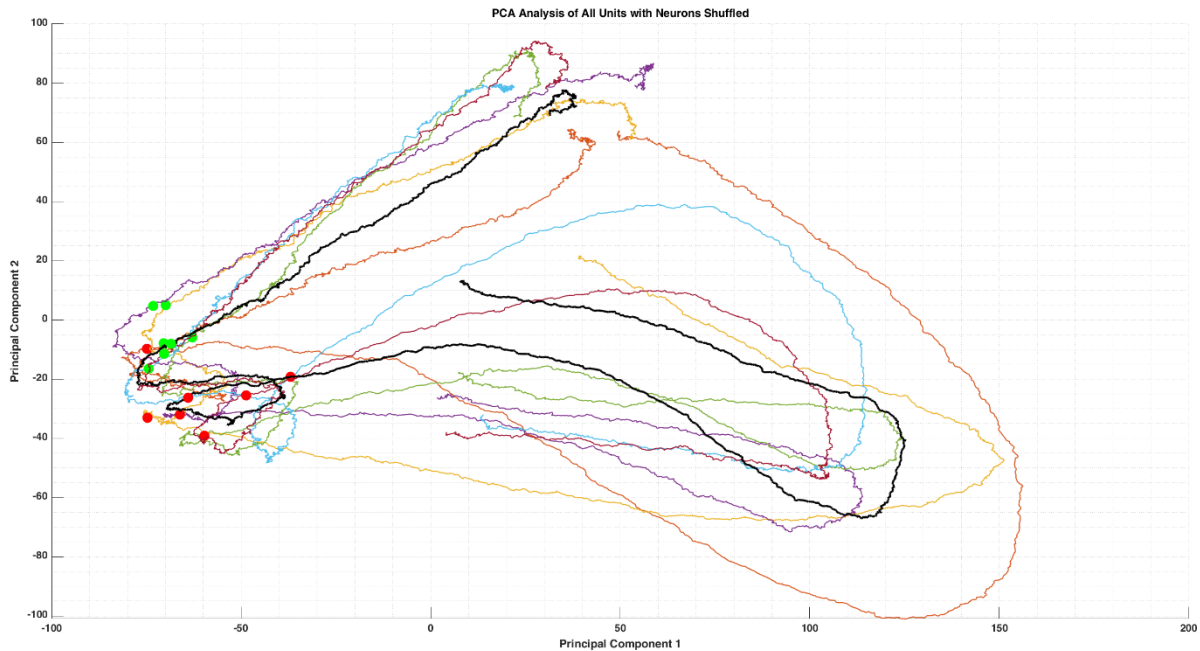

The 3D PCA is shown below which is better.

Part 4 (Shuffling Data):

In this part, first I shuffled neurons but as you can see it had no effect which is rational.

But shuffling the conditions make all of conditions like each other which is correct.