In The Name Of God

HW03

Advanced Neuroscience

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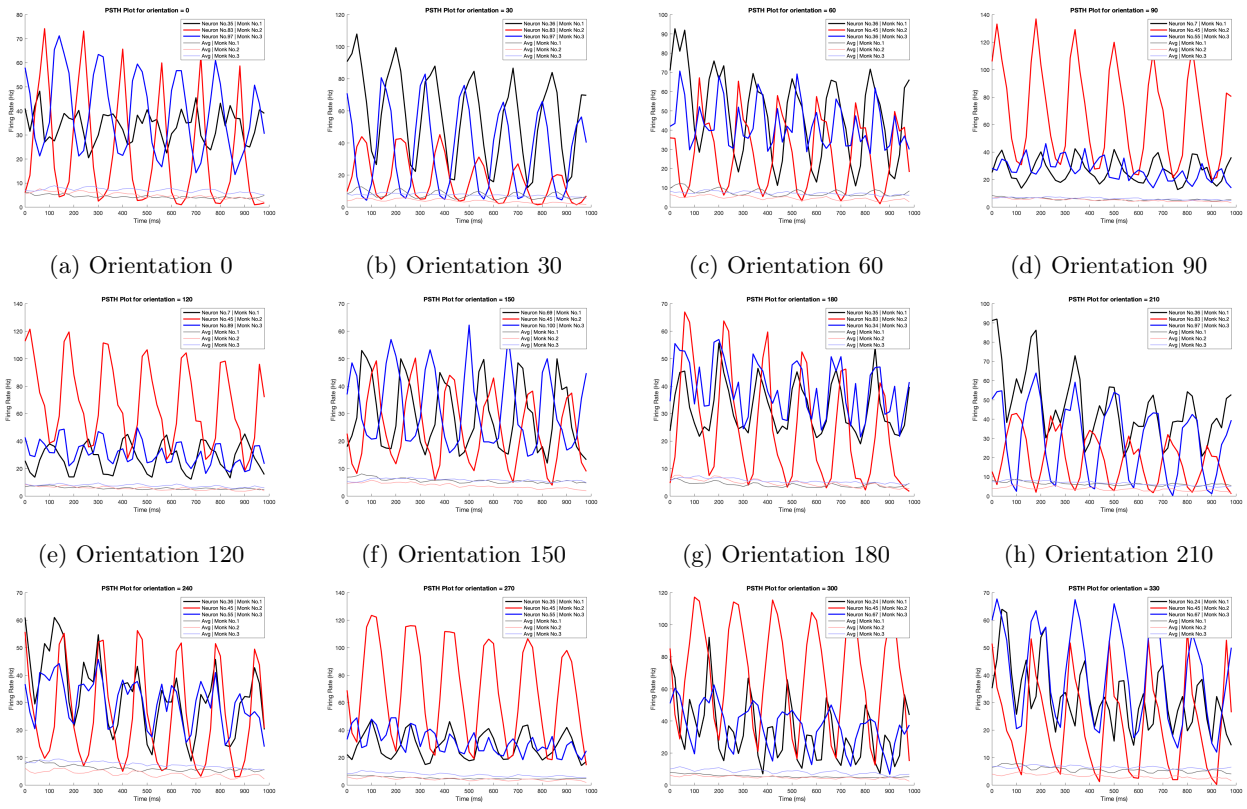
97102099

■ Q01

□ PSTH Plots



(a) Orientation 0 (b) Orientation 30 (c) Orientation 60 (d) Orientation 90

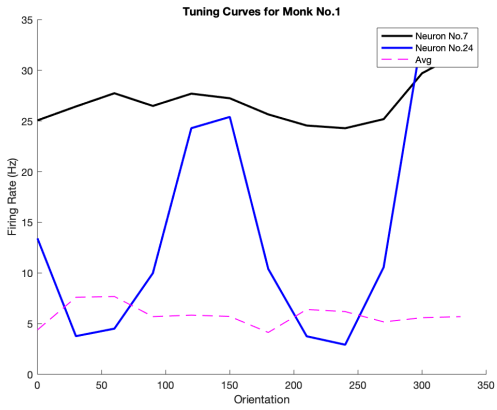
(e) Orientation 120 (f) Orientation 150 (g) Orientation 180 (h) Orientation 210

(i) Orientation 240 (j) Orientation 270 (k) Orientation 300 (l) Orientation 330

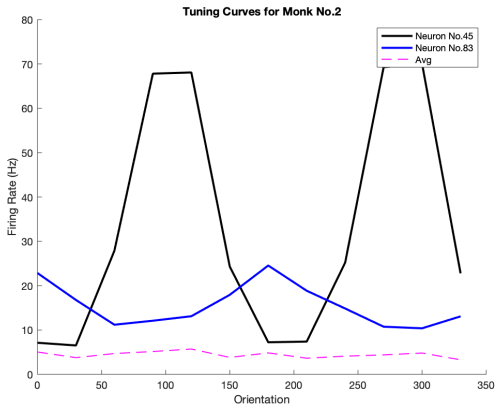
Figure 1: PSTH Plot of Area V1 Neurons for Different Orientations and Monkeys

I have plotted PSHT of different orientations in Figure 1. Most active neuron of each monkey is highlighted in black, red, and blue colors. Tuning curves of each of these neurons are plotted in Figure 2.

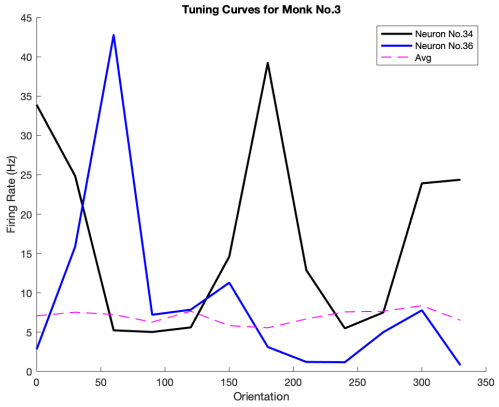
□ Tuning Curves



(a) Monkey No.1



(b) Monkey No.2



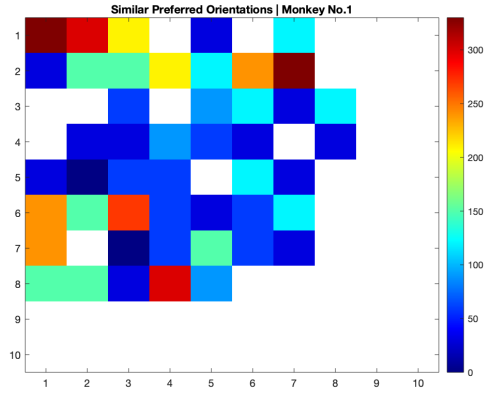
(c) Monkey No.3

Figure 2: Tuning Curves of Area V1 Neurons for Different Monkeys

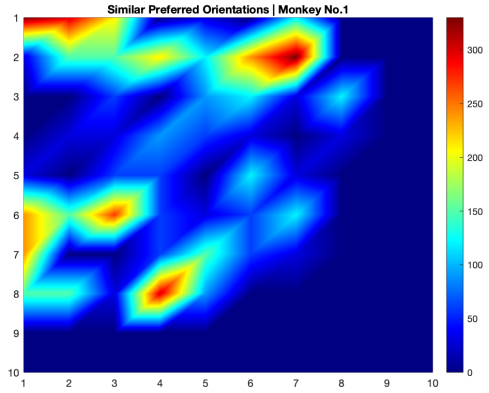
Most active neuron has the biggest firing rate in response to each stimuli, so I found these neurons by finding the maximum responses to different orientations. You can see tuning curve of these neurons and average tuning curve of all the neurons in Figure 2.

■ Q02

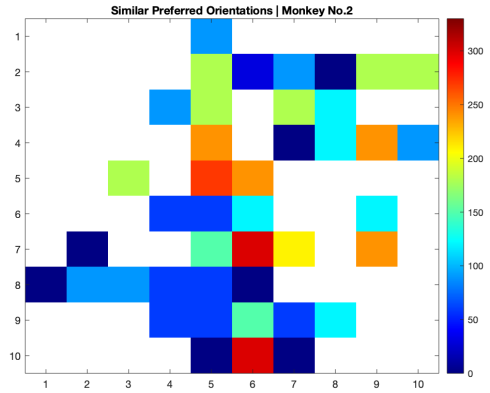
Preferred orientation of each unit is calculated using finding the neuron's largest response to the different orientations. Same colors indicate same orientation angle in Figure **??**



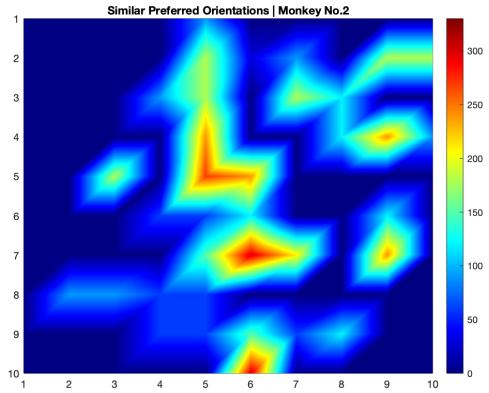
(a) Monkey No.1



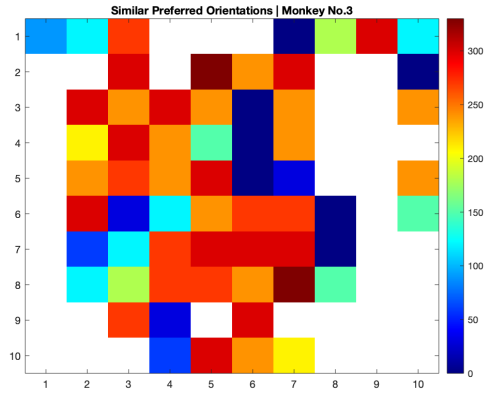
(b) Monkey No.1 - Interpolated



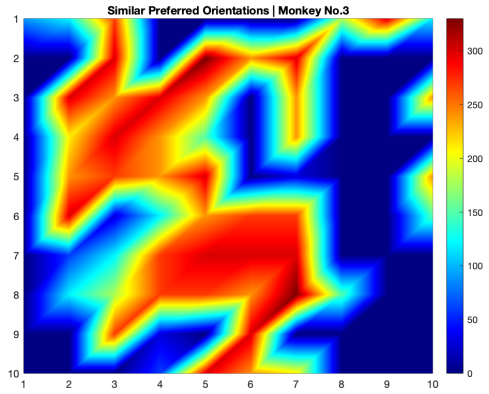
(c) Monkey No.2



(d) Monkey No.2 - Interpolated



(e) Monkey No.3



(f) Monkey No.3 - Interpolated

Figure 3: Neurons with Similar Orientation Preferences in Area V1 of Different Monkeys

I will compare Figures 3 and 4 to see if there is any pinwheel patterns in my figures or not.

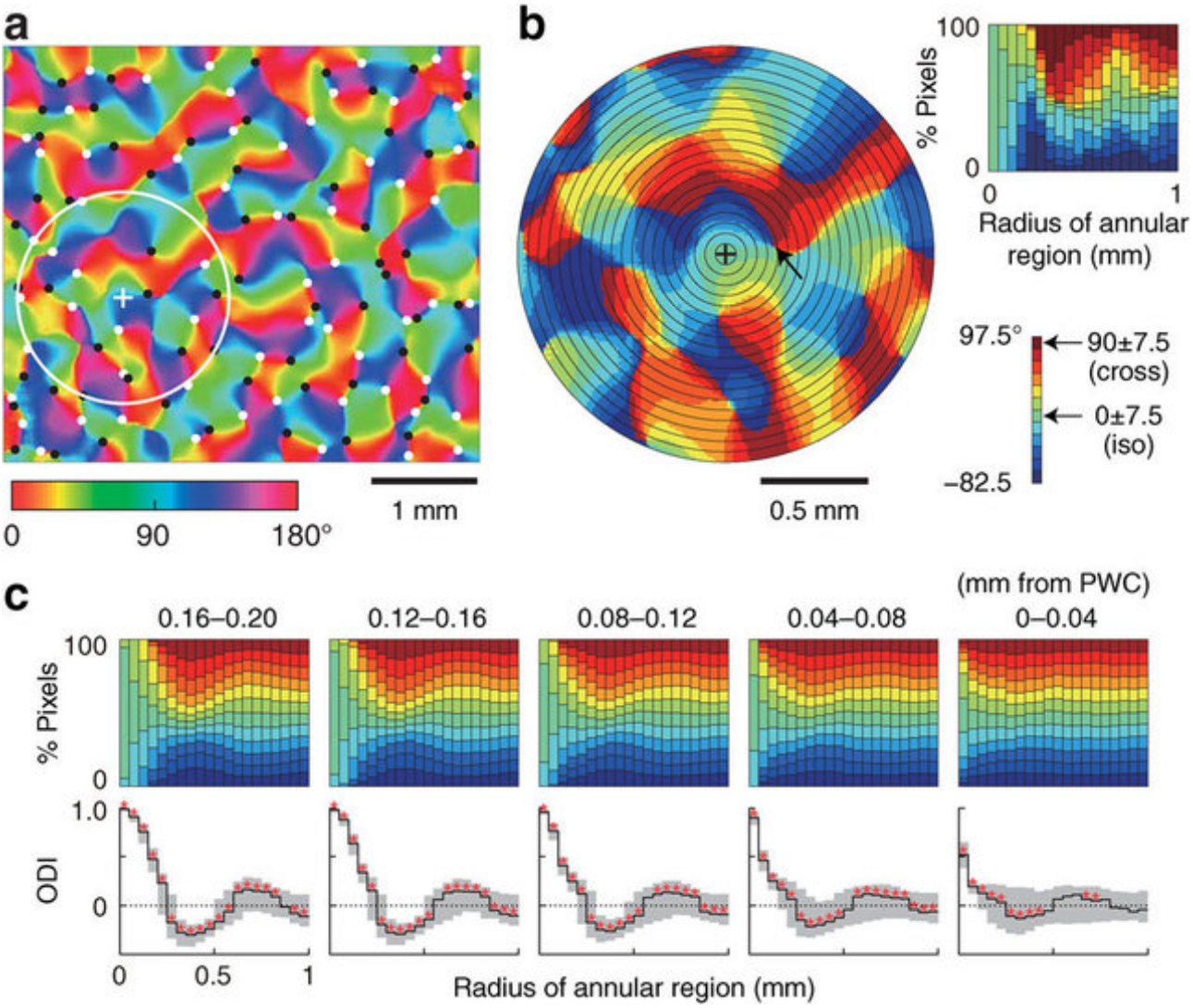
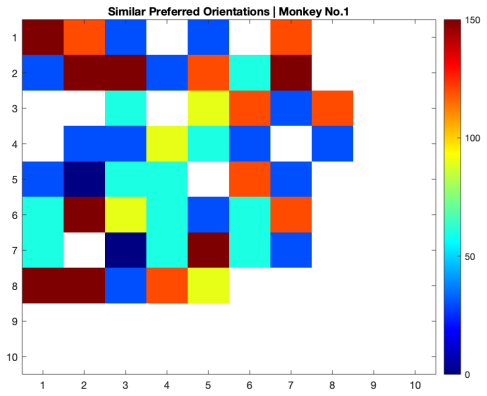
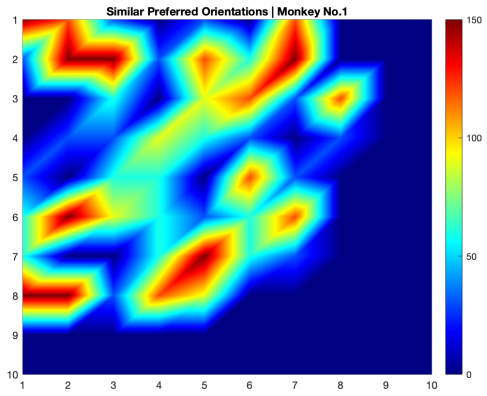


Figure 4: Spatial distribution of orientation preferences in monkey V1. (a) Orientation preference map obtained by optical imaging. Color scale at the bottom left shows preferred orientations in degrees. White and black dots indicate clockwise and counterclockwise pinwheel centers (PWCs), respectively. The white circle represents an example of a region of interest (ROI), and the plus sign indicates the center of the ROI. (b) Magnified view of ROI, consisting of 20 concentric annular regions whose radii vary at 0.5 mm intervals (black circles). Color scale at bottom right shows the range of preferred orientation relative to the preferred orientation at the ROI center (plus sign). The top right panel shows the orientation population within the ROI as a function of annular region radius. (Reference Paper Link)

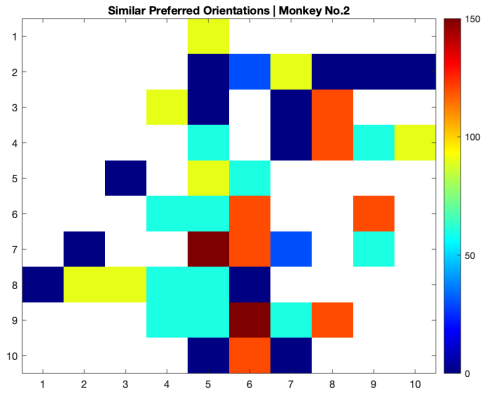
as can be seen in Figures 3 and 4, only Monkey No. 3 has this pattern to some extent. But it is noteworthy to mention that Figure 4 is plotted for orientations between 0-180, so it seems that the authors of the paper have wrapped the angles between 0-180. I have done the same in Figure 5. As can be seen in this Figure, pinwheel pattern is a little more obvious than Figure 3 but still there isn't any strong pinwheel pattern.



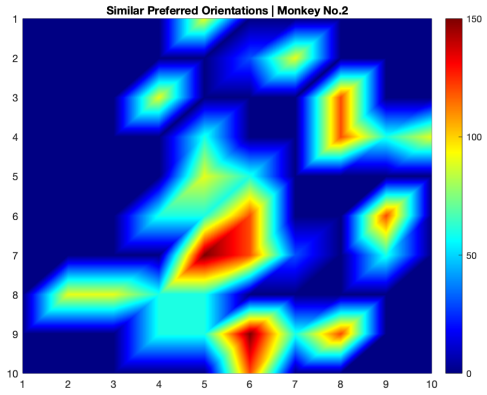
(a) Monkey No.1



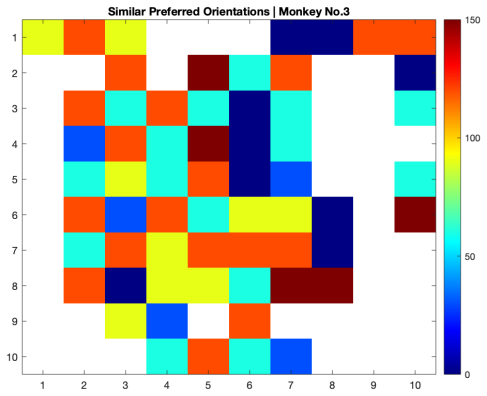
(b) Monkey No.1 - Interpolated



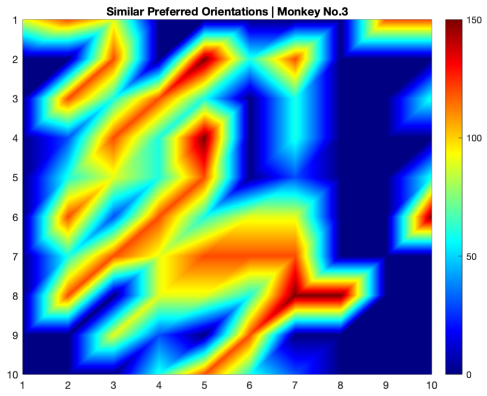
(c) Monkey No.2



(d) Monkey No.2 - Interpolated



(e) Monkey No.3



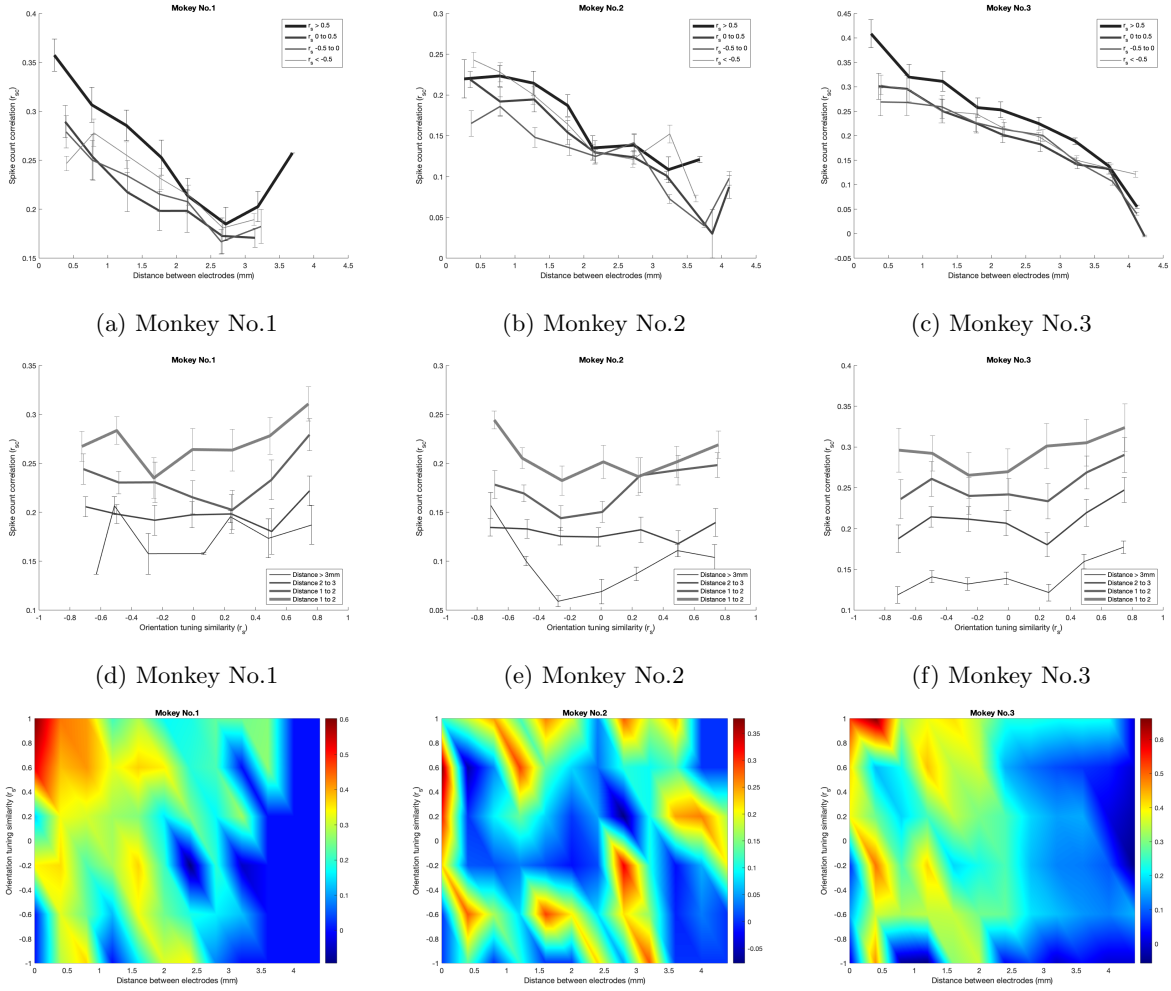
(f) Monkey No.3 - Interpolated

Figure 5: Neurons with Similar Orientation Preferences in Area V1 of Different Monkeys - Angles wrapped between 0-150

Note that the Figures 3 and 5 have low temporal resolution in comparison with Figure 4 because I have removed a lot of the neurons due to bad SNR signal.

■ Q03

□ Original Trials



(a) Monkey No.1 (b) Monkey No.2 (c) Monkey No.3

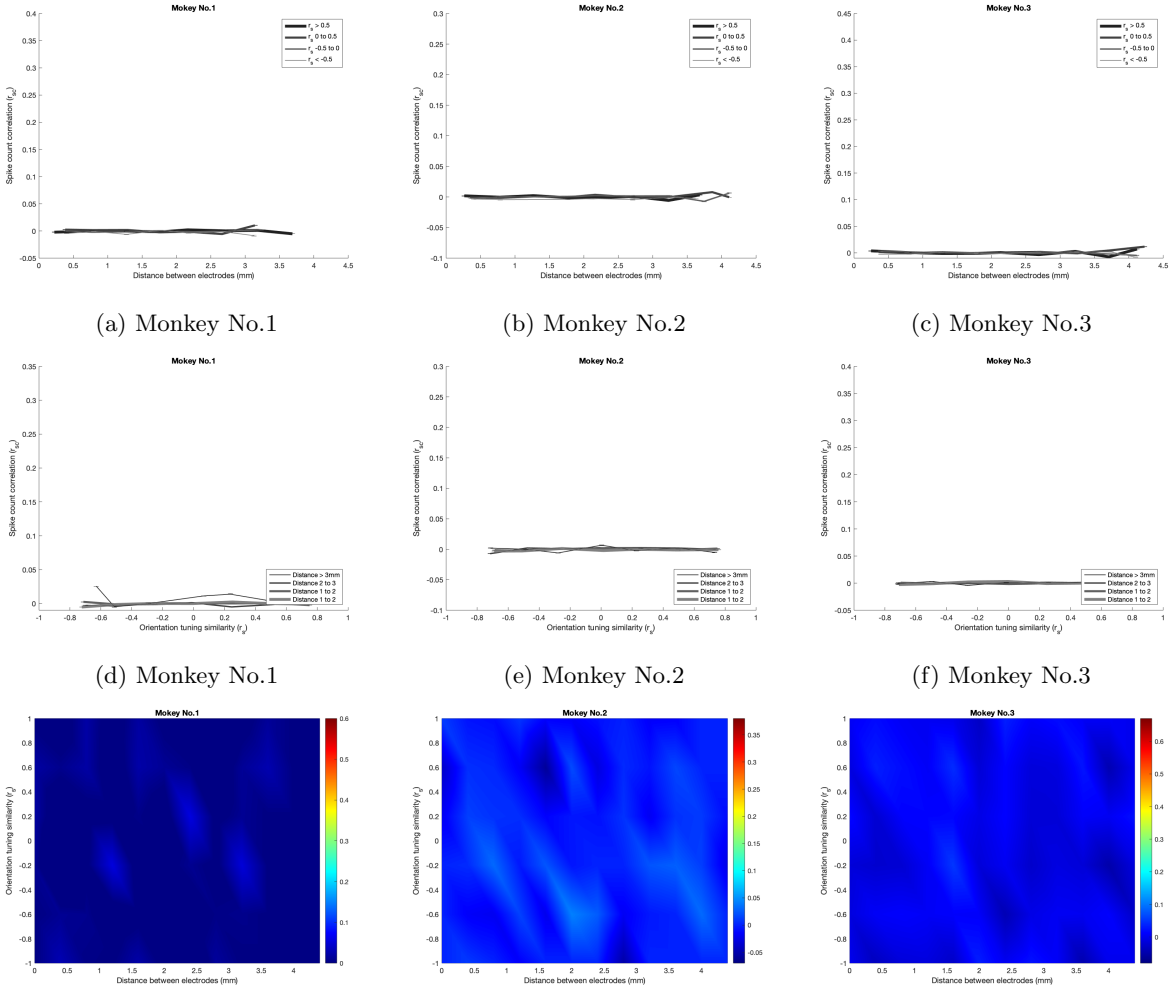
(d) Monkey No.1 (e) Monkey No.2 (f) Monkey No.3

(g) Monkey No.1 (h) Monkey No.2 (i) Monkey No.3

Figure 6: Dependence of r_{sc} on distance and tuning similarity - Colorbar in color mesh plots indicates value of r_{sc}

Result shown in Figure 6 are similar to the results of the paper, but for validating these results I need to shuffle the trials and plot the figure again. You can see these plots for shuffled trials in Figure 7.

☐ Shuffled Trials



(a) Monkey No.1 (b) Monkey No.2 (c) Monkey No.3

(d) Monkey No.1 (e) Monkey No.2 (f) Monkey No.3

(g) Monkey No.1 (h) Monkey No.2 (i) Monkey No.3

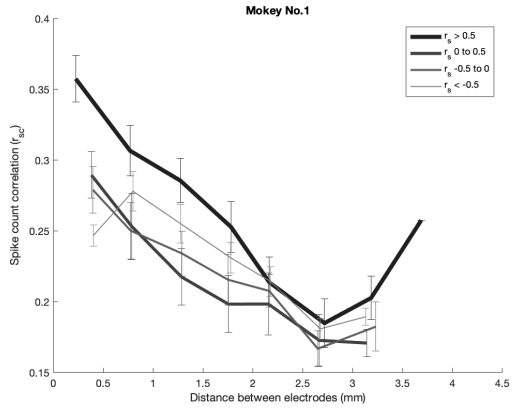
Figure 7: Dependence of r_{sc} on distance and tuning similarity for shuffled trials - Colorbar in color mesh plots indicates value of r_{sc}

As can be seen in Figure 7, the uptrend of the plot of Distance vs r_sc and the downward trend of the plot of r_s vs r_{sc} are eliminated.

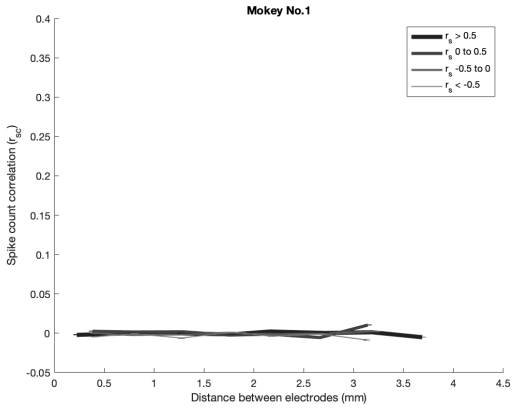
The difference between shuffled and not shuffled trials is more obvious in Figures 8, 10, and **??** where I have plotted figures related to shuffled and not shuffled trials next to each other.

□ Shuffled vs Not Shuffled Trials

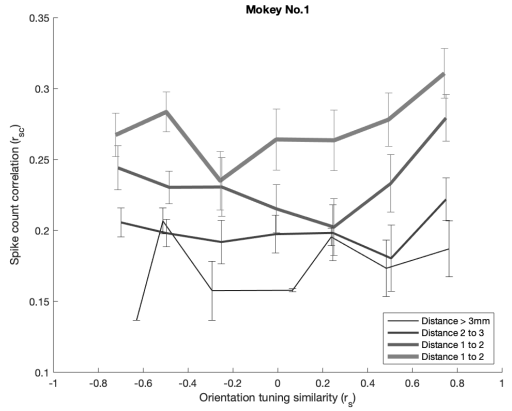
Monkey No.1



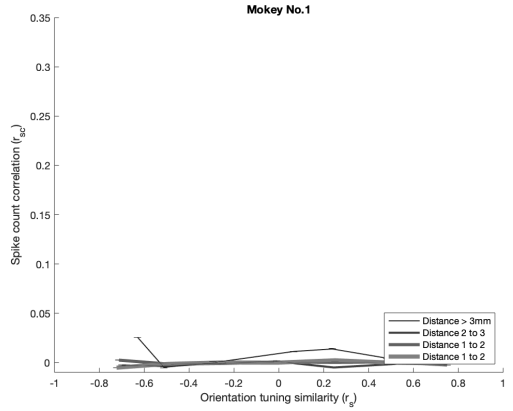
(a) Not Shuffled



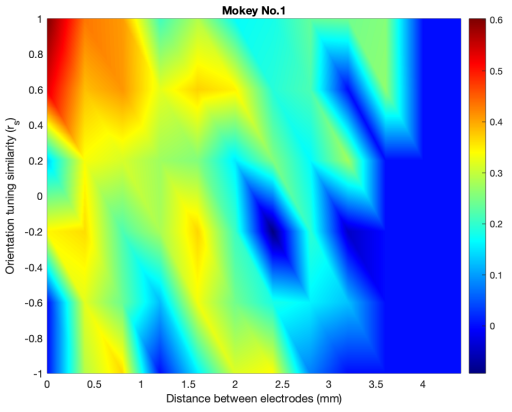
(b) Shuffled



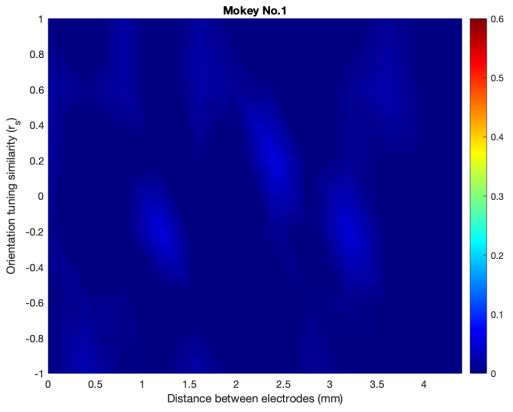
(c) Not Shuffled



(d) Shuffled



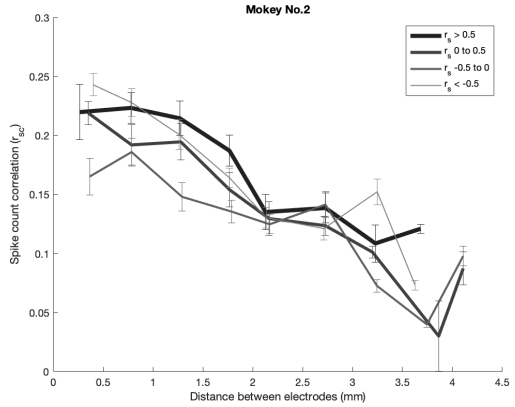
(e) Not Shuffled



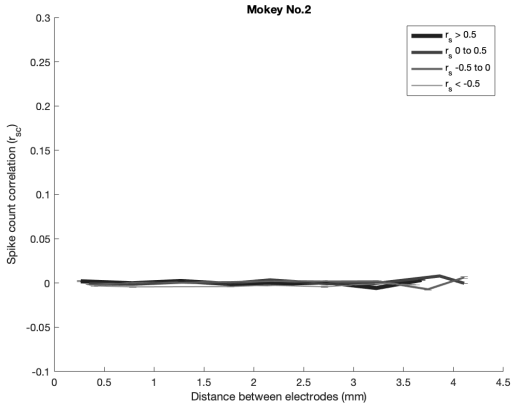
(f) Shuffled

Figure 8: Dependence of r_{sc} on distance and tuning similarity for shuffled and not shuffled trials - Colorbar in color mesh plots indicates value of r_{sc} - Monkey No.1

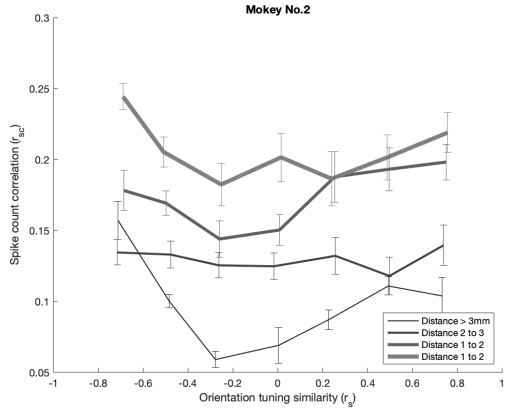
Monkey No.2



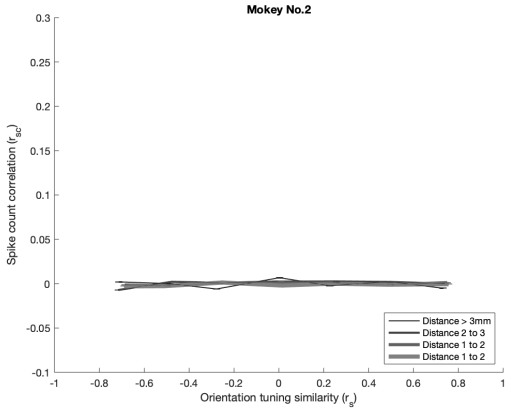
(a) Not Shuffled



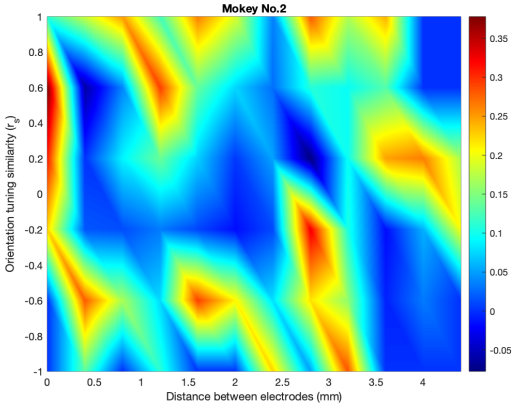
(b) Shuffled



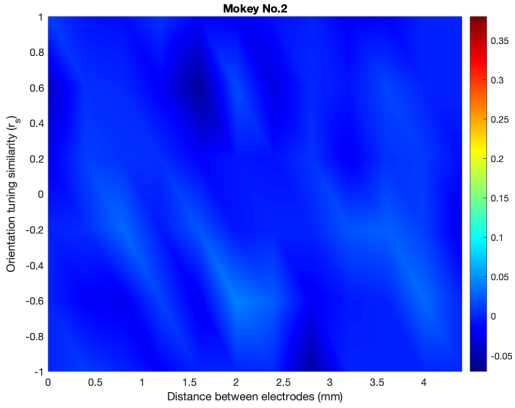
(c) Not Shuffled



(d) Shuffled



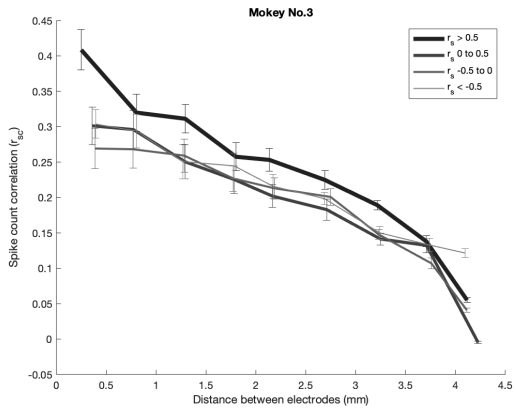
(e) Not Shuffled



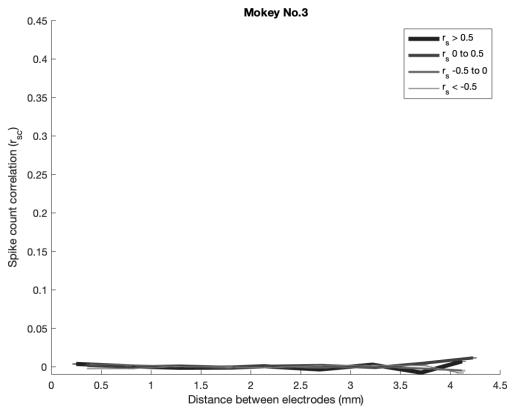
(f) Shuffled

Figure 9: Dependence of r_{sc} on distance and tuning similarity for shuffled and not shuffled trials - Colorbar in color mesh plots indicates value of r_{sc} - Monkey No.2

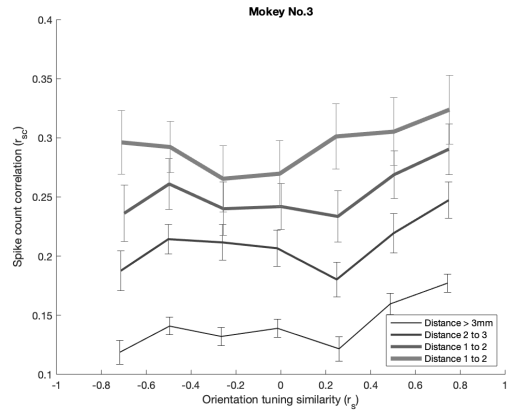
Monkey No.3



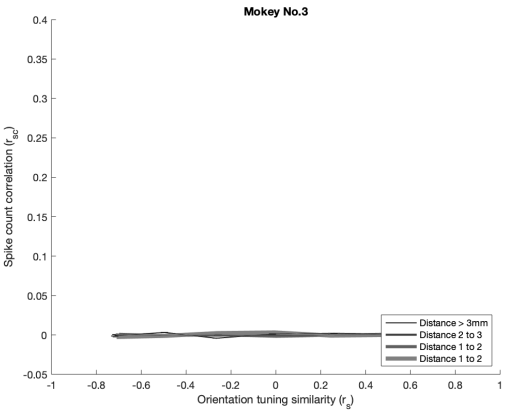
(a) Not Shuffled



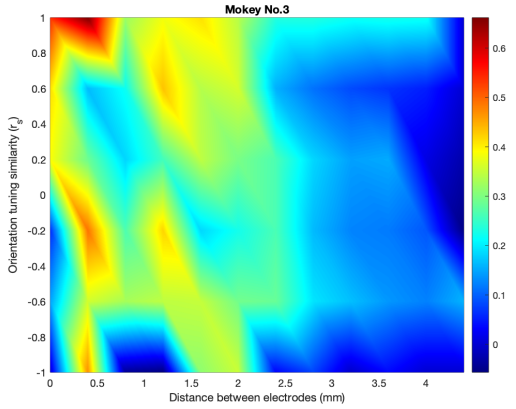
(b) Shuffled



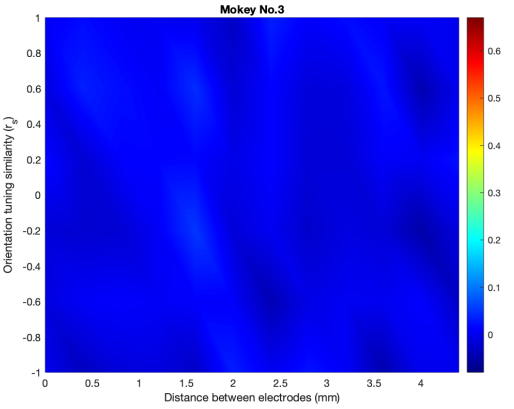
(c) Not Shuffled



(d) Shuffled



(e) Not Shuffled



(f) Shuffled

Figure 10: Dependence of r_{sc} on distance and tuning similarity for shuffled and not shuffled trials - Colorbar in color mesh plots indicates value of r_{sc} - Monkey No.3

■ Q04

In the paper it has been mentioned that "The difference in correlation of spontaneous and evoked activity suggests that sensory input can strongly reduce the correlation of ongoing activity." which means the input can decrease noise correlation which makes sense, because the neurons should concentrate on the new input rather than spontaneous activity. Also, paper mentions that "In summary, we find that the spatial structure of correlated activity is similar for spontaneous and evoked activity, indicating that the two may arise from the same mechanisms and circuits. However, during long periods of uninterrupted spontaneous activity, correlation is approximately twice as strong as during evoked activity. The stimulus-driven reduction in correlation is rapid, and particularly evident at stimulus onset and offset. After the stimulus ends, correlation rises slowly over the 1.5 s ISI. These results indicate that the processes that lead to correlated variability are altered by inputs to the network, whose effect appears to linger for many seconds after stimulus offset.".