Neuroscience Term Project

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Keyword 1 | Keyword 2 | Keyword 3 | ...

In this paper we have used the electrophysiological dataset recorded in motor cortex of two macaque monkey(N) during an instructed delayed reach-to-grasp task to create numerous plots. Meanwhile the data is recorded with a 10×10 electrode array. The area under control includes: central sulcus, M1, Premotor Cortex Dorsal (PMD) and Premotor Cortex Ventral (PMV). 96 electrodes out of 100 have the data we need. We'll be clarifying the type of the process, whether the neurons are sensitive to a particle event or not, studying the firing rate based on different events, and etc. (**?**)

Behavioural Task

The task is done by Monkey (N) and recorded during the trials. TS_ON set signals when the task begins. After 400 ms, the yellow LED turns on, a signal that the start of the trial (WS_ON). CUE_ON set is the representation of how the monkey should grasp the object; Whether it is a side grip (SG) and the two left LEDs turn on, or it's a precision grip (PG) and the two right LEDs turn on. After 300 ms CUE_OFF happens and the LEDs turn off. During the following 1000 ms, if something out of order happens, the trial leads to an error; and if not, at GO_ON set, signal to the monkey to move its hand and grip the object divides into two kinds: Low force (LF) and high force (HF). After some delay, depending on the monkey's own behaviour, SR_ON signals the start of the monkey's hand's motion. If no error happens, it should hold on the object for 500 ms, and then it receives the reward (RW_ON). At last, WS_OFF signals the end of the trial. These events are saved as bit numbers in dataset.

Materials and Methods

We used the data associated with the neurons' spike trains and the events during the trials. In order to have the raster plot, each trial has been separated from other trials, and its starting time shifted to zero. This way the behaviour of neurons can be seen during each trial. PSTH figure is the density of spikes over time, and is plotted with the same data sorting procedure (Fig. 2). Because the events were not altogether ordered and collected over time, showing the events as vertical line in Fig. 1 would cause unnecessary confusion. So, instead, a histogram of events for all the trials is provided, implementing which events have happened at which time during the trial (Fig. 3). The histogram plot of the ISI of all the trials is shown in Fig. 4. Of course, the trials are gone through a filter to eliminate the outlier data. nd should not be used.

Results

Go over your analysis/experiments step by step and describe what is shown in each figure then make a case to go to the next analysis.

Discussion

A stochastic process that generates a sequence of events, such as action potentials, is called a **point process**. If the probability of an event occurring at any given time doesn't depend at all on the preceding events , so that the events themselves are statistically independent, we have a **Poisson process**. The **Homogeneous Poisson process**, which we are involved with here, causes the Poisson distribution:

$$P_T[n] = \frac{(rT)^n}{n!}\exp(-rT) \qquad (I)$$

The probability density of time intervals between adjacent spikes is called the interspike interval distribution (ISI), and it is a useful statistic for characterizing spiking patterns. From equation (I), with n = 0, the probability of not firing a spike for period τ is $exp(-r\tau)$, so the probability of an interspike interval falling between τ and $\Delta t + \tau$ is:

$$P\left[\tau \leq t_{i+1} - t_i < \tau + \Delta t\right] = r\Delta t \exp(-r\tau) \qquad II$$

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Significance Statement

You are encouraged to submit a 120-word maximum statement about the significance of your paper written at a level understandable to an undergraduate educated scientist outside their field of speciality. The primary goal of the Significance Statement is to explain the relevance of the work in broad context to a broad readership. The Significance Statement appears in the paper itself and is required for all research papers in some journals.

Please provide details of author contributions here.

[1]A.O.(Author One) and A.T. (Author Two) contributed equally to this work (remove if not applicable).

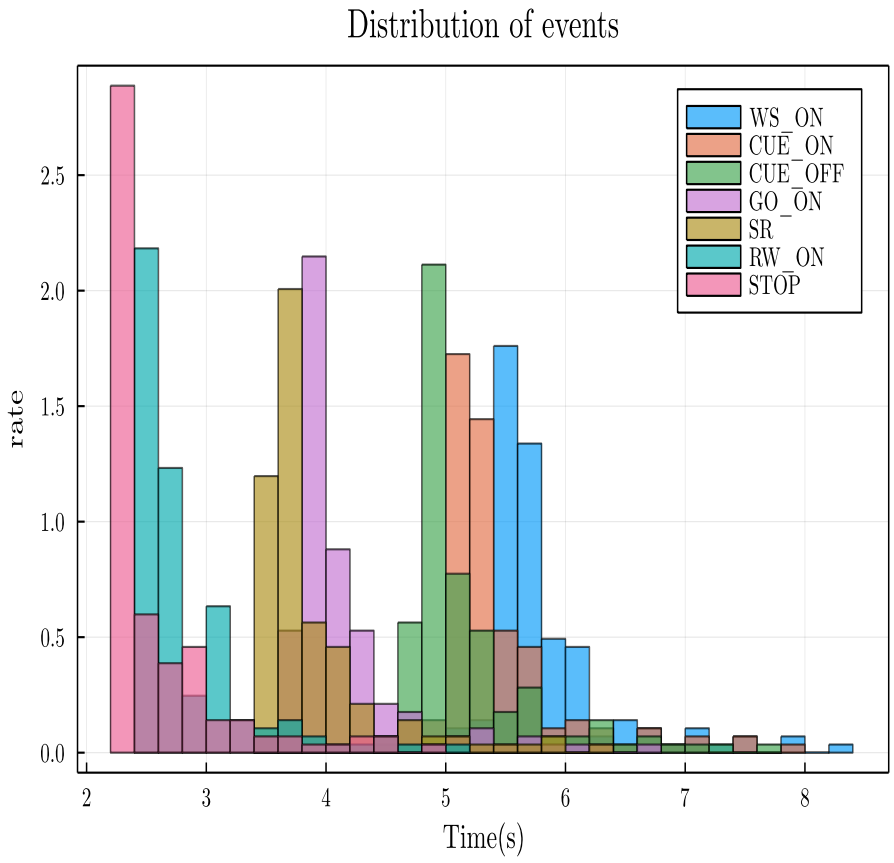

Fig. 1. The density of events in all the trials over time.

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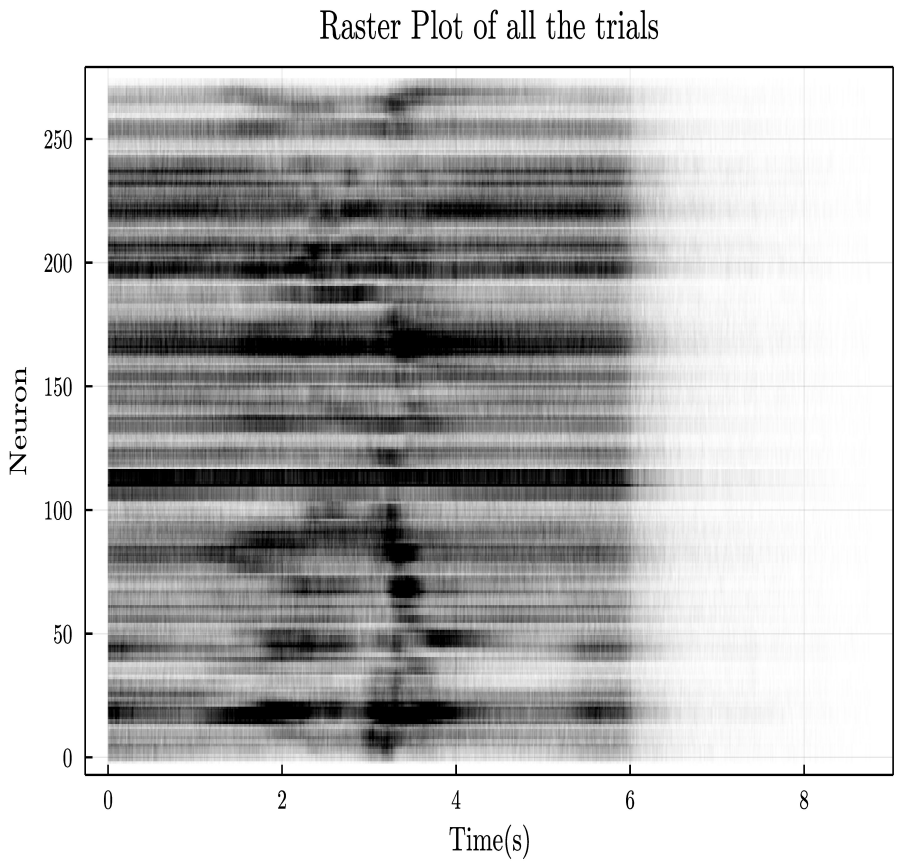

Fig. 2. Raster Plot. The rasters show multiple trials during which a neuron responds to the stimulus.

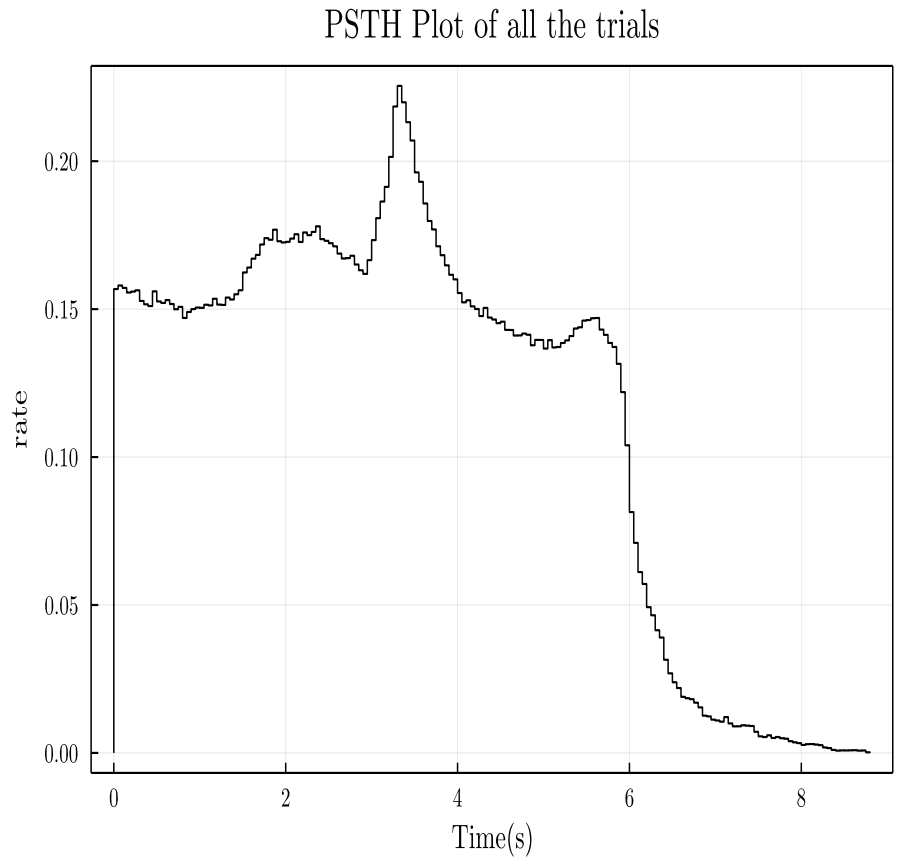

Fig. 3. PSTH. Firing rates, shown under the raster plot , were constructed from the multiple trials by counting spikes within discrete time bins and averaging over trials.

We fit the data to the general exponential equation Ae^{Bt} with $B = -2.24 \pm 0.14$

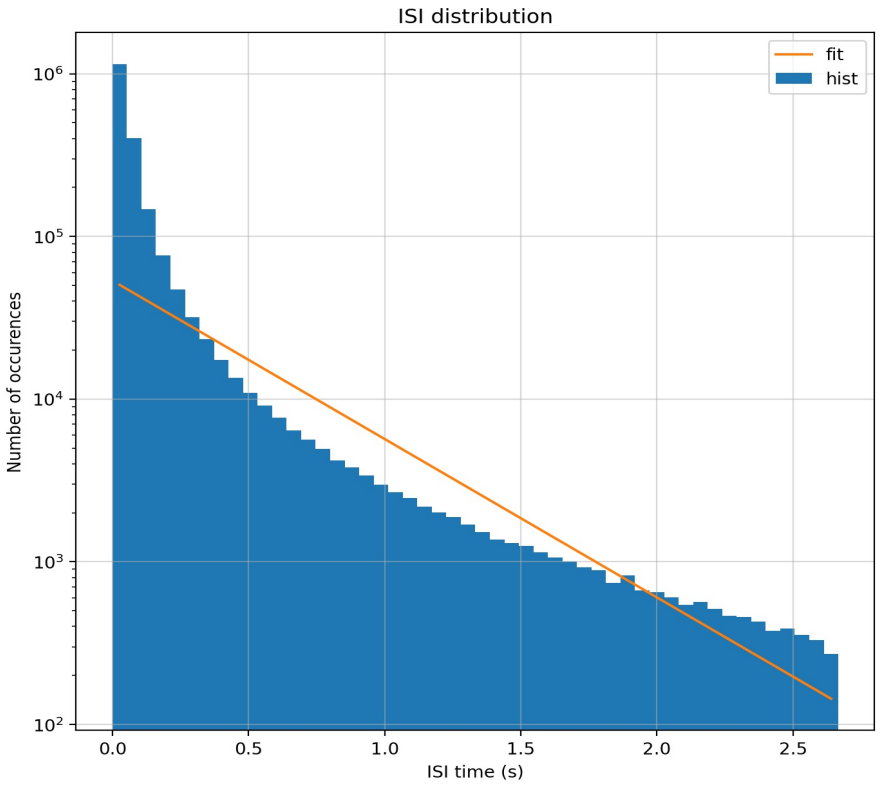

Fig. 4. The ISI distribution for filtered data. The bin size is between 0 to 8000 indexes. The y- axis then became logarithmic to fit the exponential function.