

Interactions between burst predicting neurons

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Introduction

- Neurons fire electrical signals to each other that send messages and tell our bodies what to do.
- A new discovery is burst predicting neurons.
- These are neurons that consistently fire right before a network burst, a period of high neural activity followed by a brief period of inactivity.
- These burst predicting neurons are an important discovery as they support the idea that our brains may be more resistant to network dysfunction than we originally believed.
- Our question was if any of these neurons interact or if they operate independently of each other.

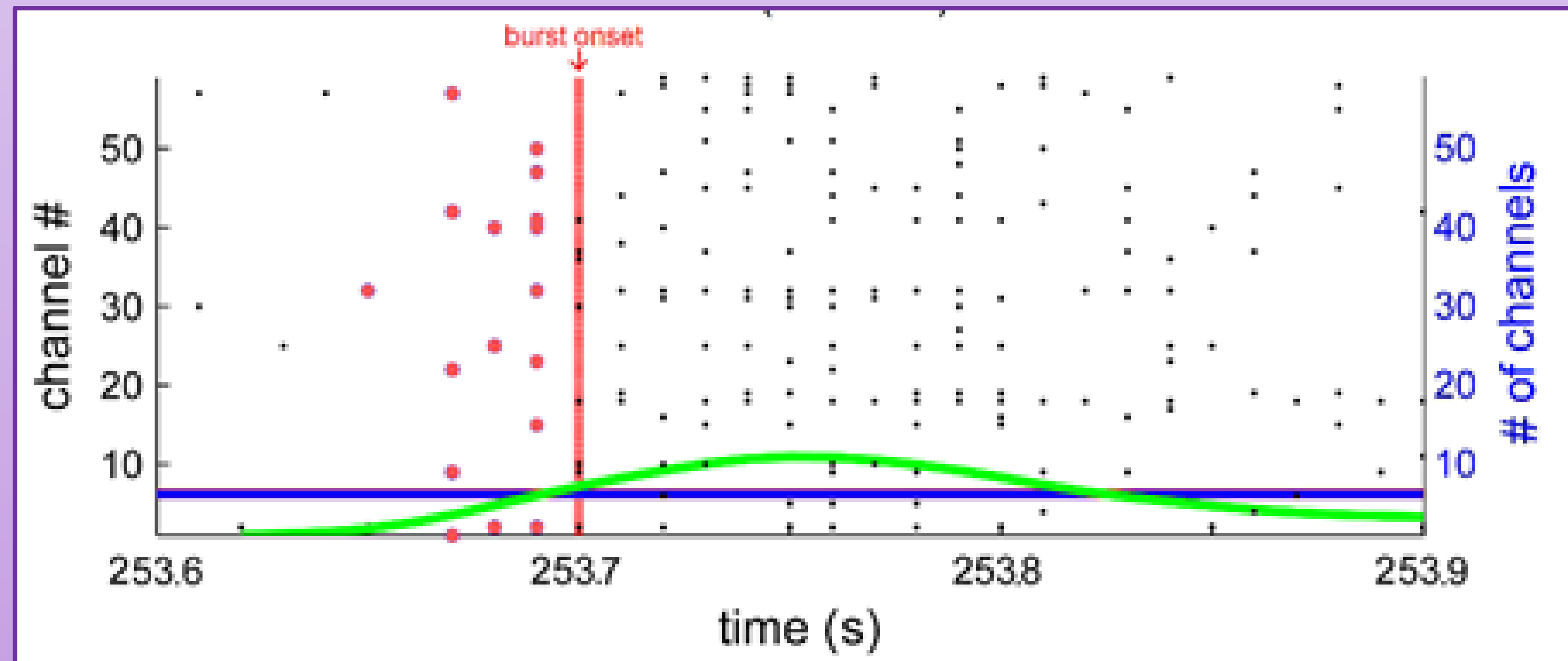


Figure 2. The activity recordings for a network burst with the red circles representing the burst predicting neurons.

Methodology

- The activity of the burst predicting neurons was measured using a multi electrode array comprised of a microelectrode grid.
- Each number on the grid represented a channel of neurons.
- We were able to measure when each electrode was firing, and from this we compared to see if any of these channels were consistently firing for the same bursts, which would imply that neurons near those channels were interacting.
- We also wanted to test if this correlation was significant or if it was purely by chance.
- In order to test this a computer program called Matlab (Matrix laboratory) was used.
- We compared the original correlation to many randomizations of the data. If the original correlation was higher than the randomize correlation, we could assume an interaction between those two burst predicting neuron areas.
- Another aspect we considered was the distance between the channels that appeared to be interacting.
- This could be calculated using the known distances between the electrodes on the grid and using the Pythagorean Theorem to find the unknown distance.

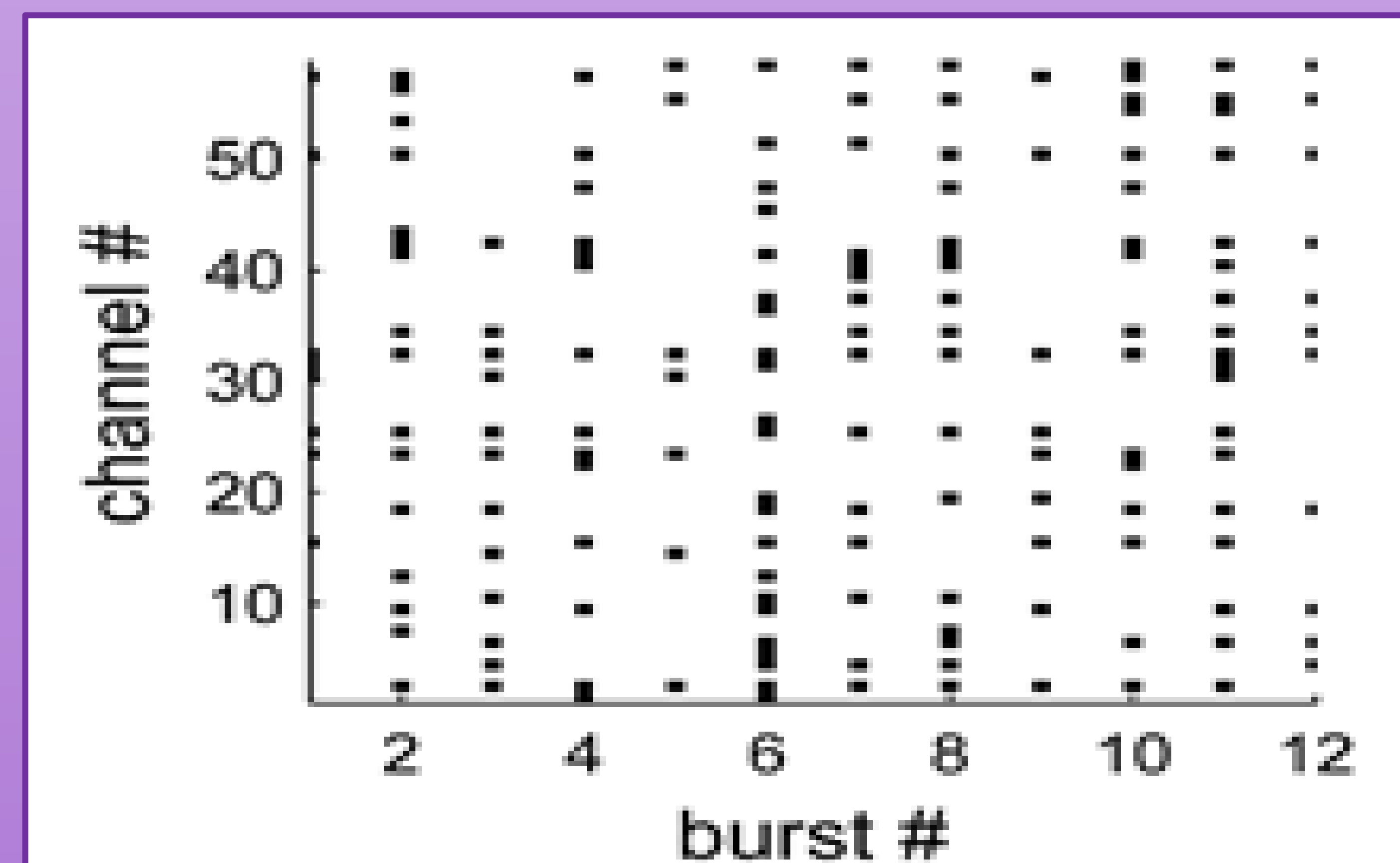


Figure 3. A raster plot depicting which electrodes showed activity before a burst.

Number of interactions per electrode

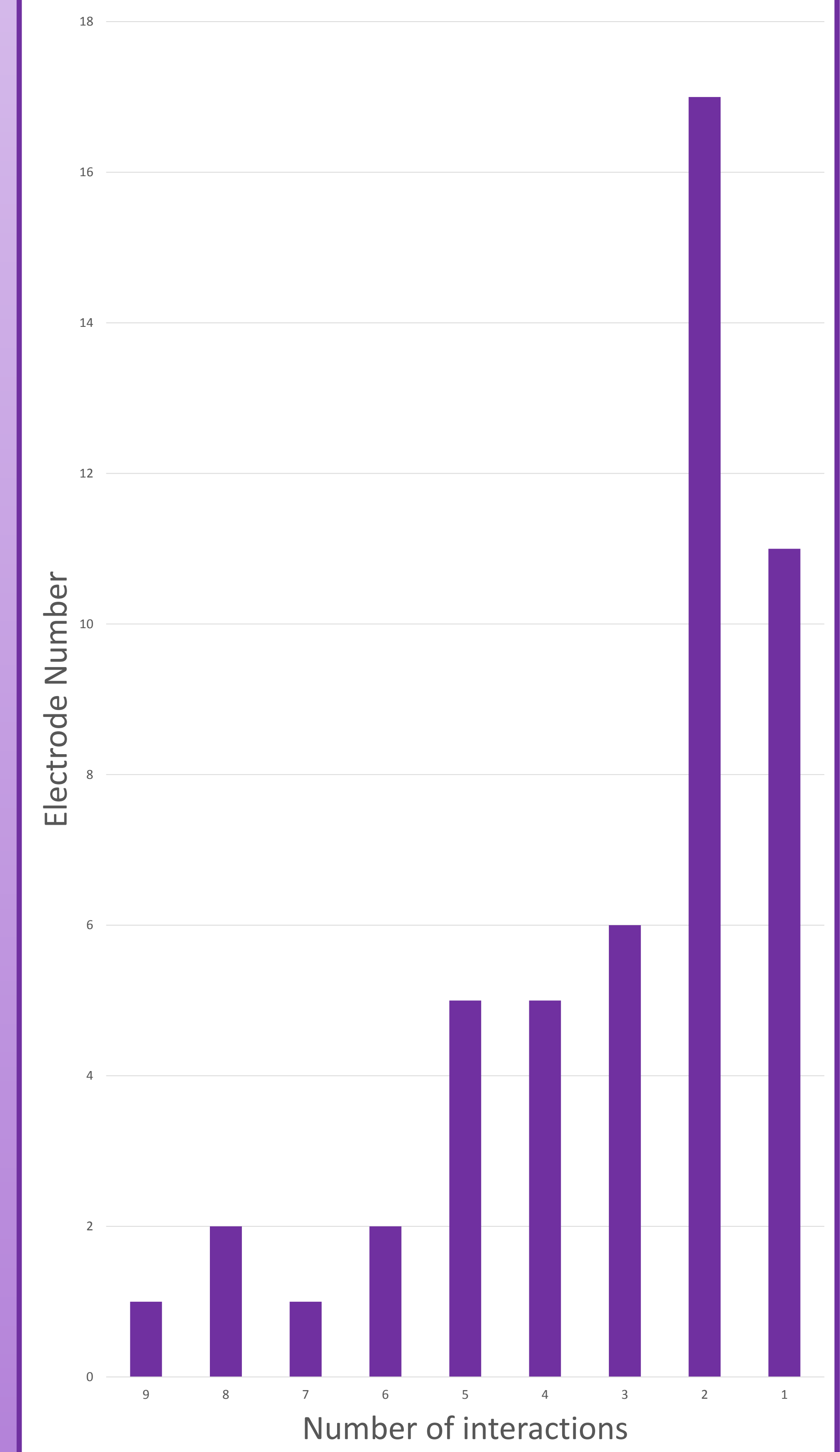


Figure 5. A representation of which electrodes interacted with other electrodes the most often

Results

- Using a program written on Matlab, we were easily able to determine the amount of channels that interacted with each other that had a significance of 99% or higher, meaning that the original correlation was almost certainly not due to chance.
- There were 76 pairs of channels that seemed to be interacting.
- Channels 3, 11, 10, 1, 21, and 6 interacted more than others, and had between 6 to 9 interactions while the other channels ranged from 1 to 5 interactions.
- When looking at the distances between the pairs of interacting channels it is important to note that even though the electrodes were organized on an 8x8 grid, only activity from 59 of them was recorded as the four corners and a reference electrode were not used.
- The distances were varied, spanning 1497 microns, with the lowest being 200 microns apart and the farthest being 1697 microns apart.
- The average distance was about 830 microns apart, however this is not a good representation of all the distances as they were so diverse.

Interaction Distances

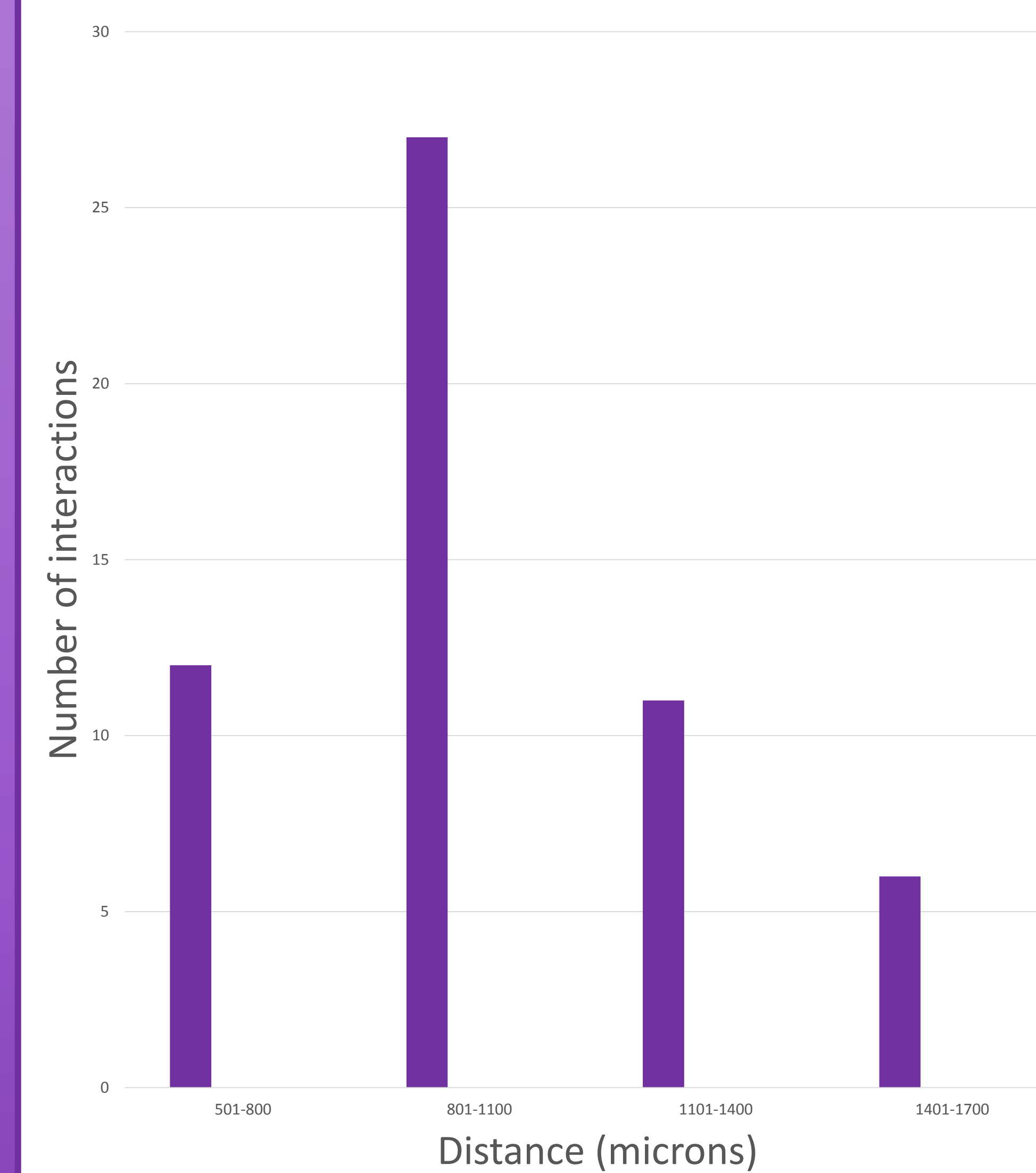


Figure 4. A representation of the distances between interacting channels.

Conclusion

- It is evident from looking at the data that not many of these channels are interacting. Only 4.44% of all possible interacts occurred and were significant.
- Additionally, there seems to be no pattern as to the distance between the few pairs of neurons that were shown to be interacting.
- Some areas for future research would be to look into which types of neurons tend to be burst leaders or why these neurons seem to be protected against ischemic damage.

Acknowledgments

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References

Kuebler E. S., Thivierge J. (in prep). Burst predicting neurons survive an in vitro glutamate injury model of cerebral ischemia.

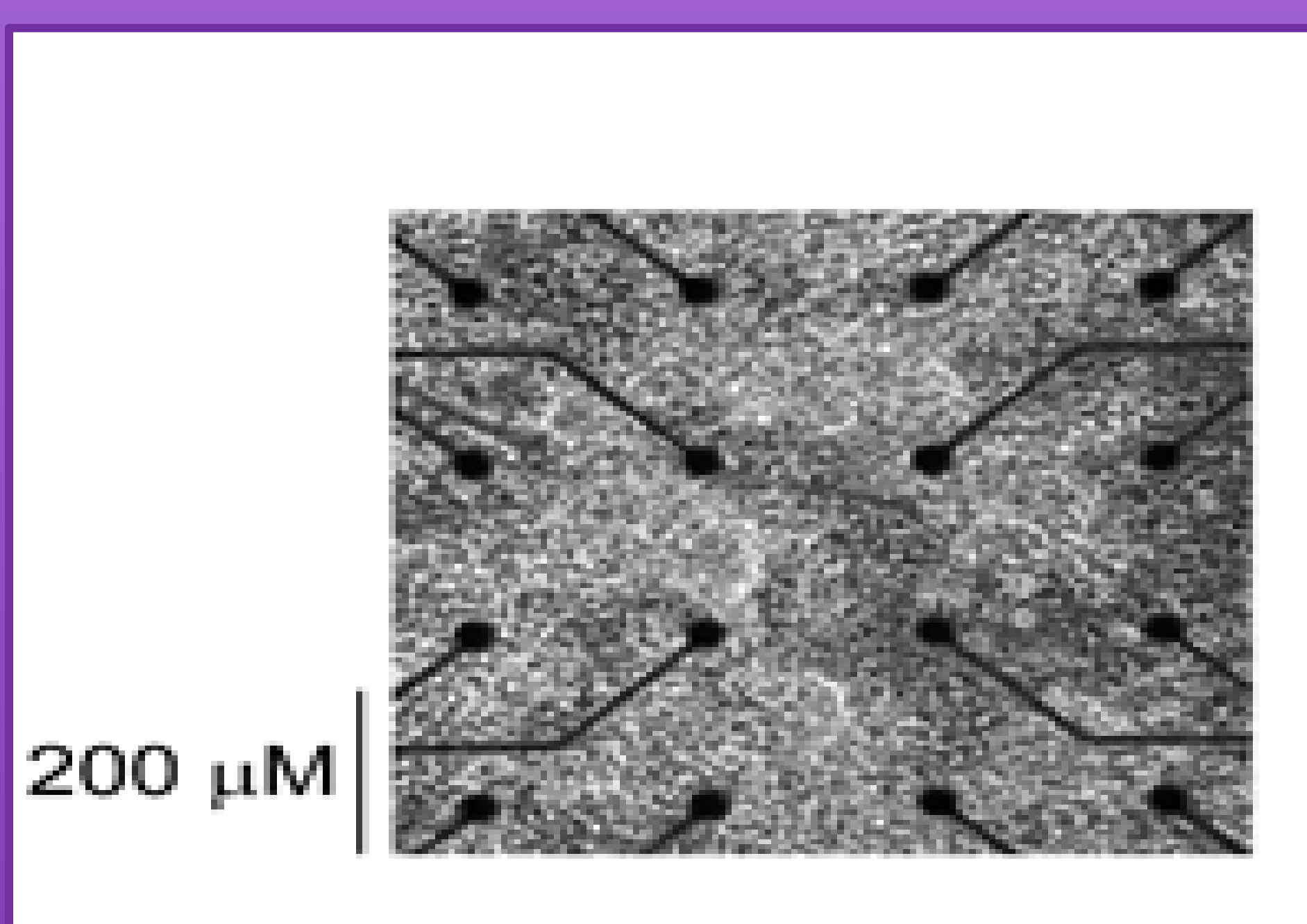


Figure 1. A 4x4 subset of the electrodes in the multi-electrode array