Classification of neurons using firing patterns and spike-field coherence

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Background

Identifying neurons based on their electrophysiological properties would allow new avenues of research.

Traditional methods of determining neuronal cell types are usually done in vitro, via cytochemical assay. Identifying cell types in vivo would allow researchers to study the behavior of specific neuronal populations in an awake behaving animal.

Somatostatin-expressing (SST) neurons are of particular interest.

SST neurons are a type of inhibitory neuron that can have complex effects via inhibition of other inhibitory neurons. This makes their activity particularly difficult to study in vitro and in anesthesized animals.

Properties include:
- high basal firing rates,
- a decrease in activity in response to a stimulus,
- high spike-field coherence, related to frequency

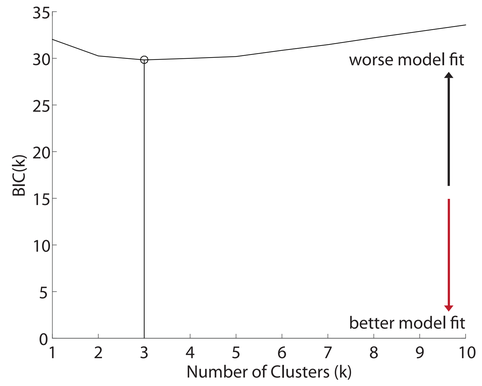
(Urban-Ciecko & Barth, 2016)

Methods

A Utah array was implanted in the V4 region of a rhesus macaque monkey. Electrodes recorded action potentials while the animal performed an attention task, in which high-contrast visual stimuli were flashed on a computer screen.

Results

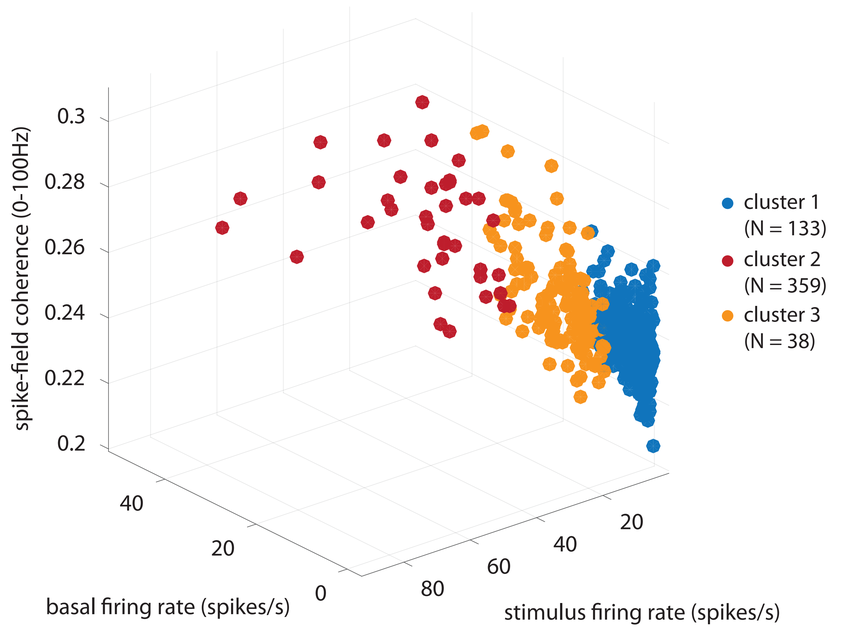
Neurons in V4 were classified using spike-field coherence, firing rate during periods of no stimulation, and firing rate when presented with a visual stimulus.



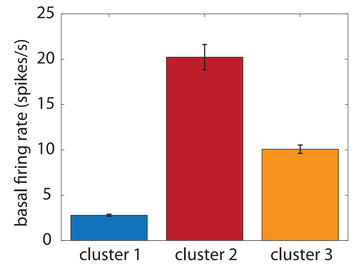
Neurons with similar properties were clustered together.

A Bayesian information criterion (BIC) identified three different clusters of neurons.

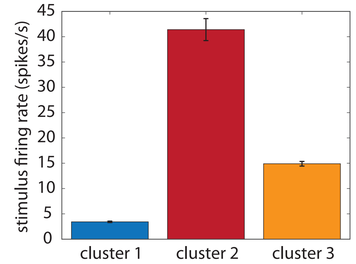
Neurons were consistently identified as belonging to one specific cluster, and the three clusters displayed distinct properties.



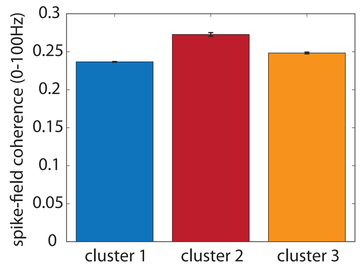
The categories identified by the BIC likely do not correspond directly to populations of unique types of neurons.



Cluster 2 had a higher basal firing rate...



....and showed a greater increase in response to visual stimuli.



Cluster two also showed slightly higher spike-field coherence.

**p < .001 for all comparisons

Further Research

Additional criteria may allow further classification:
- Examine more specific band of frequencies,
- spike-triggered average,
- waveform shape,
- correlated variability across neuronal populations
- phase consistency

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