

Clustering analysis of *in vivo* Neuropixel recordings of neuronal responses during evoked OKR in the mouse superior colliculus

Group 4: John Gaynes

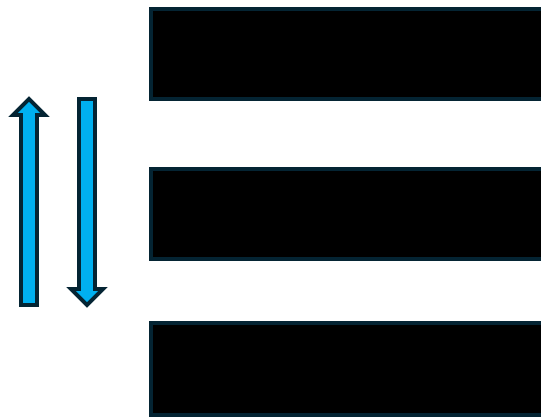
<https://github.com/neoygaj/CSPB-4502-project.git>



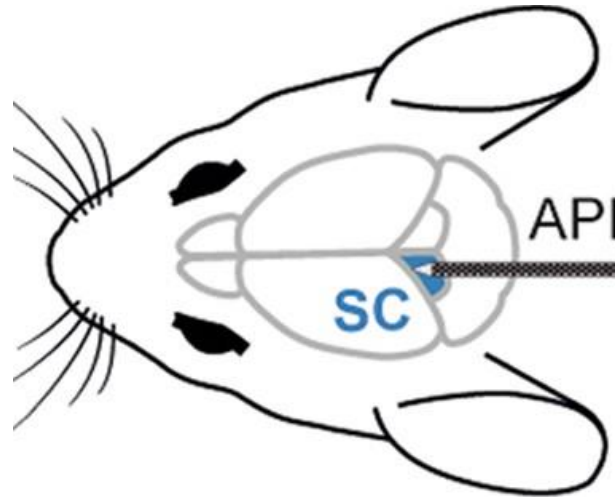
Questions sought to answer

Is there any correlation between recorded responses from 27,000 Superior Colliculus neurons from 133 experiments in response to evoked saccades in live mice?

Sibille et al, Journal of Neuroscience Methods, 2022



Drifting contrast grating and
with brief rapid shifts to
elicit saccades



386-channel neuropixel probe
Implanted in the superior colliculus
of live mice records local field potential
neural responses during saccades



Data preparation work

- ***Experiments performed by Joshua Hunt (PhD candidate, CU Anschutz Neuroscience Program)***
- Raw data was spike sorted and filtered in Kilosort software: 27,000 units, 1.7 million total waveforms
- All responses per unit/neuron were averaged together
- HDF5 file was opened and browsed to export data to be analyzed: HDF5View software
- Data was exported as a .txt file, 26,862 rows and 62 frames sampled at 1/30000 sec
- This .txt file was imported as a numerical matrix in MATLAB for analysis
- MIN, MAX and Area Under the curve were measured for regression analysis



Tools Used

- **MATLAB**

- **Hierarchical clustering:**

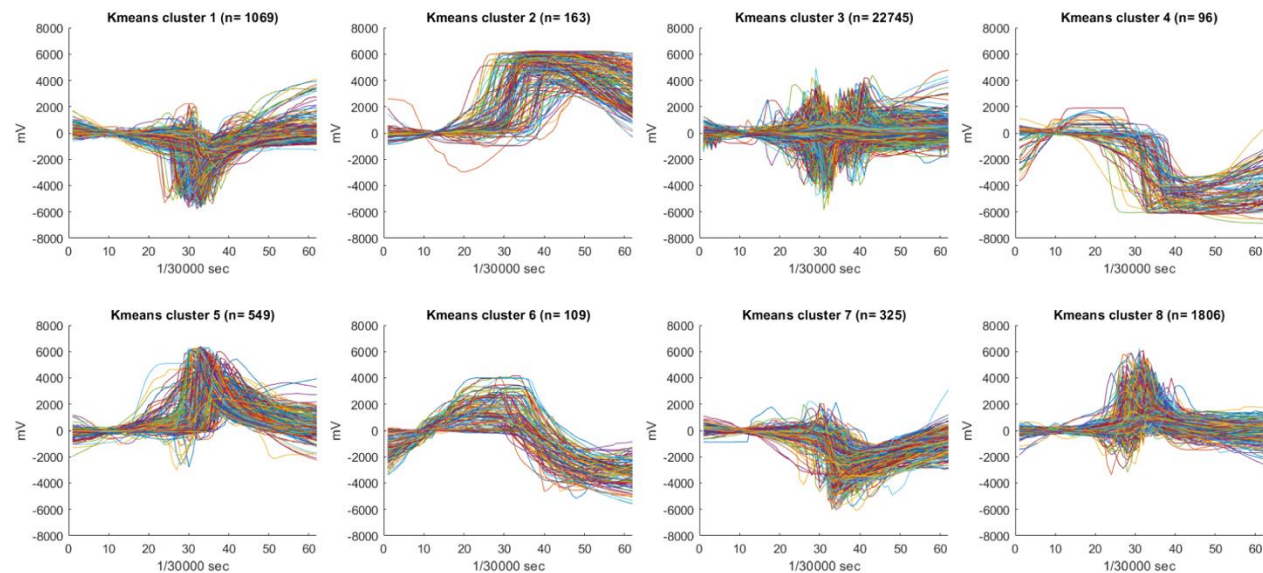
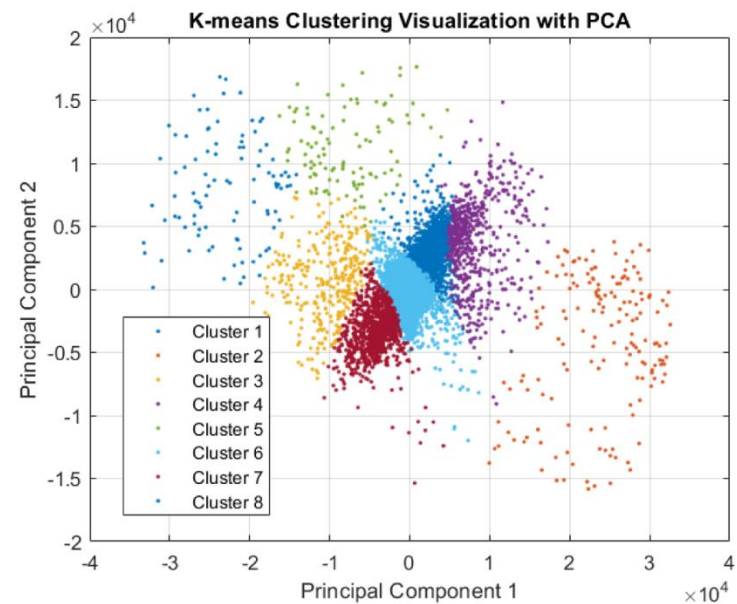
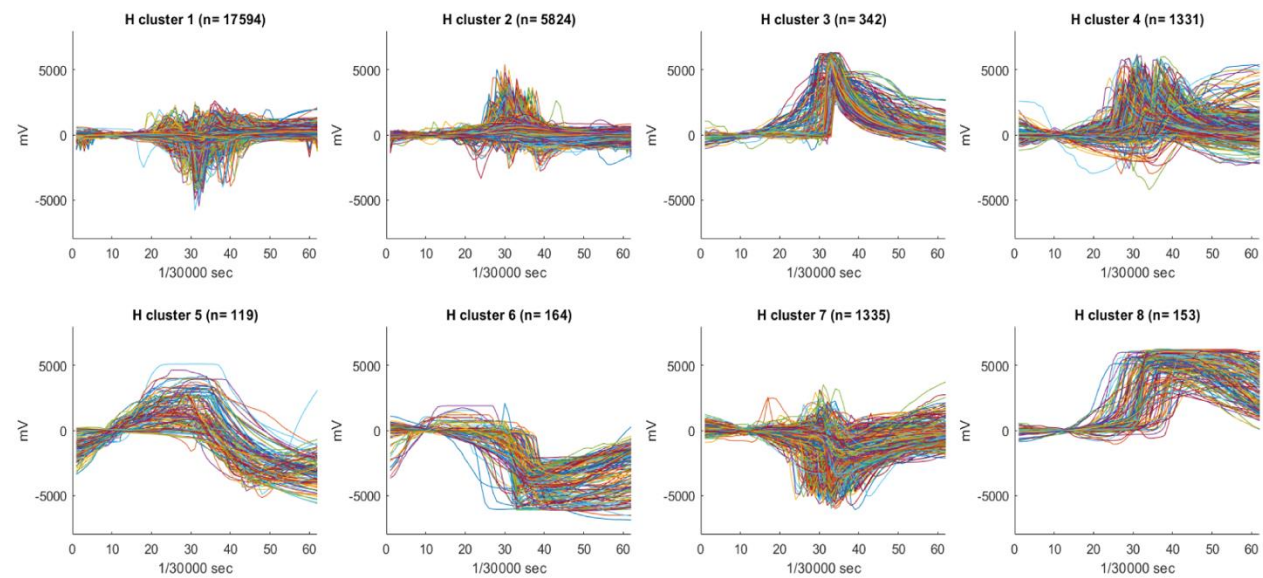
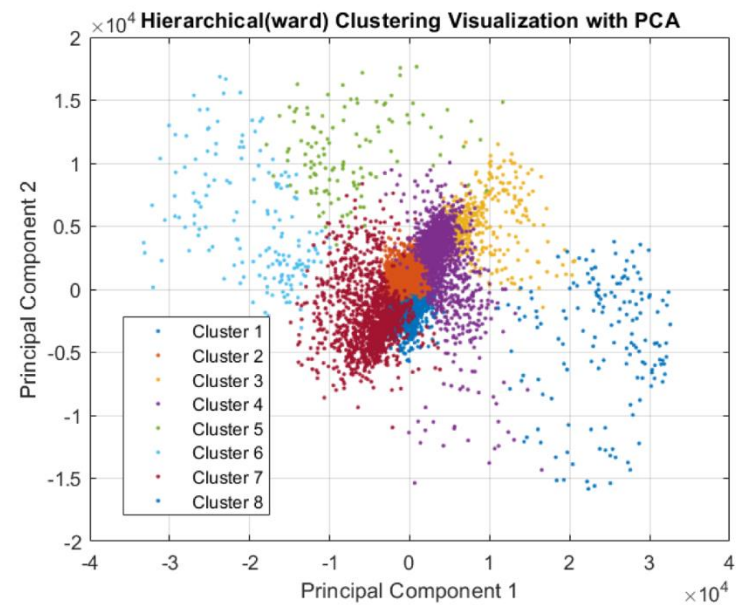
- `Z = linkage(spikewaveforms, 'ward')`
 - `cluster(Z, 'MaxClust', numClusters)`
 - PCA (dimensionality reduction): `[coeff, score, ~(eigenvalues)] = pca(spikewaveforms)`
 - `gscatter(score(:,1), score(:,2), idx)`

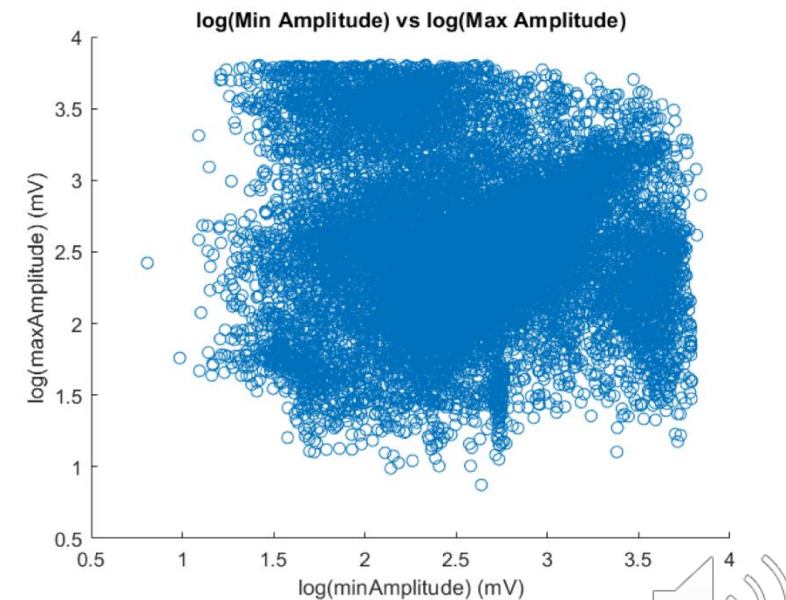
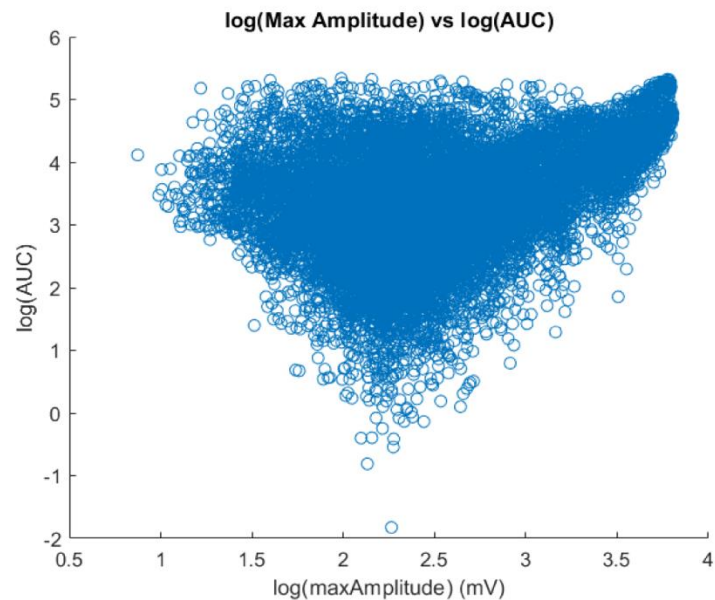
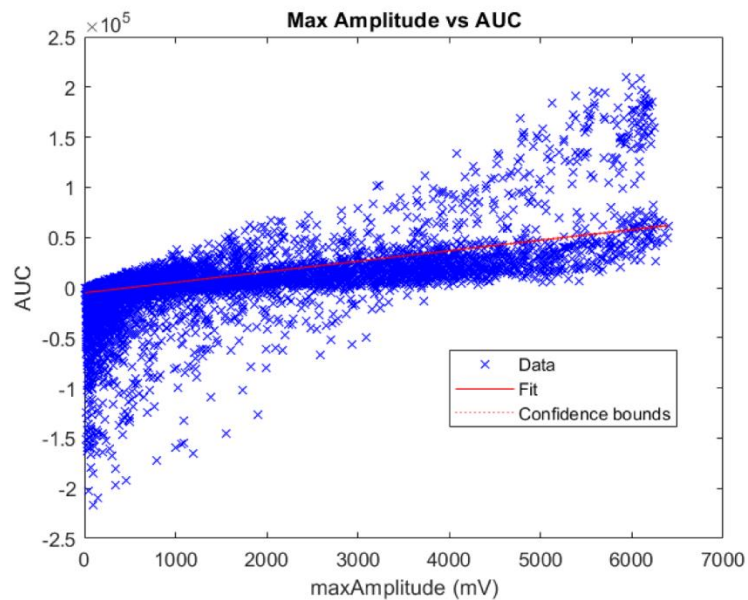
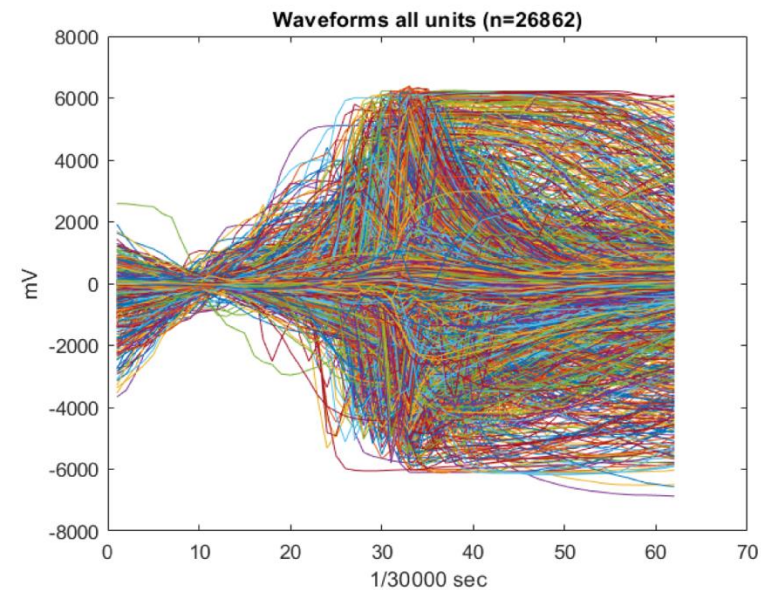
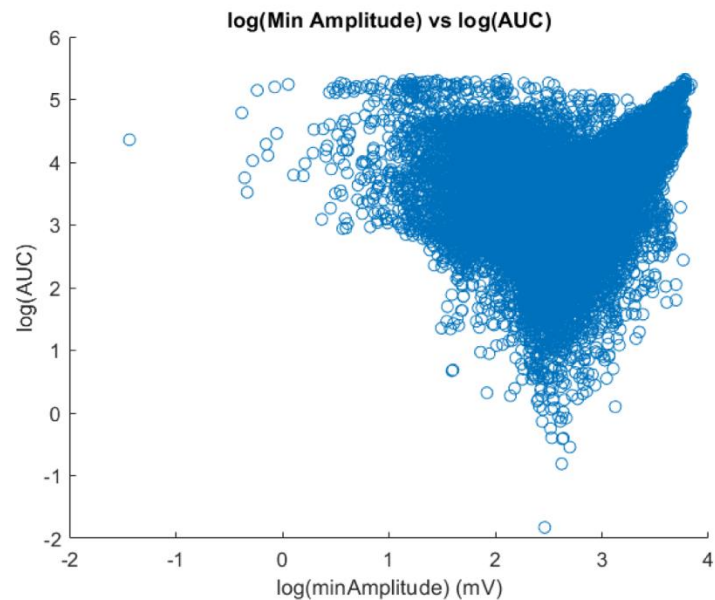
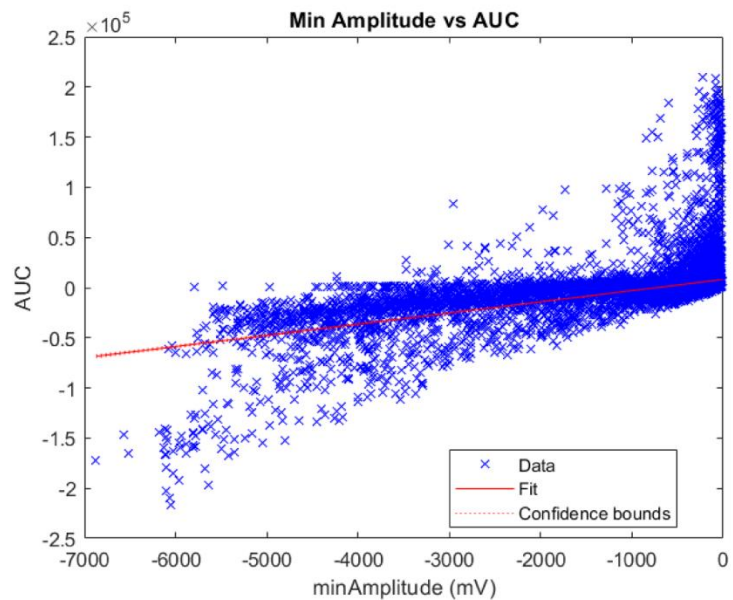
- **K-means clustering:**

- `[idx, centroids] = kmeans(spikewaveforms, #clusters, 'MaxIter', 1000, 'Replicates', 10)`
 - `[coeff, score, ~] = pca(spikewaveforms);`
 - `gscatter(score(:,1), score(:,2), idx)`

- Scatterplot for regression visualization
 - Built-in plotting (similar to matplotlib)







Knowledge gained / how can it be applied

- There is a clear separation of waveforms into 8 distinct clusters, replicated similarly with hierarchical clustering and K-means clustering.
- This suggests a structured organization of the SC with functionally specialized neurons
- Regression shows some positive correlation between Max, Min and AUC
 - Not ubiquitous in the SC
- This is most applicable to future studies to further characterize SC neuron ensembles
- Can be applied to eye tracking technologies and understanding visual disorders

