

Automatically Track Spike-sorting Stability Using Mixture of Gaussians on Chronic Neural Data



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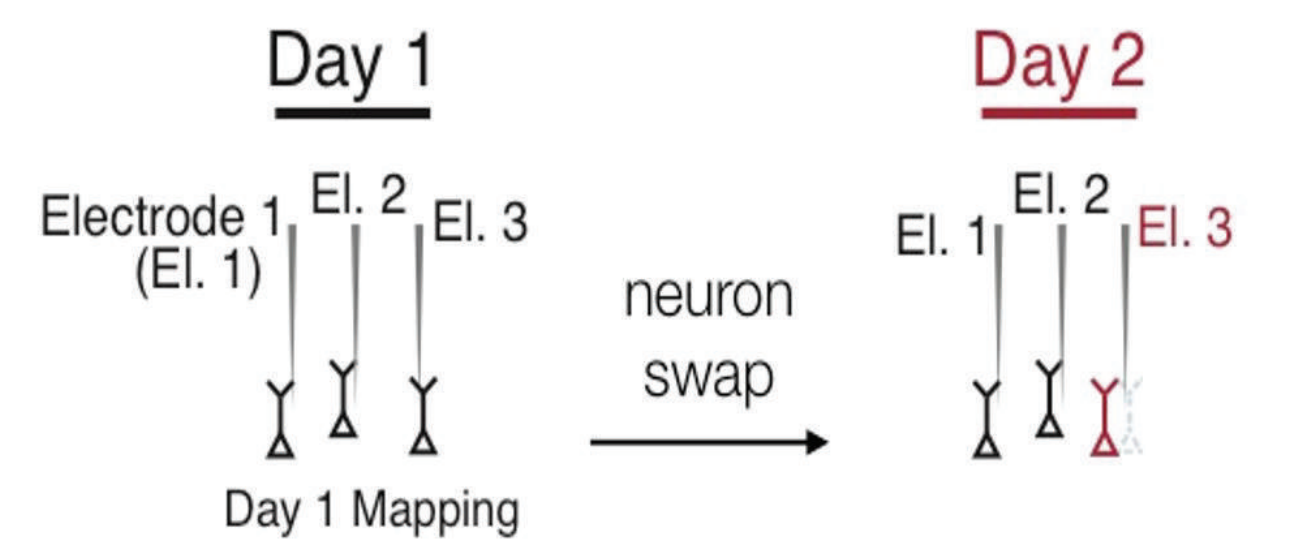
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Introduction

Measuring neuronal drift across days

Tiny waveform shifts require re-fitting model

• How could we tell if the neurons we recorded on day 1 stay the same across multiple days of experiments?



Spike-sorting algorithm

Objective: In order to improve the performance of BCI devices and to better answer neuroscience questions, we seek to quantitatively assess the stability of neurons recorded on subsequent days from the chronically implanted electrodes

Processing workflow

1. Principal components analysis (PCA) used for dimensionality reduction
 - Keep the same low-dimensional projection across days
 - First 5 components were used
2. K-means clustering for initializing cluster centroids
 - Equal covariance and prior probabilities were also used to initialize sorting
3. Fit parameters of a Mixture of Gaussians (MoG) model using Expectation Maximization (EM)
 - 3a. Evaluate log-likelihood of the data and check for convergence
 - 3b. Cluster determination using likelihood
4. If prior model existed, classify data using log-likelihood with prior parameters
$$\arg \max_k \log \mathcal{L}_{nk} = \arg \max_k \log \left\{ \mathcal{N}(x_n | \mu_k, \Sigma_k) \pi_k \right\}$$

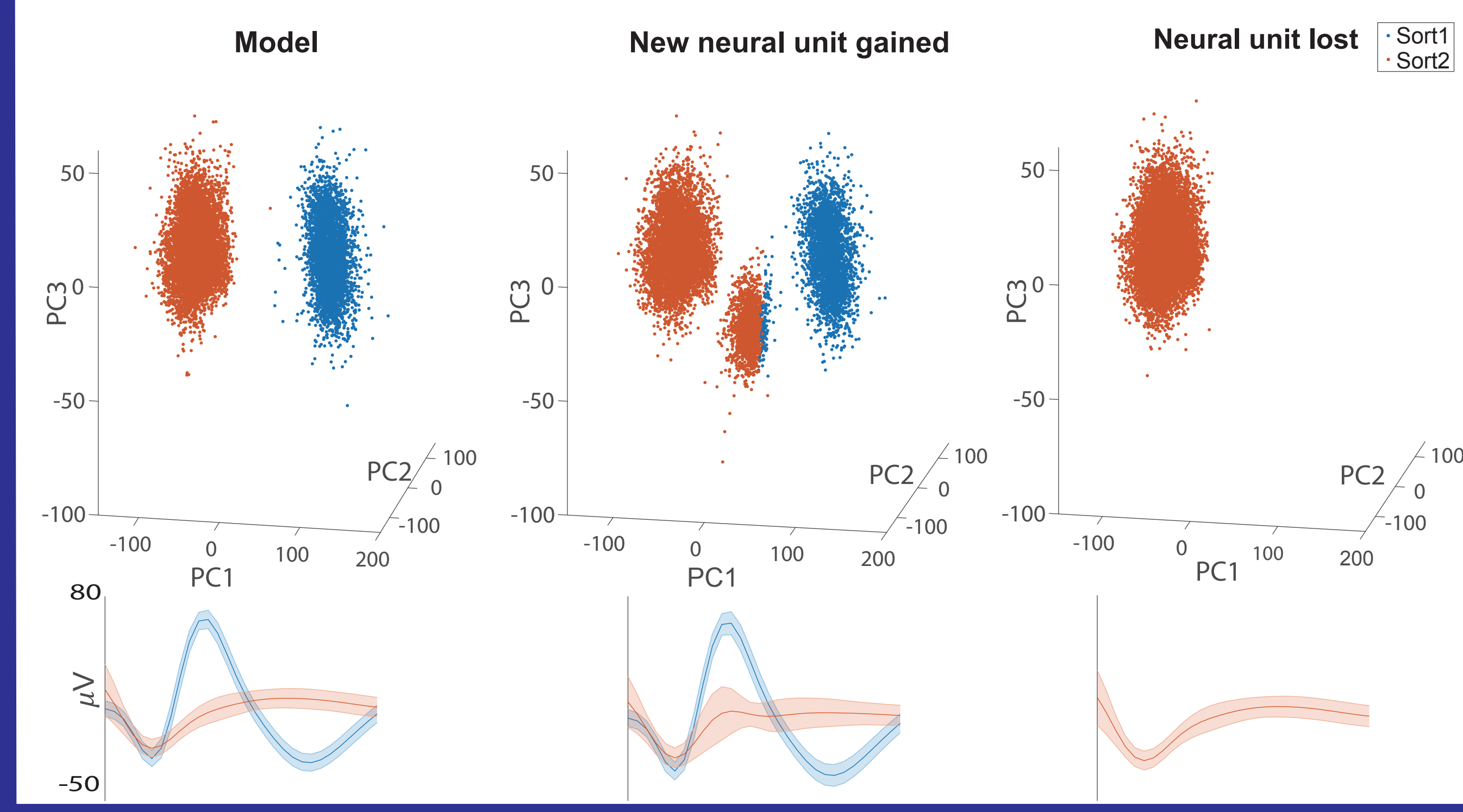
Keep the MoG model for consecutive days

vs

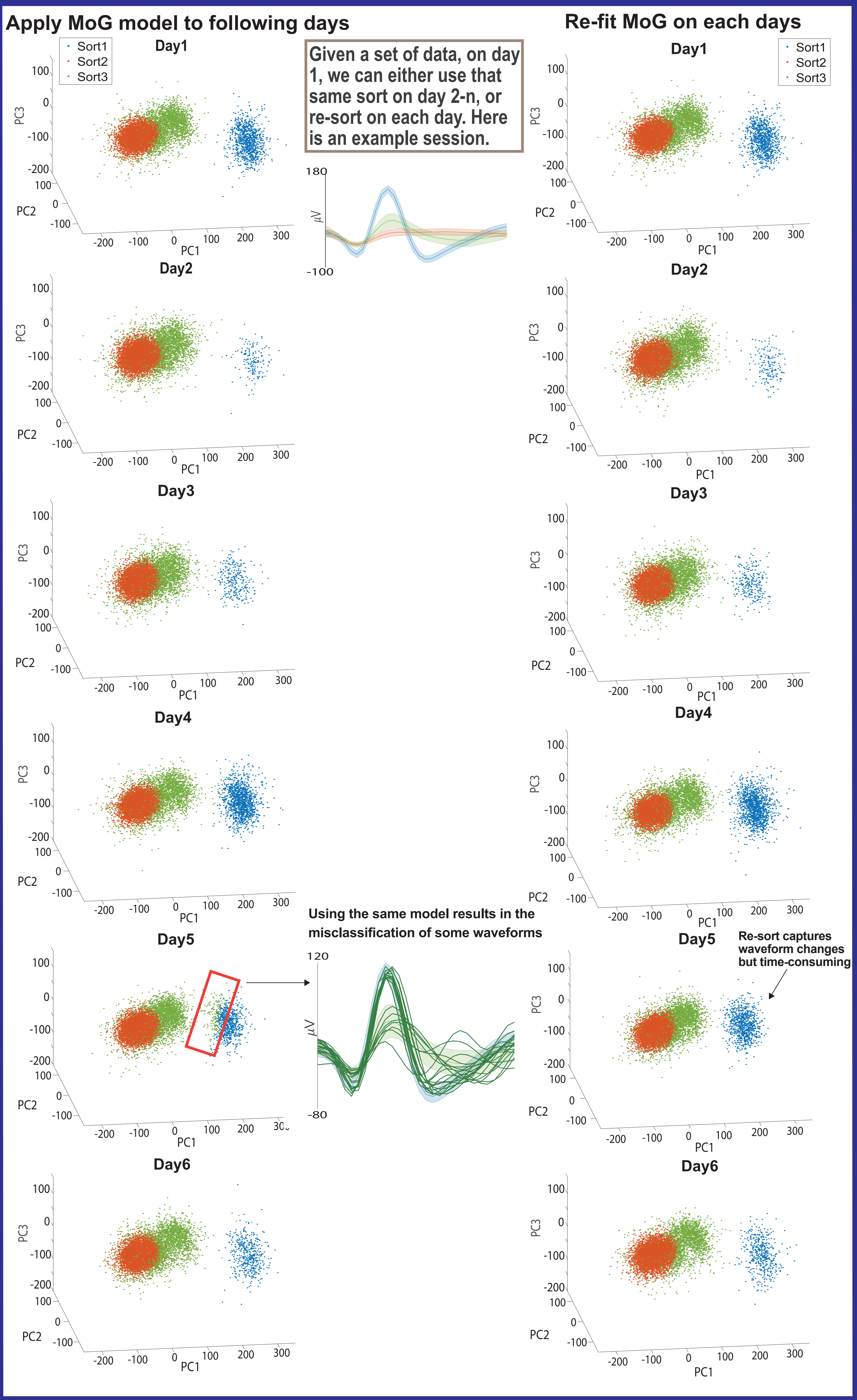
Re-fit new MoG model on each day

Toy channel method for testing

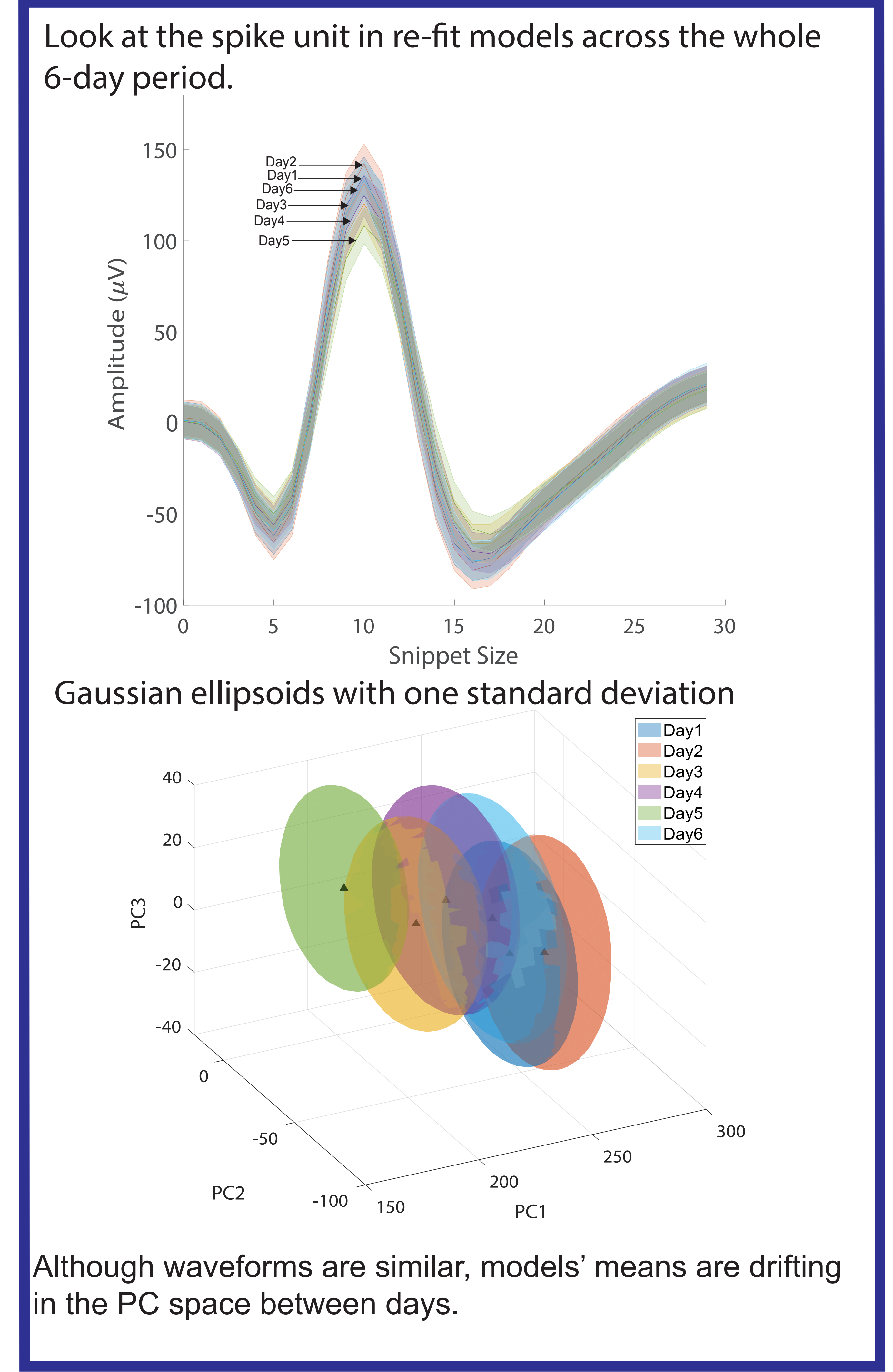
Use pre-sorted clusters from manually selected data and assemble them into extreme cases to assess algorithm's performance



Measuring neuronal drift across days



Tiny waveform shifts require re-fitting model



Conclusions

- This method can identify when new units appear or existing units disappear when testing
- However, it is not as robust for small shifts in waveform shape, which are common
- This requires an algorithm that can allow for these shifts