EE16B: Designing Information Devices and Systems II

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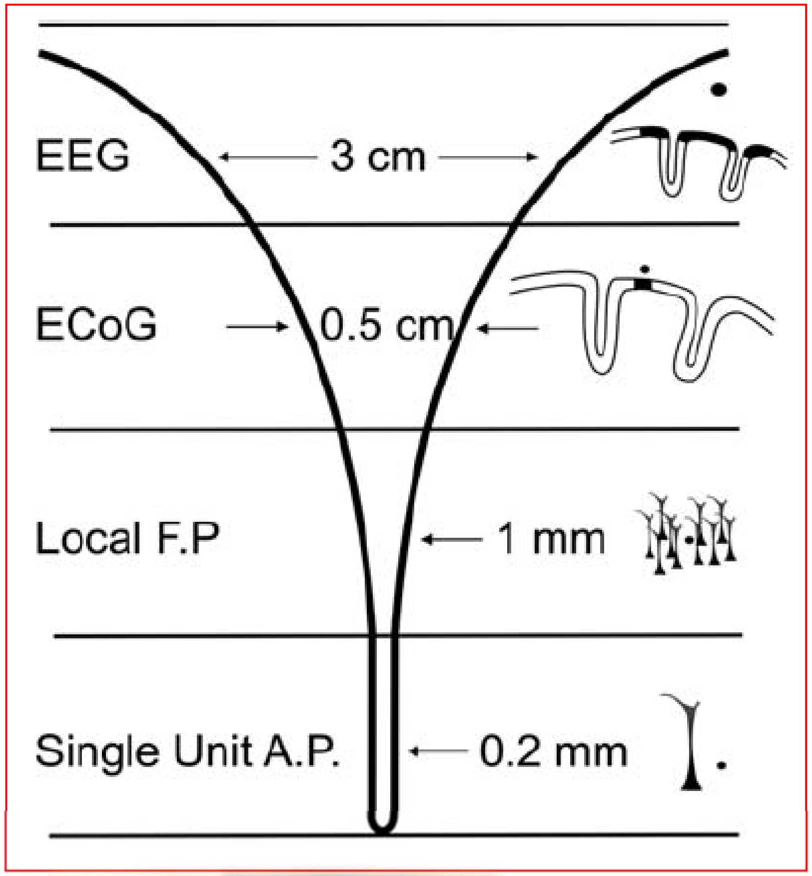
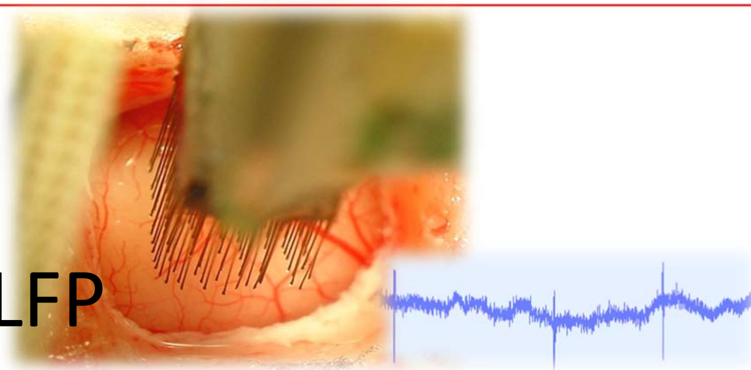
Reminder

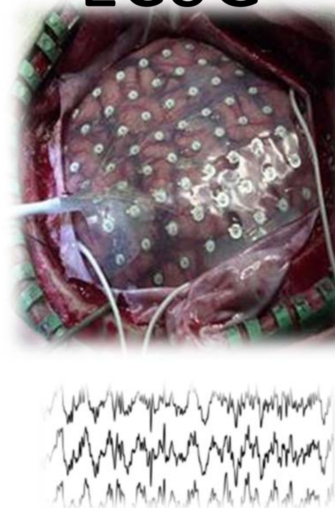
EEG

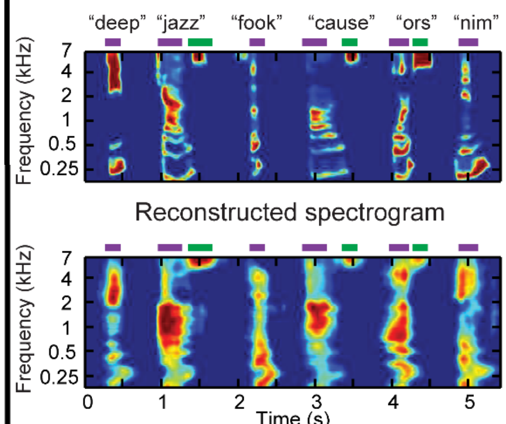




AP/LFP

ECoG



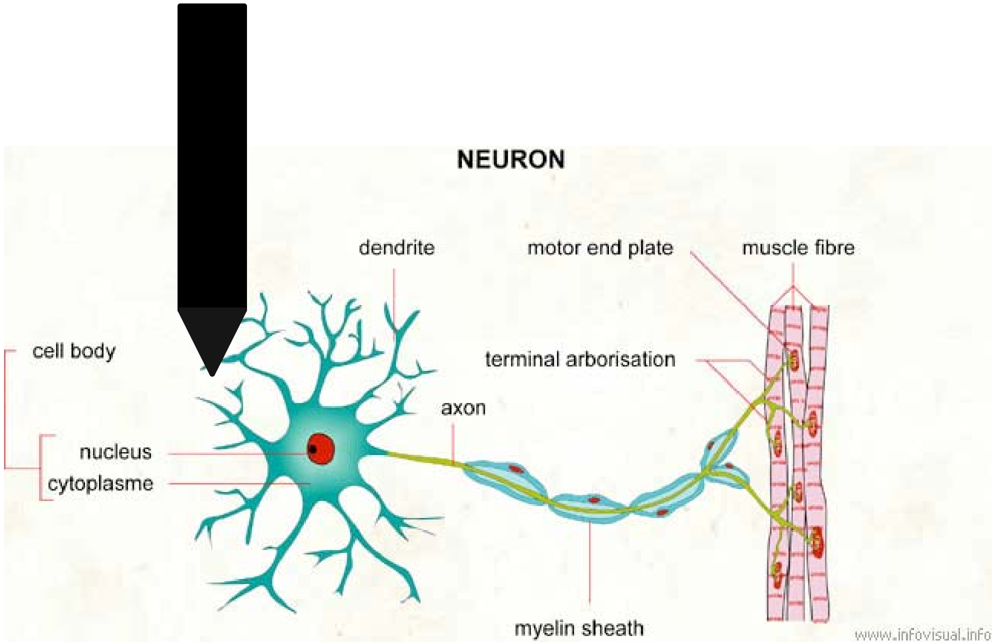


[Courtesy R.T. Knight]

Sub-Cortical: Action Potentials

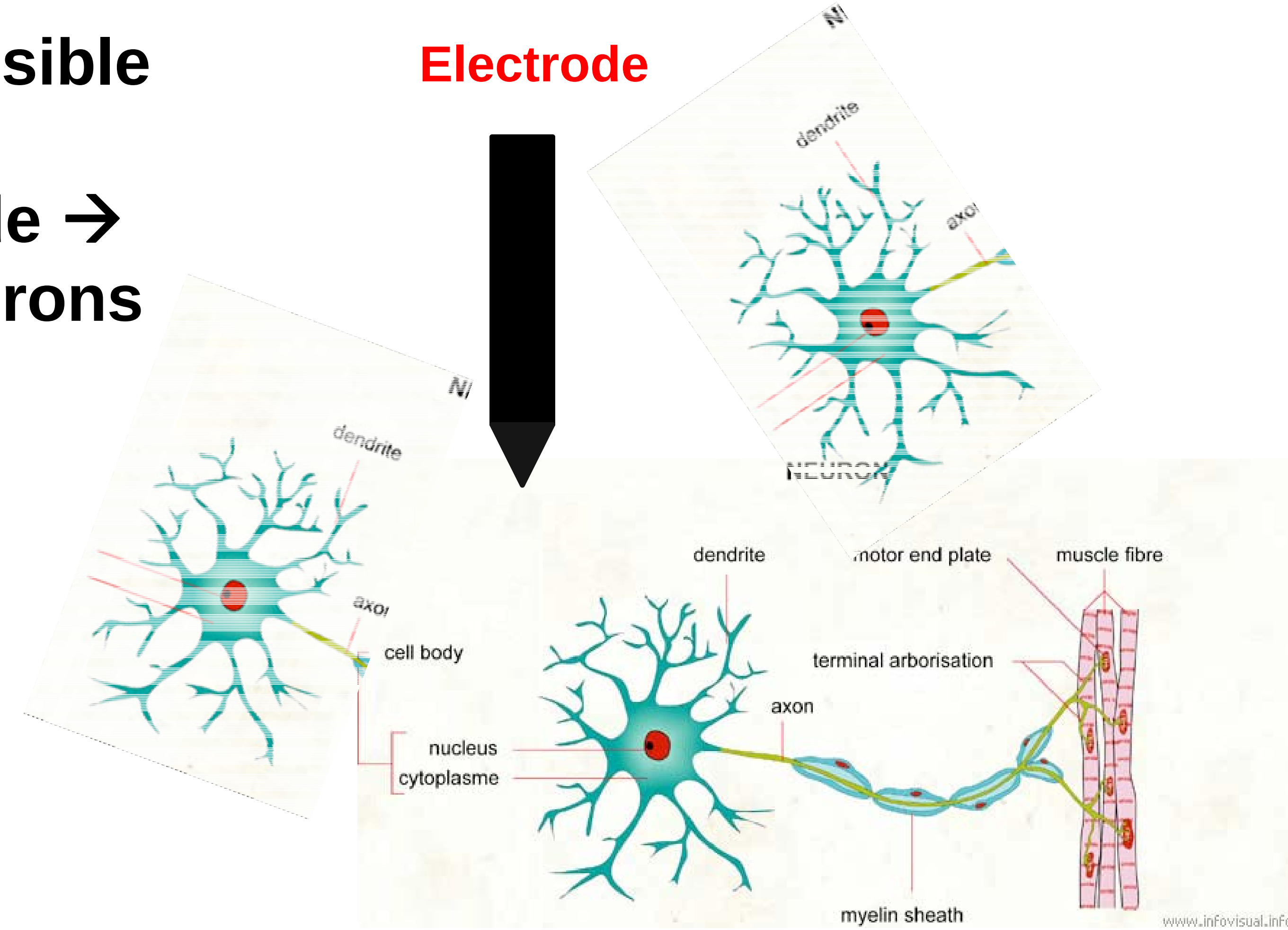
- **Simplest scenario: one electrode → one neuron**

Electrode



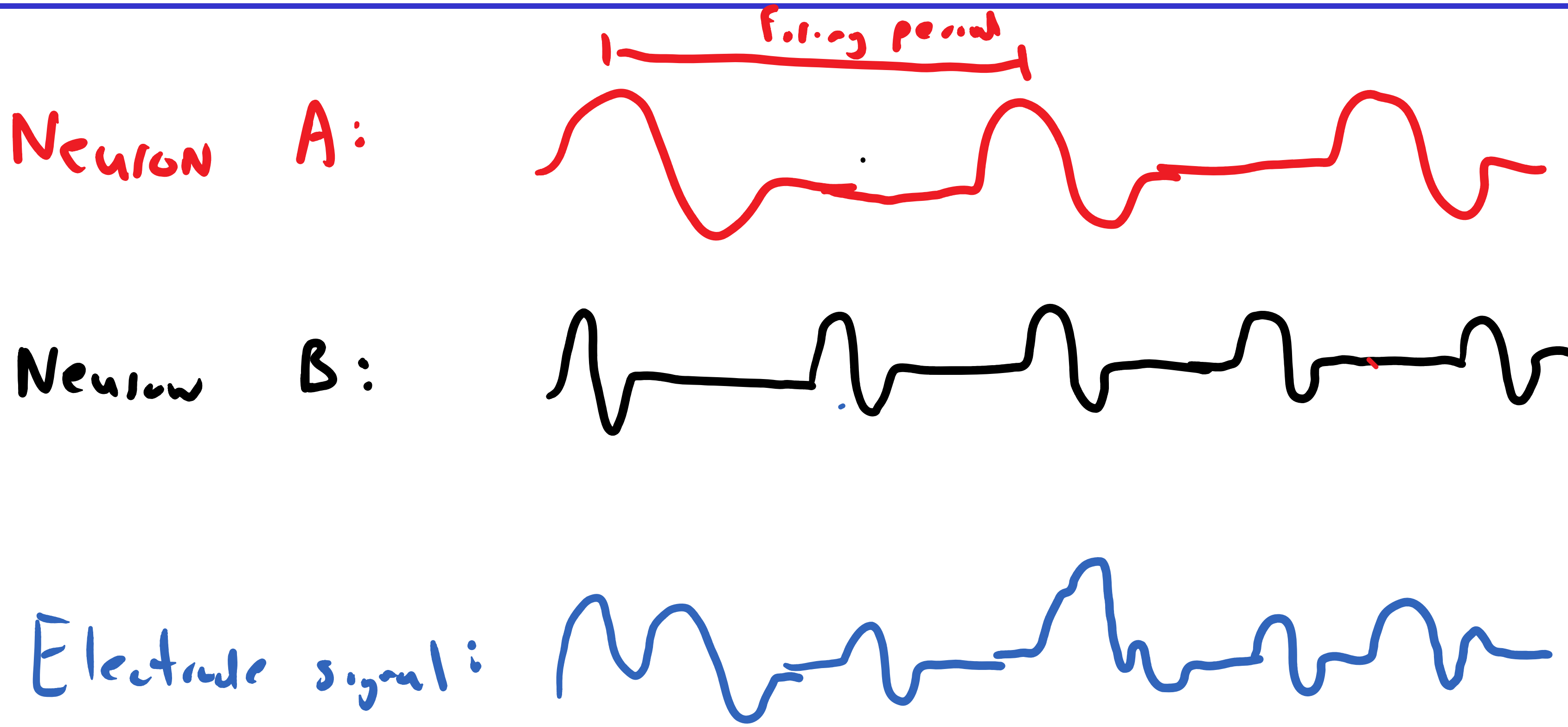
Sub-Cortical: Action Potentials

- **Another possible scenario:**
  one electrode → multiple neurons



- **Neuron A: move up**
- **Neuron B: move left**
- **Can we tell which one is which?**

Implication on recorded waveforms

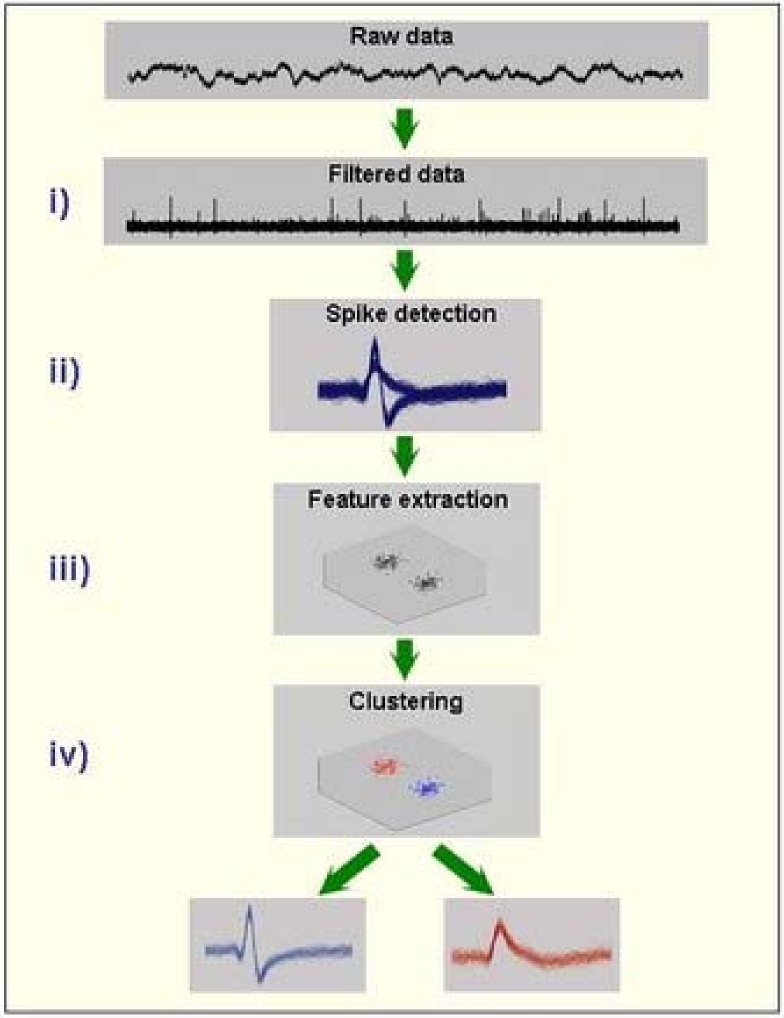


So How Can We Deal This?

- **Where have we seen something like this before?**
  – Where one signal we don’t want “gets in the way” of another one we do want

- **How did we deal with it in that case?**
  – Can we use the same approach this time?

Spike Sorting Work Flow



http://www.scholarpedia.org/article/Spike_sorting

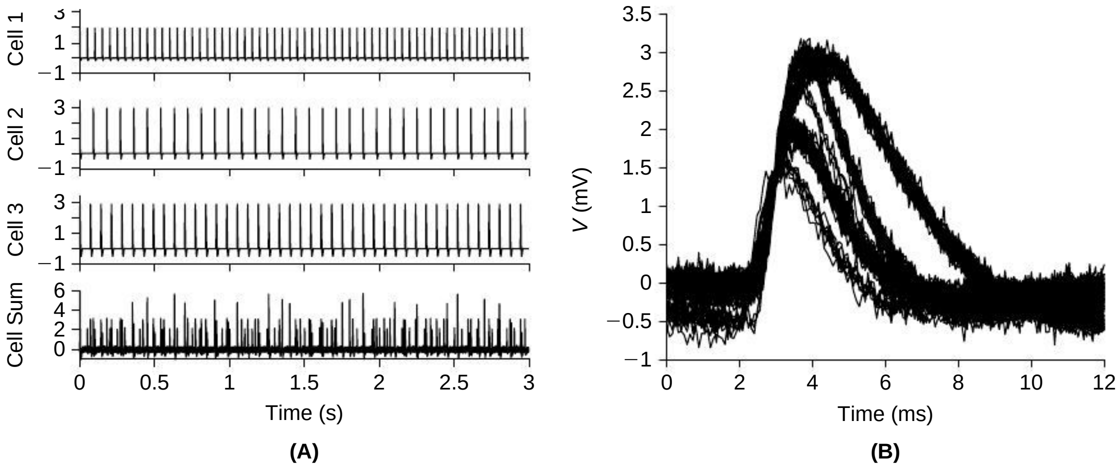


FIGURE 14.1 **A**. The three spike trains and their tainted sum, corrupted by additive Gaussian noise of zero mean and standard deviation equal to 0.1 mV. The experimentalist only has access to the latter. **B**. The spikelets are excised from the long train and aligned. The challenge is to determine both how many cells are firing and to identify which spike belongs to which cell. The eye detects at least five potentially distinct clusters. (`spikepca.m`)

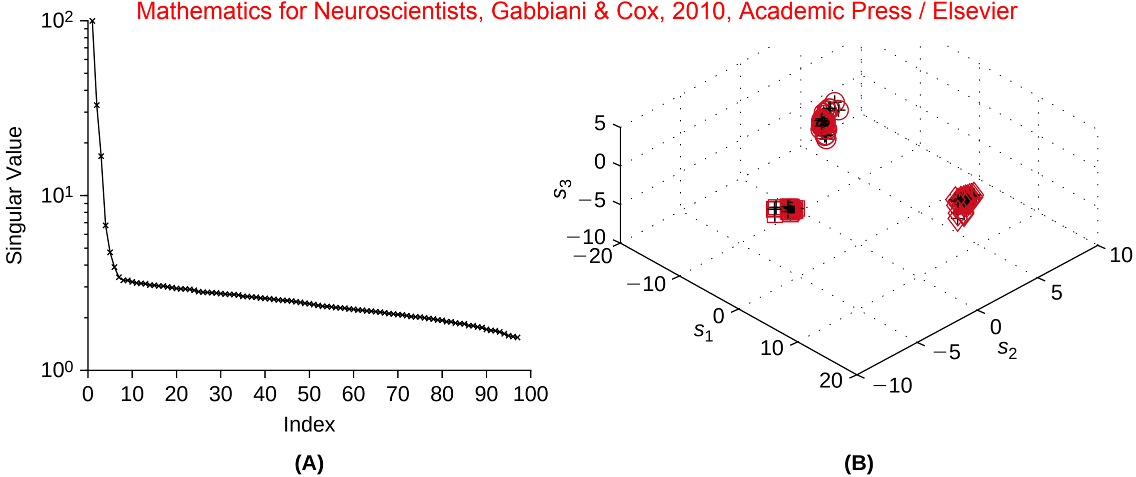
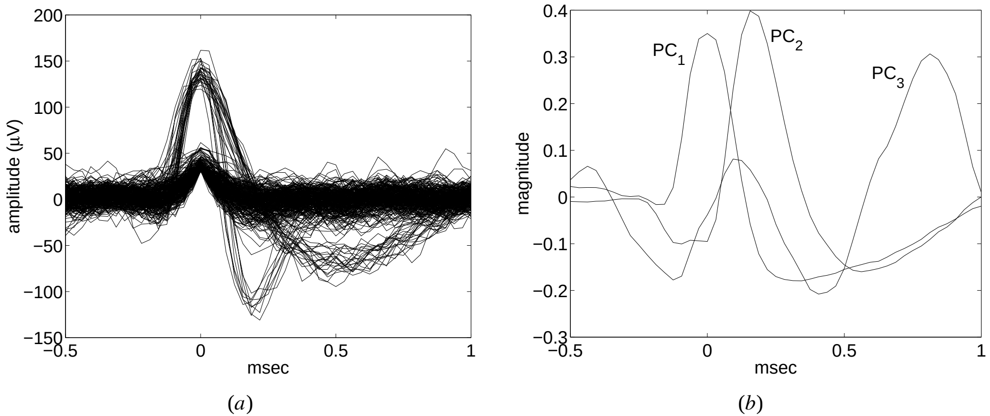


FIGURE 14.2 **A**. The singular values of the data matrix exhibit very rapid decay. This suggests that the greatest variance in the traces is captured by the first three, and possibly four, associated singular vectors, $\mathbf{y}_j$. **B**. We compute the three score vectors, $\mathbf{s}_j = \mathbf{A}^T\mathbf{y}_j$, $j = 1, 2, 3$, and plot (black +) their triples, $(\mathbf{s}_{1,k}, \mathbf{s}_{2,k}, \mathbf{s}_{3,k})$ for the traces $k = 1, \ldots, 98$. As we generated the spikes we know which cell gave rise to which spike. In red we used circles to mark the spikes from cell 1, squares to mark the spikes from cell 2, and diamonds to mark the spikes from cell 3. We note that these fall into easily separated clusters in the space of score coordinates. (`spikepca.m`)



M. S. Lewicki, "A Review of Methods for Spike Sorting: The Detection and Classification of Neural Action Potentials", Network: Comput. Neural Syst. 9 (1998, R53-R78.

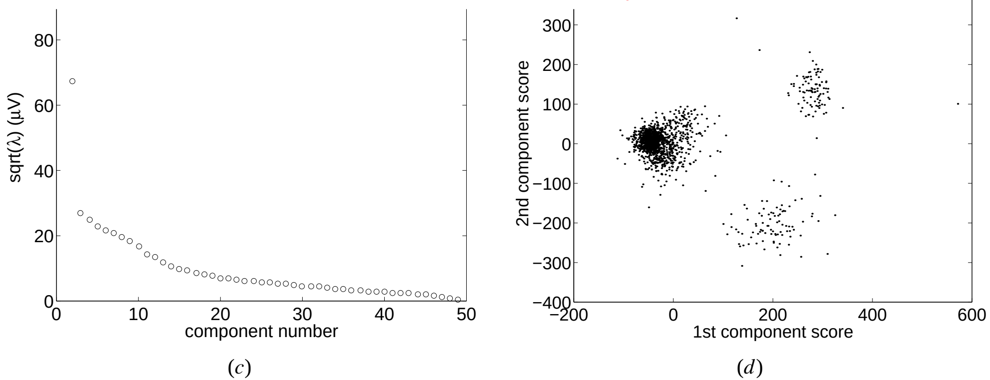


Figure 7. Results from principal component analysis of spike data. (*a*) The data used in the analysis. (*b*) The first three principal components. (*c*) The standard deviation of the scores in the direction of each component. (*d*) A scatter plot of the scores from the first two components.