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Neural Data Analysis I: Encoding

17.1 GOALS OF THIS CHAPTER

The primary goal of this chapter is to introduce you to the fundamental methods of analyzing spike trains of single neurons used to characterize their encoding properties: raster plots, peri-event time histograms, and tuning curves. While there are prepackaged tools available for these methods, in this chapter you will program these tools yourself and use them to analyze behavioral data recorded from a motor area of a macaque monkey.

17.2 BACKGROUND

In general, neuroscientists are interested in knowing what neurons are doing. More specifically, neuroscientists are often interested in neural *encoding*—how neurons represent stimuli from the outside world with changes in their firing properties. Let's say you are studying a neuron from a visual area. You would first present a research participant with controlled visual stimuli with a number of known properties—orientation, luminance, contrast, etc. Using standard electrophysiological techniques, you then record the response of the neuron to each stimulus. You can repeat the presentation of a given stimulus and then see how similar (or different) the neuronal responses are. A *raster plot* is a simple method to visually examine the trial-by-trial variability of these responses. You can examine what features these responses have in common by averaging over all responses to create a *peri-event time histogram*. Finally, to capture how the average response of the neuron varies with some sensory feature, you can generate a *tuning curve* that maps the feature value onto the average response of the neuron.