Compound action potentials: frog sciatic nerve – lab assignment

I. Data analysis

A. Determination of threshold voltage and maximum CAP amplitude

From your data trace, use the **waveform cursor** to measure CAP amplitude at each stimulus voltage (use channel 1). The cursor information is displayed in the upper right of the Scope Application window. Use the following procedure:

1. Select a single CAP in the Chart window from CAP1 (Channel 1).
2. Open the Zoom window using the Zoom window button.
3. Place the marker on the waveform baseline.
4. Place the waveform cursor on the CAP peak.
5. Read the amplitude value (ΔV) from the upper part of the Zoom window.

Note that each page (sweep) of data has a different stimulus voltage, as indicated in Table 1. Record these data in Table 1 of your Data Notebook: note the stimulus intensity that first produces a CAP and record the lowest stimulus intensity that yields maximum CAP amplitude.

B. Calculating conduction velocity

1. From your data, make a selection in both channels that includes the CAP – by dragging the mouse, highlight the CAP in channel 1. Hold down the SHIFT key and highlight the CAP in channel 2.
2. From the **Windows menu**, select the **Zoom window** (Figure 1)**.**
3. From the **Zoom window**, use the **marker** and **waveform cursor** to determine the time interval for the CAP to travel between the two recording electrodes (Figure 1).
4. Place the marker on the first CAP peak. Next, place the waveform cursor over the second CAP peak.
5. Read the value for time differential (Δt) from the **Cursor display** in the **Scope application window**. Record this value in Table 3 in your Data Notebook.
6. Using your measurement for the distance between the two recording electrodes, make the following calculation and record your answer in Table 3.

$$\text{Conduction velocity (m/sec)} = \left(\frac{\text{distance between electrodes (cm)}}{\text{time interval between CAPs (ms)}}\right) \bullet \left(\frac{100\text{ cm}}{1\text{ m}}\right) \bullet \left(\frac{1000\text{ ms}}{1\text{ sec}}\right)$$

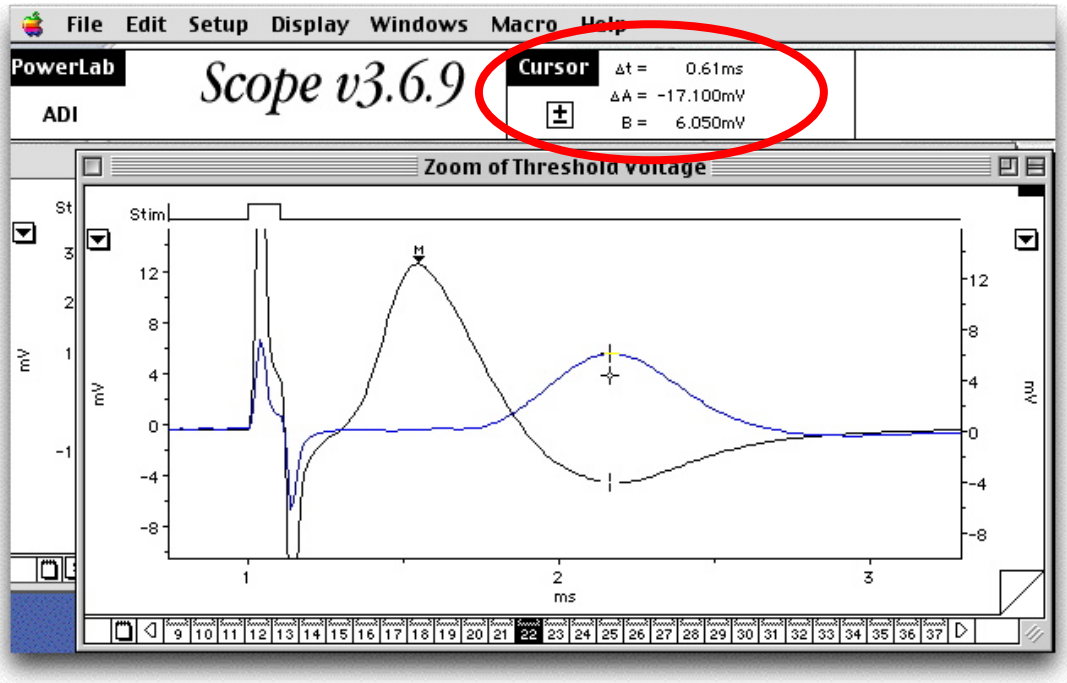

Figure 1. Scope Zoom window in overlay mode showing analysis procedure for calculating conduction velocity. Waveform cursor information is displayed in the area below the menu bar.

C. Determination of refractory period

1. Using the mouse, select the first two CAPs (produced by two stimulus pulses) recorded in each of page of data (use channel 1).
2. Open the **Zoom** window.
3. Set the **marker** to the waveform baseline prior to the first stimulus artifact (Figure 2).
4. Position the waveform cursor over the maximum point of the second CAP (Figure 1)**.**
5. Record the amplitude for the second CAP in Table 2 of your Data Notebook. The stimulus intervals used in this part of the experiment are recorded in the order shown in Table 2.
6. Determine the stimulus interval where the amplitude of the second CAP first shows a decrease. This is the **relative refractory period**. Record this value in Table 2.
7. Determine the stimulus interval where the second CAP completely disappears. This is the **absolute refractory period**. Record this value in Table 2.

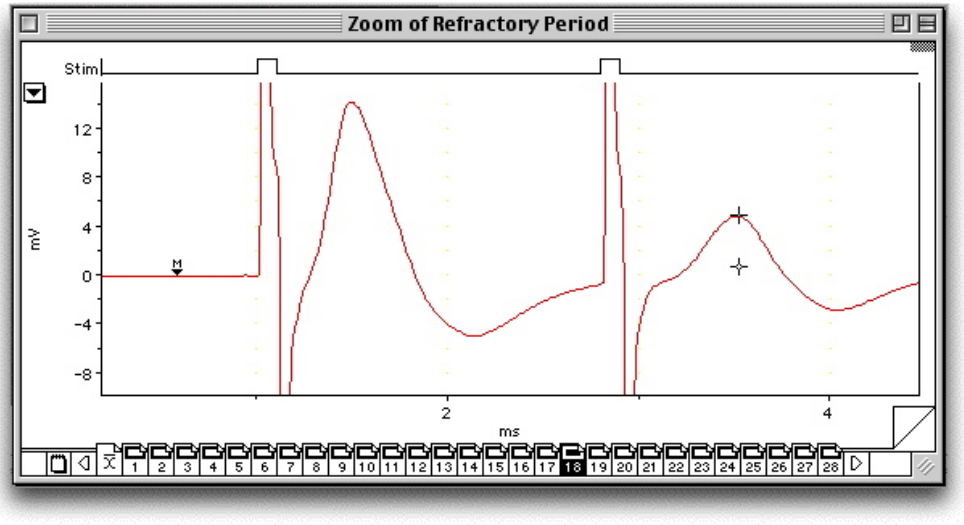

Figure 2. Scope Zoom window showing two pulses for determining refractory period.

D. Wave form – monophasic vs. biphasic

No analysis required

E. Fiber groups

Open recordings of CAPs that show multiple peaks, and use the analysis techniques described in A and B above to determine threshold voltages and conduction velocities of each group of fibers in your preparation. Enter your data in Table 4.

F. Strength-duration curve

Refer to CAPs you recorded in the last part of the experiment. For each stimulus applied for a given duration, determine the smallest stimulus intensity required to produce a CAP. Record this data in Table 5.

II. Data presentation

A. Determination of threshold/maximal stimulus intensity; demonstration of recruitment

Make a scatter plot of CAP amplitude versus stimulus voltage. Use data from Table 1 of your Data Notebook. Identify a threshold and maximal stimulus.

B. Determination of refractory periods

Make a scatter plot of CAP amplitude (second CAP) vs. stimulus interval. Use your data from Table 2 in your Data Notebook. Indicate in your graph the relative and absolute refractory periods.

C. Conduction velocity of sciatic nerve – report conduction velocity for your nerve (Table 3, Data Notebook).

D. Biphasic vs. monophasic waveforms

Produce a sample tracing of nerve stimulation that results in a biphasic waveform; produce a sample tracing or nerve stimulation that results in a monophasic waveform.

E. Evidence of different fiber groups making up the sciatic nerve

Produce a tracing that shows evidence of different fibers groups in the sciatic nerve – a tracing showing multiple peaks. Report the threshold voltages and conduction velocities of each group of fibers (Table 4, Data Notebook)

G. Strength-duration curve

Make a scatter plot of stimulus intensity (mV) vs. duration (msec) – use data from Table 5, Data Notebook. Fit a line to your data and determine the rheobase and chronaxie – report these values.

III. Lab report (see CAP.report.04)

Since this is your first lab report in the course, I have decided to provide you with a very structured assignment that walks you through the various sections of a traditionally formatted scientific paper: introduction, results, discussion, bibliography.

As you can see by looking at the assignment, for each section I have asked you specific questions that will guide your presentation of material in that section. I encourage you not to look at each section or each question within a section as an independent unit – instead, the various parts should easily flow into one another.

This should be especially true of the discussion questions. Here, you are simply working through your data in Results, interpreting it and analyzing it in the context of current knowledge in the field. The questions I gave you reflect my personal bias of how I would walk through that data, what I think are the key concepts it reflects, and how I would discuss them. It is clearly possible that you might ask

different questions and structure your discussion differently – my goal in having you follow my "personal format" is to simply give you a possible model of how to discuss the data.

In future assignments using this traditional scientific paper format, I'll expect you to structure your report and come up with your own methods for presenting data and your own questions to guide your analysis of such data. In other assignments we'll also explore other formats for scientific papers. For example, rather than using the traditional intro/results/discussion format, some journals encourage a much more open-ended style of writing where all this information is incorporated into a free-flowing essay (see Nature or Science). This format is far more similar to the type of writing you have done for research papers in non-science courses, and we'll use it for at least one lab report.