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SBE II: Homework 3

Experiment-2:

In order to estimate ϵ, we recognize the relationship of exponential decay in the Calcium concentration waveform in the provided figure. Between potential spikes, we assert that current $I_{Ca} = 0$, which eliminates concern for the parameter value of μ in this case.

The relationship of exponential decay is as follows:

$$Ca = Ca_0 e^{-\epsilon(t-t_0)}$$

From the graph, we can pick two points (one at a peak and the other at a trough, prior to the next burst), and estimate ϵ based on the time and magnitude between those points. Rearranging the previous expression we get:

$$\epsilon = -\frac{\ln \frac{Ca}{Ca_0}}{t - t_0}$$

Evaluating the above for this trend demonstrated on the data in the figure provided yielded a value of $\epsilon = 0.0025 \frac{1}{ms}$. This value is quite close (2x) to the value assigned in the parameter list, so I would classify it as a reasonable approximation.

If we wish to expand this to as well estimate for μ, we can instead look at the rising edges of the waveform (when $I_{Ca} \neq 0$) and calculate the slope of the line. Since this waveform is approximately linear for this rise, and both terms consist of ϵ, the slope, or generically $\frac{dCa}{dt}$, is approximately equal to μ. From doing this measurement on the graphs you are able to observe a value within approximately 20% of the set value of μ.