

NEUROPHYSICS 2015 – EXERCISE 2

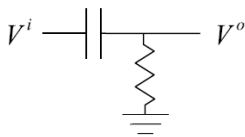
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1. RESISTIVITY

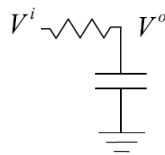
You dip two metal wires into a saline bath. What are the main determinants of the resistance between them ?

2. RC CIRCUIT

A.



B.



Apply an input step Voltage V^i from 0 to 100 mV and simulate the output response V^o . Choose $R = 100\text{ M}\Omega$ and $C = 100\text{ pF}$. Use the Euler (first order) method to discretize the dynamics.

3. METAL ELECTRODES

What happens at the metal electrode tip when penetrating a nerve cell membrane?

4. Action potential

What fraction of K^+ ions leave an axon during an action potential ? Compute $\frac{\Delta Q}{Q}$ for Cole and Curtis' measurement of a membrane with conductance $G = 40\text{ mS/cm}^2$ during an action potential of 100 mV depolarization and 1 ms duration, and a small cylindrical axon of $1\text{ }\mu\text{m}$ radius. Assume a potassium concentration of $[K^+]_i = 0.155\text{ M/l}$ and use Faraday's constant $F = 10^5 \frac{\text{C}}{\text{M}}$. How large is that fraction for a giant squid axon (1 mm radius)?

5. Single-unit recording

Download the mat file SPKS containing two extracellularly spike trains (spks1 and spks2), with spike times measured in milliseconds. Which of the two data records contains a good single unit recording? How would you describe the firing of this cell in words?

6. Read the paper

Urbanczik R, Senn W (2014) Learning by the Dendritic Prediction of Somatic Spiking. *Neuron* 81:521–528.

This paper describes a simple rule how single neurons could implement a predictive coding scheme.