Last time

Electrical Properties of Cells

Issues:
- graded potentials vs. action potentials
- electrically excitable cells vs. electrically inexcitable

Distinguishing properties of action potentials:
- threshold
- all-or-none
- refractory
- strength-duration
- accomodation
- anode-break
- decrement-free conduction

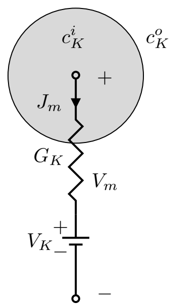


Figure 7.18

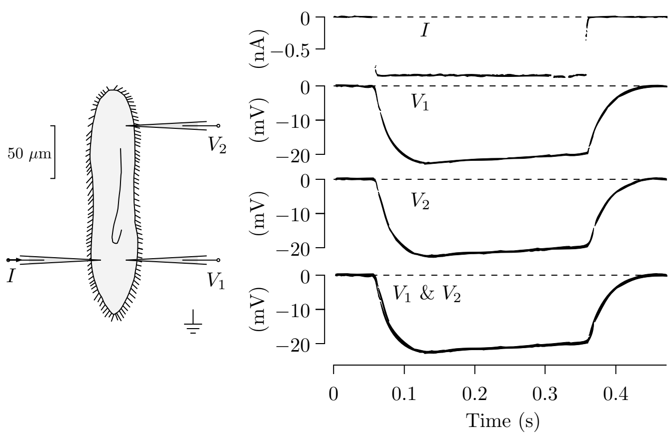


Figure 2.3

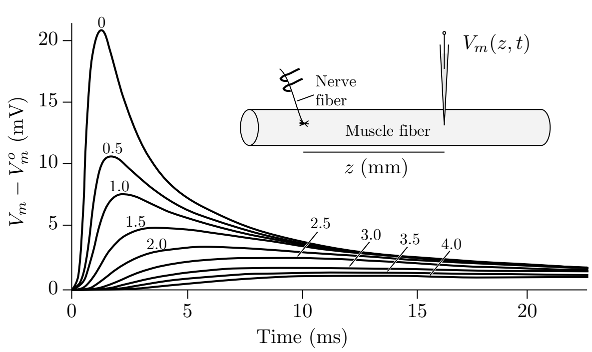
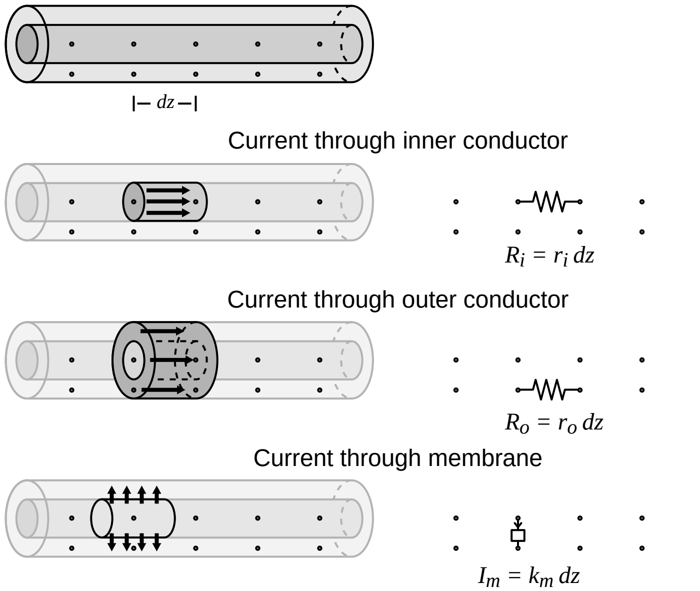
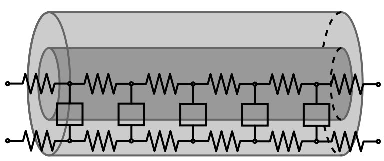


Figure 2.5

Core Conductor Model



Core Conductor Model



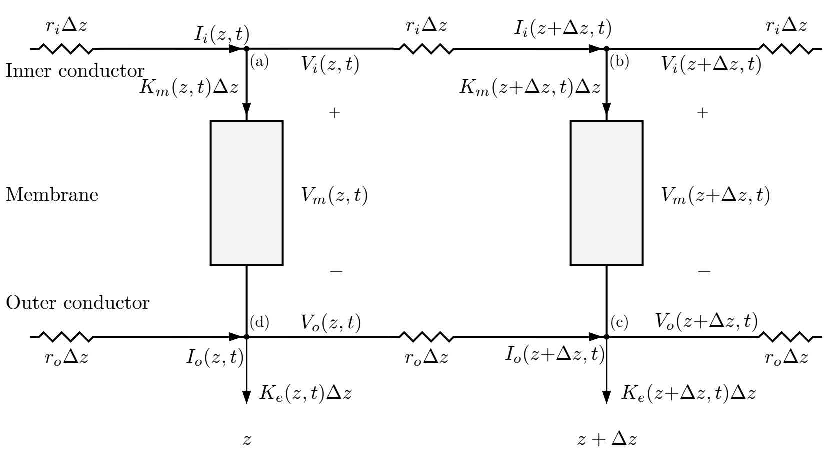


Figure 2.7

$$\textbf{KCL at (a)}: \quad I_i(z,t) - I_i(z+\Delta z,t) - K_m(z,t)\Delta z = 0$$

$$\textbf{KCL at (d)}: \quad I_o(z,t) - I_o(z+\Delta z,t) + K_m(z,t)\Delta z - K_e(z,t)\Delta z = 0$$

$$\textbf{Ohm's law at (a)} - \textbf{(b)}: \quad V_i(z,t) - V_i(z+\Delta z,t) = r_i \Delta z I_i(z+\Delta z,t)$$

$$\textbf{Ohm's law at (c)} - \textbf{(d)}: \quad V_o(z,t) - V_o(z+\Delta z,t) = r_o \Delta z I_o(z+\Delta z,t)$$

$$\frac{I_i(z+\Delta z,t) - I_i(z,t)}{\Delta z} = -K_m(z,t) \rightarrow \frac{\partial I_i(z,t)}{\partial z}$$
$$\frac{I_o(z+\Delta z,t) - I_o(z,t)}{\Delta z} = K_m(z,t) - K_e(z,t) \rightarrow \frac{\partial I_o(z,t)}{\partial z}$$
$$\frac{V_i(z+\Delta z,t) - V_i(z,t)}{\Delta z} = -r_i I_i(z+\Delta z,t) \rightarrow \frac{\partial V_i(z,t)}{\partial z}$$
$$\frac{V_o(z+\Delta z,t) - V_o(z,t)}{\Delta z} = -r_o I_o(z+\Delta z,t) \rightarrow \frac{\partial V_o(z,t)}{\partial z}$$

Core – Conductor Equations

$$\frac{\partial I_i(z,t)}{\partial z} = -K_m(z,t)$$
$$\frac{\partial I_o(z,t)}{\partial z} = K_m(z,t) - K_e(z,t)$$
$$\frac{\partial V_i(z,t)}{\partial z} = -r_i I_i(z,t)$$
$$\frac{\partial V_o(z,t)}{\partial z} = -r_o I_o(z,t)$$

$$V_m(z,t) = V_i(z,t) - V_o(z,t)$$
$$\frac{\partial V_m(z,t)}{\partial z} = \frac{\partial V_i(z,t)}{\partial z} - \frac{\partial V_o(z,t)}{\partial z} = -r_i I_i(z,t) + r_o I_o(z,t)$$
$$\frac{\partial^2 V_m(z,t)}{\partial z^2} = -r_i \frac{\partial I_i(z,t)}{\partial z} + r_o \frac{\partial I_o(z,t)}{\partial z} = r_i K_m(z,t) + r_o(K_m(z,t) - K_e(z,t))$$

THE Core – Conductor Equation

$$\frac{\partial^2 V_m(z,t)}{\partial z^2} = (r_o + r_i) K_m(z,t) - r_o K_e(z,t)$$

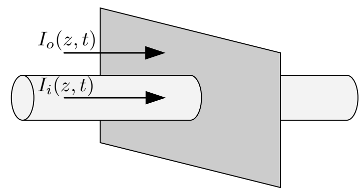
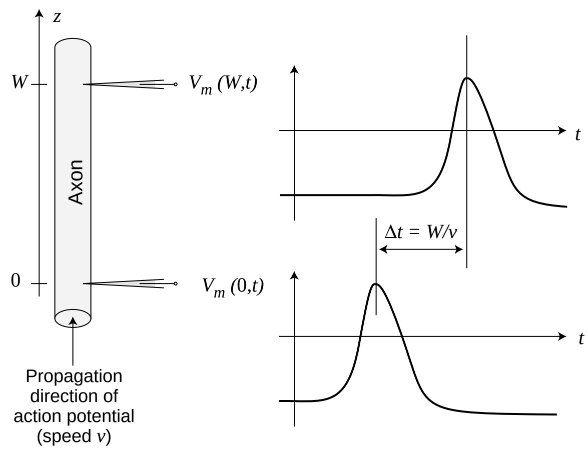


Figure 2.9



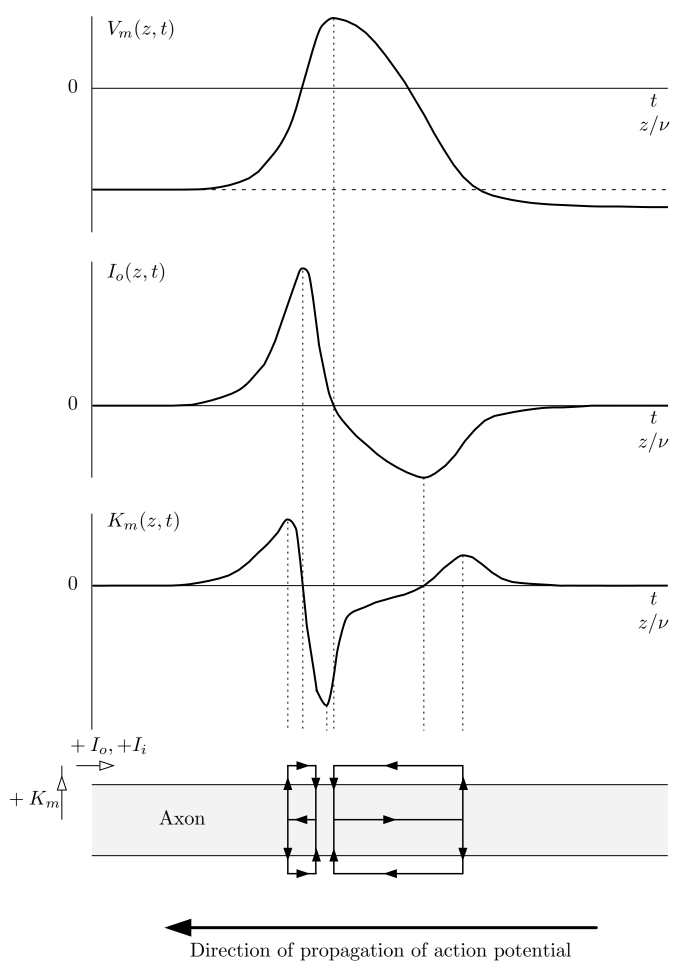


Figure 2.12