Squid axon



Physical System



Simulation

Hodgkin-Huxley cable equations

$$\frac{D}{4R_a} \cdot \frac{\partial^2 V}{\partial x^2} = C_m \frac{\partial V}{\partial t} + \overline{g}_{na} m^3 h \cdot (V - E_{na}) + \overline{g}_k n^4 \cdot (V - E_k) + g_l \cdot (V - E_l)$$

$$\frac{dm}{dt} = - {}_{m} m + \beta_m \cdot (1 - m) \qquad {}_{m} = \frac{1(V + 40)}{1 - e^{-.1(V + 40)}} \qquad \beta_m = 4e^{-(V + 65)/18)}$$

$$\frac{dh}{dt} = - {}_{h} h + \beta_h \cdot (1 - h) \qquad {}_{h} = .07e^{-.05(V + 65)} \qquad \beta_h = \frac{1}{1 + e^{-.1(V + 35)}}$$

$$\frac{dn}{dt} = - {}_{n} n + \beta_n \cdot (1 - n) \qquad {}_{n} = \frac{.01(V + 55)}{1 - e^{-.1(V + 55)}} \qquad \beta_n = .125e^{-(V + 65)/80}$$

NEURON representation

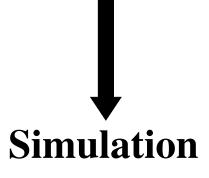
from neuron import h axon = h.Section() axon.nseg = 75 axon.diam = 100 axon.L = 20000 axon.insert('hh')

Squid axon



Physical System





Hodgkin-Huxley cable equations

$$\frac{D}{4R_a} \cdot \frac{\partial^2 V}{\partial x^2} = C_m \frac{\partial V}{\partial t} + \overline{g}_{na} m^3 h \cdot (V - E_{na}) + \overline{g}_k n^4 \cdot (V - E_k) + g_l \cdot (V - E_l)$$

$$\frac{dm}{dt} = - {}_{m} m + \beta_m \cdot (1 - m) \qquad {}_{m} = \frac{.1(V + 40)}{1 - e^{-.1(V + 40)}} \qquad \beta_m = 4e^{-(V + 65)/18)}$$

$$\frac{dh}{dt} = - {}_{h} h + \beta_h \cdot (1 - h) \qquad {}_{h} = .07e^{-.05(V + 65)} \qquad \beta_h = \frac{1}{1 + e^{-.1(V + 35)}}$$

$$\frac{dn}{dt} = - {}_{n} n + \beta_n \cdot (1 - n) \qquad {}_{n} = \frac{.01(V + 55)}{1 - e^{-.1(V + 55)}} \qquad \beta_n = .125e^{-(V + 65)/80}$$

NEURON representation

from neuron import h axon = h.Section() axon.nseg = 75 axon.diam = 100 axon.L = 20000 axon.insert('hh')

Squid axon



Physical System

Model

↓ Simulation

Hodgkin-Huxley cable equations

$$\frac{D}{4R_a} \cdot \frac{\partial^2 V}{\partial x^2} = C_m \frac{\partial V}{\partial t} \qquad \overline{g}_{na} m^3 h \cdot (V - E_{na}) + \overline{g}_k n^4 \cdot (V - E_k) + g_l \cdot (V - E_l)$$

$$\frac{dm}{dt} = - mm + \beta_m \cdot (1 - m) \qquad m = \frac{1(V + 40)}{1 - e^{-1}(V + 40)} \qquad \beta_m = 4e^{-(V + 65)/18)}$$

$$\frac{dh}{dt} = - hh + \beta_h \cdot (1 - h) \qquad h = .07e^{-.05(V + 65)} \qquad \beta_h = \frac{1}{1 + e^{-.1}(V + 35)}$$

$$\frac{dn}{dt} = - nn + \beta_n \cdot (1 - n) \qquad n = \frac{.01(V + 55)}{1 - e^{-.1}(V + 55)} \qquad \beta_n = .125e^{-(V + 65)/80}$$

NEURON representation

from neuron import h axon = h.Section() axon.nseg = 75 axon.diam = 100 axon.L = 20000 axon.insert('hh')