10/19, 2007

Grand summary

1. Passive neuron: $\tau \frac{dV}{dt} = -g_L(V - \mathcal{E}_L)$

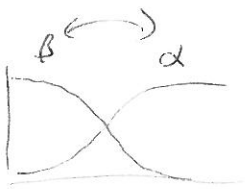
needed: $Q = CV \Rightarrow C\frac{dV}{dt} = \frac{dQ}{dt} = -I$ ← outward (convention)

"V" = IR +  ⇒ $V - \mathcal{E}_R = IR$

$I = g_L(V - \mathcal{E}_L)$

2. Active:

"V" = IR : $I = g(V,t)(V - \mathcal{E}_K)$

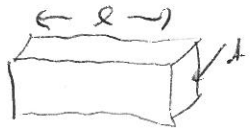


$P_{\text{closed} \to \text{open}} = \alpha(V)\,dt$

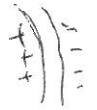
$P_{\text{open} \to \text{closed}} = \beta(V)\,dt$

⇒ HH

3. Passive cable: "V" = IR, Q = CV

+ 

$R = \frac{r_L \ell}{A} = \frac{r_m}{A}$



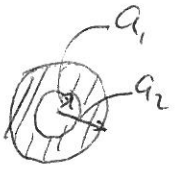
$C = C_m A$

$\frac{Q}{V} = C$

$\lambda^2 = \frac{a\, r_m}{2 r_L}$ (dim. analysis)

"Vel" $\propto \frac{\lambda}{T_m} \sim a^{1/2}$

4. Axons



$$V = \frac{Q}{\ell} \log \frac{a_2}{a_1} = \frac{Q}{C}$$

$$\Rightarrow C \sim \ell$$

$$\Rightarrow C_m \sim \frac{1}{a}$$

$$\Rightarrow \tau \frac{\partial V}{\partial t} = \tilde{\lambda}^2 \frac{\partial^2 V}{\partial x^2}$$

$\tilde{\lambda} \propto a^2$

"Vel" $\propto \frac{\tilde{\lambda}}{\tau} \sim a$

5. Synapses: lots of facts, but main pic:

$$I = \bar{g} x (V - \Sigma_R)$$

$$\dot{x} = \alpha(c)(1-x) - \beta x$$

+ NMDA (LTP)
+ short + long term plasticity

α 

CGI