Supplement materials

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Pyramidal neurons

Уравнение для сомы, радиатума и ориенса

$$C\frac{dV_s}{dt} = -I_l - I_{Kdr} - I_{Na} - I_A - I_M - I_H - I_{CaL} - I_{sAHP} - I_{mAHP} - I_{CaR} - I_{buff} - \\ -I_{syn} + I_{ext} \quad (1)$$

Уравнение для аксона

$$C\frac{dV_a}{dt} = -I_l - I_{Kdr} - I_{Na} - I_M - I_{syn} \quad (2)$$

Уравнение для LM

$$C\frac{dV_LM}{dt} = -I_l - I_{Kdr} - I_{Na} - I_A - I_{syn} + I_{ext} \quad (3)$$

Натриевый каналы

$$I_{Na} = g_{max,Na} \cdot m^2 \cdot h \cdot s \cdot (V - E_{Na}) \quad (4)$$

For dendiritic compartments

$$m_\infty = \frac{1}{1 + exp(-\frac{V+40}{3})} \ \tau_m = 0.05ms \quad (5)$$

$$h_\infty = \frac{1}{1+exp(-\frac{V+45}{3})} \ \tau_h = 0.5ms \tag{6}$$

For soma/axon compartments

$$m_\infty = \frac{1}{1+exp(-\frac{V+44}{3})} \ \tau_m = 0.05ms \tag{7}$$

$$h_\infty = \frac{1}{1+exp(-\frac{V+49}{3.5})} \ \tau_h = 1ms \tag{8}$$

For all compartments

$$s_\infty = \frac{1+Na_{att}exp(0.5(V+60))}{1+exp(0.5(V+60))} \tag{9}$$

$$\tau_s = \frac{0.00333exp(0.0024(V+60)Q)}{1+exp(0.0012(V+60)Q)} \tag{10}$$

$$Q = \frac{F}{RT} \tag{11}$$

The delayed rectifier current is given by:

$$I_{Kdr} = g_{max,Kdr} \cdot n^2 \cdot (V - E_K) \tag{12}$$

For dendiritic compartments

$$n_\infty = \frac{1}{1+exp(-0.5(V+42))} \ \tau_n = 2.2ms \tag{13}$$

For soma/axon compartments

$$n_{\infty} = \frac{1}{1 + exp(-0.3333(V + 46.3))} \;\tau_n = 3.5ms \tag{14}$$

The fast inactivating A-type K+ current is described by

$$I_A = g_{max,A} \cdot n_A \cdot l \cdot (V - E_K) \tag{15}$$

$$\alpha_{n_A} = \frac{-0.01(V + 21.3)}{exp(\frac{V+21.3}{-35}) - 1} \tag{16}$$

$$\beta_{n_A} = \frac{0.01(V + 21.3)}{exp(\frac{V+21.3}{35}) - 1} \tag{17}$$

$$\alpha_l = \frac{-0.01(V + 58)}{exp(\frac{V+58}{8.2}) - 1} \tag{18}$$

$$\beta_l = \frac{0.01(V + 58)}{exp(\frac{V+58}{-8.2}) - 1} \tag{19}$$

$$\tau_l = \;= \begin{cases} 5 + 0.26(V + 20) & \text{if } V > 20 \\ 5 & \text{otherwise} \end{cases} \tag{20}$$

The hyperpolarizing H-current is given by:

$$I_H = g_{max,H} \cdot H \cdot (V - E_H) \tag{21}$$

$$H_{\infty} = \frac{1}{1 + exp(0.125(V + 75))} \tag{22}$$

$$\tau_H = \frac{exp(0.033264(V + 75))}{0.35(1 + exp(0.0083(V + 75)))} \tag{23}$$

The slowly activating voltage-dependent potassium current, IM, is given by the equations:

$$I_M = g_{max,M} \cdot T_{adj} \cdot q \cdot (V - E_K)\ T_{adj} = 10^{-4} \cdot 2.3^{0.1(T-296)} \tag{24}$$

$$\alpha_q = \frac{10^{-3}(V+30)}{1 - exp(\frac{V+30}{-9})} \tag{25}$$

$$\beta_q = \frac{-10^{-3}(V+30)}{1 - exp(\frac{V+30}{9})} \tag{26}$$

The slow after-hyperpolarizing current, IsAHP

$$I_{sAHP} = g_{max,sAHP} \cdot p^3 \cdot (V - E_K) \tag{27}$$

$$\frac{dp}{dt} = \frac{C_{Ca} - p(1 + C_{Ca})}{\tau_p(1 + C_{Ca})} \tag{28}$$

$$\tau_p = max(\frac{1}{0.003 \cdot (1 + C_{Ca})3^(0.1(T-295))},\ 0.5) \tag{29}$$

$$C_{Ca} = \Big(\frac{[Ca^{2+}]_{in}}{0.025}\Big)^2 \tag{30}$$