beeler_reuter_1977_version01

1 “environment” component

This component has no equations.

2 “membrane” component

membrane_voltage_diff_eq

$$\frac{\mathrm{d}(V)}{\mathrm{d}(time)} = -(\frac{1.0}{C}) * (i\_Na + i\_s + i\_x1 + i\_K1)$$

3 “sodium_current” component

i_Na_calculation

$$i\_Na = \left(g\_Na * (m)^{3.0} * h * j + g\_Nac\right) * (V - E\_Na)$$

4 “sodium_current_m_gate” component

alpha_m_calculation

$$alpha\_m = \frac{-1 * (V + 47.0)}{\left(e^{-0.1*(V+47.0)} - 1.0\right)}$$

beta_m_calculation

$$beta\_m = 40.0 * e^{-0.056*(V+72.0)}$$

dm_dt

$$\frac{\mathrm{d}(m)}{\mathrm{d}(time)} = (alpha\_m * (1.0 - m) - beta\_m * m)$$

5 “sodium_current_h_gate” component

alpha_h_calculation

$$alpha\_h = 0.126 * e^{-0.25*(V+77.0)}$$

beta_h_calculation

$$beta\_h = \frac{1.7}{\left(e^{-0.082*(V+22.5)} + 1.0\right)}$$

dh_dt

$$\frac{\mathrm{d}(h)}{\mathrm{d}(time)} = (alpha\_h * (1.0 - h) - beta\_h * h)$$

6 “sodium_current_j_gate” component

alpha_j_calculation

$$alpha\_j = \frac{0.055 * e^{-0.25*(V+78.0)}}{\left(e^{-0.2*(V+78.0)} + 1.0\right)}$$

beta_j_calculation

$$beta\_j = \frac{0.3}{\left(e^{-0.1*(V+32.0)} + 1.0\right)}$$

dj_dt

$$\frac{\mathrm{d}(j)}{\mathrm{d}(time)} = (alpha\_j * (1.0 - j) - beta\_j * j)$$

7 “slow_inward_current” component

E_s_calculation

$$E\_s = (-82.3 - 13.0287 * \ln Cai)$$

i_s_calculation

$$i\_s = g\_s * d * f * (V - E\_s)$$

dCai_dt

$$\frac{\mathrm{d}(Cai)}{\mathrm{d}(time)} = (-0.001 * i\_s + 0.07 * (0.001 - Cai))$$

8 “slow_inward_current_d_gate” component

alpha_d_calculation

$$alpha\_d = \frac{0.095 * e^{-(\frac{(V+-5.0)}{100.0})}}{\left(1.0 + e^{-(\frac{(V+-5.0)}{13.89})}\right)}$$

beta_d_calculation

$$beta\_d = \frac{0.07 * e^{-(\frac{(V+44.0)}{59.0})}}{\left(1.0 + e^{\frac{(V+44.0)}{20.0}}\right)}$$

dd_dt

$$\frac{\mathrm{d}(d)}{\mathrm{d}(time)} = (alpha\_d * (1.0 - d) - beta\_d * d)$$

9 “slow_inward_current_f_gate” component

alpha_f_calculation

$$alpha\_f = \frac{0.012 * e^{-(\frac{(V+28.0)}{125.0})}}{\left(1.0 + e^{\frac{(V+28.0)}{6.67}}\right)}$$

beta_f_calculation

$$beta\_f = \frac{0.0065 * e^{-(\frac{(V+30.0)}{50.0})}}{\left(1.0 + e^{-(\frac{(V+30.0)}{5.0})}\right)}$$

df_dt

$$\frac{\mathrm{d}(f)}{\mathrm{d}(time)} = (alpha\_f * (1.0 - f) - beta\_f * f)$$

10 “time_dependent_outward_current” component

i_x1_calculation

$$i\_x1 = x1 * 0.8 * \frac{\left(e^{0.04*(V+77.0)} - 1.0\right)}{e^{0.04*(V+35.0)}}$$

11 “time_dependent_outward_current_x1_gate” component

alpha_x1_calculation

$$alpha\_x1 = 5E-4 * \frac{e^{\frac{(V+50.0)}{12.1}}}{\left(1.0 + e^{\frac{(V+50.0)}{17.5}}\right)}$$

beta_x1_calculation

$$beta\_x1 = 0.0013 * \frac{e^{-(\frac{(V+20.0)}{16.67})}}{\left(1.0 + e^{-(\frac{(V+20.0)}{25.0})}\right)}$$

dx1_dt

$$\frac{\mathrm{d}(x1)}{\mathrm{d}(time)} = (alpha\_x1 * (1.0 - x1) - beta\_x1 * x1)$$

12 "time_independent_outward_current" component

i_K1_calculation

$$i\_K1 = 0.35 * \left(4.0 * \frac{\left(e^{0.04*(V+85.0)} - 1.0\right)}{\left(e^{0.08*(V+53)} + e^{0.04*(V+53.0)}\right)} + 0.2 * \frac{(V + 23.0)}{\left(1.0 - e^{-0.04*(V+23.0)}\right)}\right)$$