Supplementary Material

Model Equations

Table 1 through 23 contained all the equations, parameters values and initial conditions necessary to carry out the simulations presented in this article. Unless otherwise noted, the units are as follows: time in seconds (s), voltage in millivolts (mV), concentration in millimoles/liter (mmol/L), current in picoamperes (pA), conductance in nanosiemens (nS), capacitance in picofarads (pF), volume in nanoliters (nL), and temperature in kelvin (K).

Atrial Myocyte Model

The atrial myocyte model was represented by the Maleckar et al. mathematical model [1], which was based on a previous model of the adult human atrial myocyte action potential (AP), that of Nygren et al. [2]. The stimulus used to evoke an AP was a rectangular current pulse (I_{stim}) with amplitude of 280 pA and duration of 6 ms. Equations of the stretch-activated current (I_{SAC}) were taken from Kuijpers et al [3], which were assumed to be a nonselective cation current with a near-linear current-voltage relation on the basis of experimental observations [4]. When I_{SAC} was integrated in the myofibroblast-myocyte (Mfb-M) coupling, equations of intracellular ion concentrations of Na^+, K^+ and Ca^{2+} ($[Na^+]_i$, $[K^+]_i$, and $[Ca^{2+}]_i$) followed Table 12. Without I_{SAC} in Mfb-M coupling, they followed Table 8.

Table 1. Na^+ current: I_{Na}

$$I_{\mathrm{Na}} = P_{\mathrm{Na}} m^3 (0.9h_1 + 0.1h_2)[Na^+]_c V_{\mathrm{M}} \frac{\mathrm{F}^2}{\mathrm{RT}} \frac{e^{(V_{\mathrm{M}}-E_{\mathrm{Na}})\mathrm{F/RT}} - 1.0}{e^{V_{\mathrm{M}}\mathrm{F/RT}} - 1.0}$$

$$\bar{m} = \frac{1.0}{1.0 + e^{(V_{\mathrm{M}}+27.12)/-8.21}}$$

$$\bar{h} = \frac{1.0}{1.0 + e^{(V_{\mathrm{M}}+63.6)/5.3}}$$

$$\frac{dm}{dt} = \frac{\bar{m} - m}{\tau_m}$$

$$\tau_m = 0.000042 e^{-((V_{\mathrm{M}}+25.57)/28.8)^2} + 0.000024$$

$$\frac{dh_1}{dt} = \frac{\bar{h} - h_1}{\tau_{h_1}}$$

$$\tau_{h_1} = \frac{0.03}{1.0 + e^{(V_{\mathrm{M}}+35.1)/3.2}} + 0.0003$$

$$\frac{dh_2}{dt} = \frac{\bar{h} - h_2}{\tau_{h_2}}$$

$$\tau_{h_2} = \frac{0.12}{1.0 + e^{(V_{\mathrm{M}}+35.1)/3.2}} + 0.003$$

$$E_{\mathrm{Na}} = \frac{\mathrm{RT}}{\mathrm{F}} \log \frac{[\mathrm{Na}^+]_{\mathrm{c}}}{[\mathrm{Na}^+]_{\mathrm{i}}}$$

Table 2. Ca^{2+} current: I_{CaL}

$$I_{\mathrm{CaL}} = \bar{g}_{\mathrm{CaL}} d_{\mathrm{L}} [f_{\mathrm{Ca}} f_{\mathrm{L1}} + (1 - f_{\mathrm{Ca}}) f_{\mathrm{L2}}](V_{\mathrm{M}} - E_{\mathrm{Ca,app}})$$

$$\bar{d}_{\mathrm{L}} = \frac{1.0}{1.0 + e^{(V_{\mathrm{M}}+9.0)/\text{-}5.8}} \qquad \bar{f}_{\mathrm{L}} = \frac{1.0}{1.0 + e^{(V_{\mathrm{M}}+27.4)/7.1}}$$

$$\frac{dd_{\mathrm{L}}}{dt} = \frac{\bar{d}_{\mathrm{L}} - d_{\mathrm{L}}}{\tau_{d_{\mathrm{L}}}} \qquad \tau_{d_{\mathrm{L}}} = 0.0027e^{-\left((V_{\mathrm{M}}+35.0)/30.0\right)^2} + 0.002$$

$$\frac{df_{\mathrm{L1}}}{dt} = \frac{\bar{f}_{\mathrm{L}} - f_{\mathrm{L1}}}{\tau_{f_{\mathrm{L1}}}} \qquad \tau_{f_{\mathrm{L1}}} = 0.161e^{-\left((V_{\mathrm{M}}+40.0)/14.4\right)^2} + 0.01$$

$$\frac{df_{\mathrm{L2}}}{dt} = \frac{\bar{f}_{\mathrm{L}} - f_{\mathrm{L2}}}{\tau_{f_{\mathrm{L2}}}} \qquad \tau_{f_{\mathrm{L2}}} = 1.3323e^{-\left((V_{\mathrm{M}}+40.0)/14.2\right)^2} + 0.0626$$

$$f_{\mathrm{Ca}} = \frac{[\mathrm{Ca}^{2+}]_{\mathrm{d}}}{[\mathrm{Ca}^{2+}]_{\mathrm{d}} + k_{\mathrm{Ca}}}$$

Table 3. Transient and ultrarapidly delayed rectifier K$^+$ currents: I_{t} and I_{Kur}

$$I_{\mathrm{t}} = \bar{g}_{\mathrm{t}} r s (V_{\mathrm{M}} - E_{\mathrm{K}})$$

$$\bar{r} = \frac{1.0}{1.0 + e^{(V_{\mathrm{M}}-1.0)/\text{-}11.0}} \qquad \bar{s} = \frac{1.0}{1.0 + e^{(V_{\mathrm{M}}+40.5)/11.5}}$$

$$\frac{dr}{dt} = \frac{\bar{r} - r}{\tau_r} \qquad \tau_r = 0.0035e^{-(V_{\mathrm{M}}/30.0)^2} + 0.0015$$

$$\frac{ds}{dt} = \frac{\bar{s} - s}{\tau_s} \qquad \tau_s = 0.025635e^{-\left((V_{\mathrm{M}}+52.45)/15.89\right)^2} + 0.01414$$

$$I_{\mathrm{Kur}} = \bar{g}_{\mathrm{Kur}} r_{\mathrm{Kur}} s_{\mathrm{Kur}} (V_{\mathrm{M}} - E_{\mathrm{K}})$$

$$\bar{r}_{\mathrm{Kur}} = \frac{1.0}{1.0 + e^{(V_{\mathrm{M}}+6.0)/\text{-}8.6}} \qquad \bar{s}_{\mathrm{Kur}} = \frac{1.0}{1.0 + e^{(V_{\mathrm{M}}+7.5)/10.0}}$$

$$\frac{dr_{\mathrm{Kur}}}{dt} = \frac{\bar{r}_{\mathrm{Kur}} - r_{\mathrm{Kur}}}{\tau_{r_{\mathrm{Kur}}}} \qquad \tau_{r_{\mathrm{Kur}}} = \frac{0.009}{1.0 + e^{(V_{\mathrm{M}}+5.0)/12.0}} + 0.0005$$

$$\frac{ds_{\mathrm{Kur}}}{dt} = \frac{\bar{s}_{\mathrm{Kur}} - s_{\mathrm{Kur}}}{\tau_{s_{\mathrm{Kur}}}} \qquad \tau_{s_{\mathrm{Kur}}} = \frac{0.59}{1.0 + e^{(V_{\mathrm{M}}+60.0)/10.0}} + 3.05$$

$$E_{\mathrm{K}} = \frac{\mathrm{RT}}{\mathrm{F}} \log \frac{[\mathrm{K}^+]_{\mathrm{c}}}{[\mathrm{K}^+]_{\mathrm{i}}}$$

Table 4. Delayed rectifier K$^+$ currents: $I_{\mathrm{K,s}}$ and $I_{\mathrm{K,r}}$

$$I_{\mathrm{K,s}} = \bar{g}_{\mathrm{K,s}} n (V_{\mathrm{M}} - E_{\mathrm{K}})$$

$$\bar{n} = \frac{1.0}{1.0 + e^{(V_{\mathrm{M}}-19.9)/\text{-}12.7}} \qquad \tau_n = 0.7 + 0.4e^{-\left((V_{\mathrm{M}}-20.0)/20.0\right)^2}$$

$$\frac{dn}{dt} = \frac{\bar{n} - n}{\tau_n} \qquad E_{\mathrm{K}} = \frac{\mathrm{RT}}{\mathrm{F}} \log \frac{[\mathrm{K}^+]_{\mathrm{c}}}{[\mathrm{K}^+]_{\mathrm{i}}}$$

$$I_{\mathrm{K,r}} = \bar{g}_{\mathrm{K,r}} p_{\mathrm{a}} p_{\mathrm{i}} (V_{\mathrm{M}} - E_{\mathrm{K}})$$

$$\bar{p}_{\mathrm{a}} = \frac{1.0}{1.0 + e^{(V_{\mathrm{M}}+15.0)/\text{-}6.0}} \qquad p_{\mathrm{i}} = \frac{1.0}{1.0 + e^{(V_{\mathrm{M}}+55.0)/24.0}}$$

$$\frac{dp_{\mathrm{a}}}{dt} = \frac{\bar{p}_{\mathrm{a}} - p_{\mathrm{a}}}{\tau_{p_{\mathrm{a}}}} \qquad \tau_{p_{\mathrm{a}}} = 0.03118 + 0.21718e^{-\left((V_{\mathrm{M}}+20.1376)/22.1996\right)^2}$$

Table 5. Inward rectifier K$^+$ currents: I_{K1}

$$I_{\mathrm{K1}} = \bar{g}_{\mathrm{K1}}[\mathrm{K}^+]_{\mathrm{c}}^{0.4457}\frac{V_{\mathrm{M}} - E_{\mathrm{K}}}{1.0 + e^{1.5(V_{\mathrm{M}} - E_{\mathrm{K}} + 3.6)\mathrm{F/RT}}}$$

$$E_{\mathrm{K}} = \frac{\mathrm{RT}}{\mathrm{F}}\log\frac{[\mathrm{K}^+]_{\mathrm{c}}}{[\mathrm{K}^+]_{\mathrm{i}}}$$

Table 6. Background inward currents: $I_{\mathrm{B,Na}}$ and $I_{\mathrm{B,Ca}}$

$I_{\mathrm{B,Na}} = \bar{g}_{\mathrm{B,Na}}(V_{\mathrm{M}} - E_{\mathrm{Na}})$	$I_{\mathrm{B,Ca}} = \bar{g}_{\mathrm{B,Ca}}(V_{\mathrm{M}} - E_{\mathrm{Ca}})$
$E_{\mathrm{Na}} = \frac{\mathrm{RT}}{\mathrm{F}}\log\frac{[\mathrm{Na}^+]_{\mathrm{c}}}{[\mathrm{Na}^+]_{\mathrm{i}}}$	$E_{\mathrm{Ca}} = \frac{\mathrm{RT}}{2\mathrm{F}}\log\frac{[\mathrm{Ca}^{2+}]_{\mathrm{c}}}{[\mathrm{Ca}^{2+}]_{\mathrm{i}}}$

Table 7. Pump and exchanger currents: I_{NaK}, I_{CaP}, and I_{NaCa}

$$I_{\mathrm{NaK}} = \bar{I}_{\mathrm{NaK}}\frac{[\mathrm{K}^+]_{\mathrm{c}}}{[\mathrm{K}^+]_{\mathrm{c}} + k_{\mathrm{NaK,K}}}\cdot\frac{[\mathrm{Na}^+]_{\mathrm{i}}^{1.5}}{[\mathrm{Na}^+]_{\mathrm{i}}^{1.5} + k_{\mathrm{NaK,Na}}^{1.5}}\cdot\frac{V_{\mathrm{M}} + 150.0}{V_{\mathrm{M}} + 200.0}$$

$$I_{\mathrm{CaP}} = \bar{I}_{\mathrm{CaP}}\frac{[\mathrm{Ca}^{2+}]_{\mathrm{i}}}{[\mathrm{Ca}^{2+}]_{\mathrm{i}} + k_{\mathrm{CaP}}}$$

$$I_{\mathrm{NaCa}} = k_{\mathrm{NaCa}}\frac{[\mathrm{Na}^+]_{\mathrm{i}}^3[\mathrm{Ca}^{2+}]_{\mathrm{c}}e^{\gamma\mathrm{VF/RT}} - [\mathrm{Na}^+]_{\mathrm{c}}^3[\mathrm{Ca}^{2+}]_{\mathrm{i}}e^{(\gamma\text{-}1.0)\mathrm{VF/RT}}}{1.0 + d_{\mathrm{NaCa}}\left([\mathrm{Na}^+]_{\mathrm{c}}^3[\mathrm{Ca}^{2+}]_{\mathrm{i}} + [\mathrm{Na}^+]_{\mathrm{i}}^3[\mathrm{Ca}^{2+}]_{\mathrm{c}}\right)}$$

Table 8. Intracellular ion concentrations: $[\mathrm{Na}^+]_{\mathrm{i}}$, $[\mathrm{K}^+]_{\mathrm{i}}$, and $[\mathrm{Ca}^{2+}]_{\mathrm{i}}$

$$\frac{d[\mathrm{Na}^+]_{\mathrm{i}}}{dt} = -\frac{I_{\mathrm{Na}} + I_{\mathrm{B,Na}} + 3I_{\mathrm{NaK}} + 3I_{\mathrm{NaCa}}}{\mathrm{Vol_i\,F}}$$

$$\frac{d[\mathrm{K}^+]_{\mathrm{i}}}{dt} = -\frac{I_{\mathrm{t}} + I_{\mathrm{Kur}} + I_{\mathrm{K1}} + I_{\mathrm{K,s}} + I_{\mathrm{K,r}} - 2I_{\mathrm{NaK}}}{\mathrm{Vol_i\,F}}$$

$$\frac{d[\mathrm{Ca}^{2+}]_{\mathrm{i}}}{dt} = -\frac{-I_{\mathrm{di}} + I_{\mathrm{B,Ca}} + I_{\mathrm{CaP}} - 2I_{\mathrm{NaCa}} + I_{\mathrm{up}} - I_{\mathrm{rel}}}{2.0\ \mathrm{Vol_i\,F}} - \frac{dO}{dt}$$

$$\frac{dO}{dt} = 0.08\frac{dO_{\mathrm{TC}}}{dt} + 0.16\frac{dO_{\mathrm{TMgC}}}{dt} + 0.045\frac{dO_{\mathrm{C}}}{dt}$$

$$\frac{d[\mathrm{Ca}^{2+}]_{\mathrm{d}}}{dt} = -\frac{I_{\mathrm{CaL}} - I_{\mathrm{di}}}{2.0\ \mathrm{Vol_d\,F}}$$

$$I_{\mathrm{di}} = ([\mathrm{Ca}^{2+}]_{\mathrm{d}} - [\mathrm{Ca}^{2+}]_{\mathrm{i}})\frac{2\mathrm{F\ Vol_d}}{\tau_{\mathrm{di}}}$$

Table 9. Cleft space ion concentrations: $[\mathrm{Na}^+]_{\mathrm{c}}$, $[\mathrm{K}^+]_{\mathrm{c}}$, and $[\mathrm{Ca}^{2+}]_{\mathrm{c}}$

$$\frac{d[\mathrm{Na}^+]_{\mathrm{c}}}{dt} = \frac{[\mathrm{Na}^+]_{\mathrm{b}} - [\mathrm{Na}^+]_{\mathrm{c}}}{\tau_{\mathrm{Na}}} + \frac{I_{\mathrm{Na}} + I_{\mathrm{B,Na}} + 3I_{\mathrm{NaK}} + 3I_{\mathrm{NaCa}}}{\mathrm{Vol_c\,F}}$$

$$\frac{d[\mathrm{K}^+]_{\mathrm{c}}}{dt} = \frac{[\mathrm{K}^+]_{\mathrm{b}} - [\mathrm{K}^+]_{\mathrm{c}}}{\tau_{\mathrm{K}}} + \frac{I_{\mathrm{t}} + I_{\mathrm{Kur}} + I_{\mathrm{K1}} + I_{\mathrm{K,s}} + I_{\mathrm{K,r}} - 2I_{\mathrm{NaK}}}{\mathrm{Vol_c\,F}}$$

$$\frac{d[\mathrm{Ca}^{2+}]_{\mathrm{c}}}{dt} = \frac{[\mathrm{Ca}^{2+}]_{\mathrm{b}} - [\mathrm{Ca}^{2+}]_{\mathrm{c}}}{\tau_{\mathrm{Ca}}} + \frac{I_{\mathrm{CaL}} + I_{\mathrm{B,Ca}} + I_{\mathrm{CaP}} - 2I_{\mathrm{NaCa}}}{2.0\ \mathrm{Vol_c\,F}}$$

Table 10. Intracellular Ca^{2+} buffering

$$\frac{dO_{\mathrm{C}}}{dt} = 200000.0[\mathrm{Ca}^{2+}]_{\mathrm{i}}(1.0 - O_{\mathrm{C}}) - 476.0O_{\mathrm{C}}$$

$$\frac{dO_{\mathrm{TC}}}{dt} = 78400.0[\mathrm{Ca}^{2+}]_{\mathrm{i}}(1.0 - O_{\mathrm{TC}}) - 392.0O_{\mathrm{TC}}$$

$$\frac{dO_{\mathrm{TMgC}}}{dt} = 200000.0[\mathrm{Ca}^{2+}]_{\mathrm{i}}\left(1.0 - O_{\mathrm{TMgC}} - O_{\mathrm{TMgMg}}\right) - 6.6O_{\mathrm{TMgC}}$$

$$\frac{dO_{\mathrm{TMgMg}}}{dt} = 2000.0[\mathrm{Mg}^{2+}]_{\mathrm{i}}\left(1.0 - O_{\mathrm{TMgC}} - O_{\mathrm{TMgMg}}\right) - 666.0O_{\mathrm{TMgMg}}$$

Table 11. Ca^{2+} handling by the sarcoplasmic reticulum

$$I_{\mathrm{up}} = \bar{I}_{\mathrm{up}} \frac{[\mathrm{Ca}^{2+}]_{\mathrm{i}}/k_{\mathrm{cyca}} - k_{\mathrm{xcs}}^{2}[\mathrm{Ca}^{2+}]_{\mathrm{up}}/k_{\mathrm{srca}}}{\left([\mathrm{Ca}^{2+}]_{\mathrm{i}} + k_{\mathrm{cyca}}\right)/k_{\mathrm{cyca}} + k_{\mathrm{xcs}}\left([\mathrm{Ca}^{2+}]_{\mathrm{up}} + k_{\mathrm{srca}}\right)/k_{\mathrm{srca}}}$$

$$I_{\mathrm{tr}} = \left([\mathrm{Ca}^{2+}]_{\mathrm{up}} - [\mathrm{Ca}^{2+}]_{\mathrm{rel}}\right)\frac{2\mathrm{F}\ \mathrm{Vol}_{\mathrm{rel}}}{\tau_{\mathrm{tr}}}$$

$$I_{\mathrm{rel}} = \alpha_{\mathrm{rel}}\left(\frac{F_2}{F_2 + 0.25}\right)^{2}\left([\mathrm{Ca}^{2+}]_{\mathrm{rel}} - [\mathrm{Ca}^{2+}]_{\mathrm{i}}\right)$$

$$\frac{dO_{\mathrm{Calse}}}{dt} = 480.0[\mathrm{Ca}^{2+}]_{\mathrm{rel}}(1.0 - O_{\mathrm{Calse}}) - 400.0O_{\mathrm{Calse}}$$

$$\frac{d[\mathrm{Ca}^{2+}]_{\mathrm{rel}}}{dt} = \frac{I_{\mathrm{tr}} - I_{\mathrm{rel}}}{2\mathrm{F}\ \mathrm{Vol}_{\mathrm{rel}}} - 31.0\frac{dO_{\mathrm{Calse}}}{dt}$$

$$\frac{d[\mathrm{Ca}^{2+}]_{\mathrm{up}}}{dt} = \frac{I_{\mathrm{up}} - I_{\mathrm{tr}}}{2\mathrm{F}\ \mathrm{Vol}_{\mathrm{up}}}$$

$$\frac{dF_1}{dt} = \mathrm{r}_{\mathrm{recov}}(1.0 - F_1 - F_2) - r_{\mathrm{act}}F_1$$

$$\frac{dF_2}{dt} = r_{\mathrm{act}}F_1 - r_{\mathrm{inact}}F_2$$

$$r_{\mathrm{act}} = 203.8\left[\left(\frac{[\mathrm{Ca}^{2+}]_{\mathrm{i}}}{[\mathrm{Ca}^{2+}]_{\mathrm{i}} + k_{\mathrm{rel,i}}}\right)^{4} + \left(\frac{[\mathrm{Ca}^{2+}]_{\mathrm{d}}}{[\mathrm{Ca}^{2+}]_{\mathrm{d}} + k_{\mathrm{rel,d}}}\right)^{4}\right]$$

$$r_{\mathrm{inact}} = 33.96 + 339.6\left(\frac{[\mathrm{Ca}^{2+}]_{\mathrm{i}}}{[\mathrm{Ca}^{2+}]_{\mathrm{i}} + k_{\mathrm{rel,i}}}\right)^{4}$$

Table 12. Stretch-activated current: I_{SAC}

$$I_{\mathrm{SAC}} = I_{\mathrm{SAC,Na}} + I_{\mathrm{SAC,K}} + I_{\mathrm{SAC,Ca}}$$

$$I_{\mathrm{SAC,Na}} = \bar{P}_{\mathrm{Na}}g_{\mathrm{SAC}}\frac{\mathrm{z}_{\mathrm{Na}}^{2}\mathrm{F}^{2}V_{\mathrm{M}}}{\mathrm{RT}} \cdot \frac{[\mathrm{Na}^{+}]_{\mathrm{i}} - [\mathrm{Na}^{+}]_{\mathrm{c}}e^{-(z_{\mathrm{Na}}\mathrm{F}V_{\mathrm{M}})/\mathrm{RT}}}{1.0 - e^{-(z_{\mathrm{Na}}\mathrm{F}V_{\mathrm{M}})/\mathrm{RT}}}$$

$$I_{\mathrm{SAC,K}} = \bar{P}_{\mathrm{K}}g_{\mathrm{SAC}}\frac{\mathrm{z}_{\mathrm{K}}^{2}\mathrm{F}^{2}V_{\mathrm{M}}}{\mathrm{RT}} \cdot \frac{[\mathrm{K}^{+}]_{\mathrm{i}} - [\mathrm{K}^{+}]_{\mathrm{c}}e^{-(z_{\mathrm{K}}\mathrm{F}V_{\mathrm{M}})/\mathrm{RT}}}{1.0 - e^{-(z_{\mathrm{K}}\mathrm{F}V_{\mathrm{M}})/\mathrm{RT}}}$$

$$I_{\mathrm{SAC,Ca}} = \bar{P}_{\mathrm{Ca}}g_{\mathrm{SAC}}\frac{\mathrm{z}_{\mathrm{Ca}}^{2}\mathrm{F}^{2}V_{\mathrm{M}}}{\mathrm{RT}} \cdot \frac{[\mathrm{Ca}^{2+}]_{\mathrm{i}} - [\mathrm{Ca}^{2+}]_{\mathrm{c}}e^{-(z_{\mathrm{Ca}}\mathrm{F}V_{\mathrm{M}})/\mathrm{RT}}}{1.0 - e^{-(z_{\mathrm{Ca}}\mathrm{F}V_{\mathrm{M}})/\mathrm{RT}}}$$

$$g_{\mathrm{SAC}} = \frac{G_{\mathrm{SAC}}}{1.0 + K_{\mathrm{SAC}} e^{-(\alpha_{\mathrm{SAC}}(\lambda - 1))}}$$

$$\bar{P}_{\mathrm{Na}} : \bar{P}_{\mathrm{K}} : \bar{P}_{\mathrm{Ca}} = 1{:}1{:}1$$

$$\frac{d[\mathrm{Na}^+]_{\mathrm{i}}}{dt} = -\frac{I_{\mathrm{Na}} + I_{\mathrm{B,Na}} + 3I_{\mathrm{NaK}} + 3I_{\mathrm{NaCa}} + I_{\mathrm{SAC,Na}}}{\mathrm{Vol_i F}}$$

$$\frac{d[\mathrm{K}^+]_{\mathrm{i}}}{dt} = -\frac{I_{\mathrm{t}} + I_{\mathrm{Kur}} + I_{\mathrm{K1}} + I_{\mathrm{K,s}} + I_{\mathrm{K,r}} - 2I_{\mathrm{NaK}} + I_{\mathrm{SAC,K}}}{\mathrm{Vol_i F}}$$

$$\frac{d[\mathrm{Ca}^{2+}]_{\mathrm{i}}}{dt} = -\frac{-I_{\mathrm{di}} + I_{\mathrm{B,Ca}} + I_{\mathrm{CaP}} - 2I_{\mathrm{NaCa}} + I_{\mathrm{up}} - I_{\mathrm{rel}} + I_{\mathrm{SAC,Ca}}}{2.0\ \mathrm{Vol_i F}} - \frac{dO}{dt}$$

Atrial Myofibroblast Model

The atrial Mfb model was represented by the MacCannell et al. mathematical model [5]. Mathematical formulations of the currents through voltage-gated sodium channels ($I_{\mathrm{Na\_Mfb}}$) and mechano-gated channels ($I_{\mathrm{MGC\_Mfb}}$) was based on experimental data from Chatelier et al. [6] and Kamkin et al. [7], respectively.

Table 13. Time- and voltage-dependent K$^+$ current: $\mathrm{I_{Kv\_Mfb}}$

$$I_{\mathrm{Kv\_Mfb}} = \bar{g}_{\mathrm{Kv,Mfb}} r_{\mathrm{Kv}} s_{\mathrm{Kv}} \left(V_{\mathrm{Mfb}} - E_{\mathrm{K,Mfb}}\right)$$

$$\bar{r}_{\mathrm{Kv}} = \left(1.0 + e^{-(V_{\mathrm{Mfb}} + 20.0)/11.0}\right)^{-1} \qquad \bar{s}_{\mathrm{Kv}} = \left(1.0 + e^{(V_{\mathrm{Mfb}} + 23.0)/7.0}\right)^{-1}$$

$$\frac{dr_{\mathrm{Kv}}}{dt} = \frac{\bar{r}_{\mathrm{Kv}} - r_{\mathrm{Kv}}}{\tau_{r_{\mathrm{Kv}}}} \qquad \tau_{r_{\mathrm{Kv}}} = 0.0203 + 0.138 \cdot e^{(-(V_{\mathrm{Mfb}} + 20.0)/25.9)^2}$$

$$\frac{ds_{\mathrm{Kv}}}{dt} = \frac{\bar{s}_{\mathrm{Kv}} - s_{\mathrm{Kv}}}{\tau_{s_{\mathrm{Kv}}}} \qquad \tau_{s_{\mathrm{Kv}}} = 1.574 + 5.268 \cdot e^{(-(V_{\mathrm{Mfb}} + 23.0)/22.7)^2}$$

$$E_{\mathrm{K,Mfb}} = \frac{\mathrm{RT}}{\mathrm{F}} \log \frac{[\mathrm{K}^+]_{\mathrm{c,Mfb}}}{[\mathrm{K}^+]_{\mathrm{i,Mfb}}}$$

Table 14. Time-independent inward-rectifying K+ current: $I_{\mathrm{K1\_Mfb}}$

$$I_{\mathrm{K1\_Mfb}} = \bar{g}_{\mathrm{K1,Mfb}} \left(\alpha_{\mathrm{K1}} / (\alpha_{\mathrm{K1}} + \beta_{\mathrm{K1}})\right)\left(V_{\mathrm{Mfb}} - E_{\mathrm{K,Mfb}}\right)$$

$$\alpha_{\mathrm{K1}} = 0.1\left(1.0 + e^{0.06(V_{\mathrm{Mfb}} - E_{\mathrm{K}} - 200.0)}\right)^{-1}$$

$$\beta_{\mathrm{K1}} = \frac{3.0 \cdot e^{0.0002(V_{\mathrm{Mfb}} - E_{\mathrm{K}} + 100.0)} + e^{0.1(V_{\mathrm{Mfb}} - E_{\mathrm{K}} + 10.0)}}{1.0 + e^{-0.5(V_{\mathrm{Mfb}} - E_{\mathrm{K}})}}$$

$$E_{\mathrm{K,Mfb}} = \frac{\mathrm{RT}}{\mathrm{F}} \log \frac{[\mathrm{K}^+]_{\mathrm{c,Mfb}}}{[\mathrm{K}^+]_{\mathrm{i,Mfb}}}$$

Table 15. Na$^+$-K$^+$ pump current: $I_{\mathrm{NaK\_Mfb}}$

$$I_{\mathrm{NaK\_Mfb}} = \bar{I}_{\mathrm{NaK,Mfb}} \cdot \frac{[\mathrm{K}^+]_{\mathrm{c,Mfb}}}{[\mathrm{K}^+]_{\mathrm{c,Mfb}} + k_{\mathrm{mK}}} \cdot \frac{{[\mathrm{Na}^+]_{\mathrm{i,Mfb}}}^{1.5}}{{[\mathrm{Na}^+]_{\mathrm{i,Mfb}}}^{1.5} + {k_{\mathrm{mNa}}}^{1.5}} \cdot \frac{V_{\mathrm{Mfb}} + 150.0}{V_{\mathrm{Mfb}} + 200.0}$$

Table 16. Background inward current: $I_{\mathrm{B,Na\_Mfb}}$

$$I_{\mathrm{B,Na\_Mfb}} = \bar{g}_{\mathrm{B,Na,Mfb}}\left(V_{\mathrm{Mfb}} - E_{\mathrm{Na,Mfb}}\right)$$

$$E_{\mathrm{Na,Mfb}} = \frac{\mathrm{RT}}{\mathrm{F}} \log \frac{[\mathrm{Na}^+]_{\mathrm{c,Mfb}}}{[\mathrm{Na}^+]_{\mathrm{i,Mfb}}}$$

Table 17. Na$^+$ current: $I_{\mathrm{Na\_Mfb}}$

$$I_{\mathrm{Na\_Mfb}} = \bar{g}_{\mathrm{Na,Mfb}} m_{\mathrm{Mfb}} j_{\mathrm{Mfb}}^{0.12}\left(V_{\mathrm{Mfb}} - E_{\mathrm{Na,Mfb}}\right)$$

$$\bar{m}_{\mathrm{Mfb}} = \frac{-0.0102 - 1.0063}{1.0 + e^{(V_{\mathrm{Mfb}}+42.1)/10.53}} + 1.0063 \qquad \bar{j}_{\mathrm{Mfb}} = \frac{1.04 - 0.004}{1.0 + e^{(V_{\mathrm{Mfb}}+84.82)/9.4}} + 0.004$$

$$\frac{dm_{\mathrm{Mfb}}}{dt} = \frac{\bar{m}_{\mathrm{Mfb}} - m_{\mathrm{Mfb}}}{\tau_{m_{\mathrm{Mfb}}}} \qquad \frac{dj_{\mathrm{Mfb}}}{dt} = \frac{\bar{j}_{\mathrm{Mfb}} - j_{\mathrm{Mfb}}}{\tau_{j_{\mathrm{Mfb}}}}$$

$$\tau_{m_{\mathrm{Mfb}}} = \frac{1}{\alpha_{m_{\mathrm{Mfb}}} + \beta_{m_{\mathrm{Mfb}}}} \qquad \tau_{j_{\mathrm{Mfb}}} = \frac{1}{\alpha_{j_{\mathrm{Mfb}}} + \beta_{j_{\mathrm{Mfb}}}}$$

$$\alpha_{m_{\mathrm{Mfb}}} = \begin{cases} 0.0077 \dfrac{V_{\mathrm{Mfb}} + 68.19}{1.0 - e^{-0.18(V_{\mathrm{Mfb}}+68.19)}} \\ 0.0433, \quad \text{if } V_{\mathrm{Mfb}} = -68.19 \end{cases}$$

$$\beta_{m_{\mathrm{Mfb}}} = 0.004 e^{-V_{\mathrm{Mfb}}/11.98}$$

$$\alpha_{j_{\mathrm{Mfb}}} = \begin{cases} \left(-14.5 e^{0.17 V_{\mathrm{Mfb}}} + 1.8 e^{1.56 V_{\mathrm{Mfb}}}\right) \cdot \dfrac{V_{\mathrm{Mfb}} + 35.73}{1.0 + e^{3.31(V_{\mathrm{Mfb}}+3.86)}} \\ 0, \quad \text{if } V_{\mathrm{Mfb}} \geq -40.0 \end{cases}$$

$$\beta_{j_{\mathrm{Mfb}}} = \begin{cases} 5.05 \times 10^{-5} \dfrac{e^{-0.0995 V_{\mathrm{Mfb}}}}{1.0 + e^{-0.01(V_{\mathrm{Mfb}}-84.02)}} \\ 0.11 \dfrac{e^{-4.13 \times 10^{-4} V_{\mathrm{Mfb}}}}{1.0 + e^{-0.09(V_{\mathrm{Mfb}}+42.44)}}, \text{ if } V_{\mathrm{Mfb}} \geq -40.0 \end{cases}$$

$$E_{\mathrm{Na,Mfb}} = \frac{\mathrm{RT}}{\mathrm{F}} \log \frac{[\mathrm{Na}^+]_{\mathrm{c,Mfb}}}{[\mathrm{Na}^+]_{\mathrm{i,Mfb}}}$$

Table 18. Mechano-gated channel mediated current: $I_{\mathrm{MGC\_Mfb}}$

$$I_{\mathrm{MGC\_Mfb}} = \bar{g}_{\mathrm{MGC,Mfb}} \cdot \left(V_{\mathrm{Mfb}} - E_{\mathrm{MGC,Mfb}}\right)$$

Table 19. Intracellular ion concentrations: $[\mathrm{Na}^+]_{\mathrm{i,Mfb}}$, $[\mathrm{K}^+]_{\mathrm{i,Mfb}}$, and $[\mathrm{Ca}^{2+}]_{\mathrm{i,Mfb}}$

$$\text{Without } I_{\mathrm{Na\_Mfb}}\text{:} \quad \frac{d[\mathrm{Na}^+]_{\mathrm{i,Mfb}}}{dt} = -\frac{I_{\mathrm{B,Na\_Mfb}} + 3 I_{\mathrm{NaK\_Mfb}}}{\mathrm{Vol}_{\mathrm{i,Mfb}}\mathrm{F}}$$

$$\text{With } I_{\mathrm{Na\_Mfb}}\text{:} \quad \frac{d[\mathrm{Na}^+]_{\mathrm{i,Mfb}}}{dt} = -\frac{I_{\mathrm{Na\_Mfb}} + I_{\mathrm{B,Na\_Mfb}} + 3 I_{\mathrm{NaK\_Mfb}}}{\mathrm{Vol}_{\mathrm{i,Mfb}}\mathrm{F}}$$

$$\frac{d[\mathrm{K}^{+}]_{\mathrm{i,Mfb}}}{dt} = -\frac{I_{\mathrm{K1\_Mfb}} + I_{\mathrm{Kv\_Mfb}}}{\mathrm{Vol}_{\mathrm{i,Mfb}}\,\mathrm{F}}$$

Mfb-M electrical coupling

Table 20. Transmembrane potential of myocyte and Mfb

$$\frac{dV_{\mathrm{M}}}{dt} = -\frac{1}{\mathrm{C}_{\mathrm{m,M}}}\left(I_{\mathrm{M}}(V_{\mathrm{M}},t) + \sum_{\mathrm{i=1}}^{\mathrm{n}} G_{\mathrm{gap}}\left(V_{\mathrm{M}} - V_{\mathrm{Mfb,i}}\right)\right)$$

$$\frac{dV_{\mathrm{Mfb,i}}}{dt} = -\frac{1}{\mathrm{C}_{\mathrm{m,Mfb}}}\left(I_{\mathrm{Mfb,i}}\left(V_{\mathrm{Mfb,i}},t\right) + G_{\mathrm{gap}}\left(V_{\mathrm{Mfb,i}} - V_{\mathrm{M}}\right)\right)$$

Without I_{SAC}: $I_{\mathrm{M}}(V_{\mathrm{M}},t) =$

$$I_{\mathrm{Na}} + I_{\mathrm{CaL}} + I_{\mathrm{t}} + I_{\mathrm{Kur}} + I_{\mathrm{K1}} + I_{\mathrm{K,r}} + I_{\mathrm{K,s}} + I_{\mathrm{B,Na}} + I_{\mathrm{B,Ca}} + I_{\mathrm{NaK}} + I_{\mathrm{CaP}} + I_{\mathrm{NaCa}} - I_{\mathrm{Stim}}$$

With I_{SAC}: $I_{\mathrm{M}}(V_{\mathrm{M}},t) =$

$$I_{\mathrm{Na}} + I_{\mathrm{CaL}} + I_{\mathrm{t}} + I_{\mathrm{Kur}} + I_{\mathrm{K1}} + I_{\mathrm{K,r}} + I_{\mathrm{K,s}} + I_{\mathrm{B,Na}} + I_{\mathrm{B,Ca}} + I_{\mathrm{NaK}} + I_{\mathrm{CaP}} + I_{\mathrm{NaCa}} + I_{\mathrm{SAC}} - I_{\mathrm{Stim}}$$

Without $I_{\mathrm{Na\_Mfb}}$ and $I_{\mathrm{MGC\_Mfb}}$: $I_{\mathrm{Mfb,i}}\left(V_{\mathrm{Mfb,i}},t\right) = I_{\mathrm{Kv\_Mfb}} + I_{\mathrm{K1\_Mfb}} + I_{\mathrm{NaK\_Mfb}} + I_{\mathrm{B,Na\_Mfb}}$

With $I_{\mathrm{Na\_Mfb}}$ and $I_{\mathrm{MGC\_Mfb}}$: $I_{\mathrm{Mfb,i}}\left(V_{\mathrm{Mfb,I}},t\right) =$

$$I_{\mathrm{Kv\_Mfb}} + I_{\mathrm{K1\_Mfb}} + I_{\mathrm{NaK\_Mfb}} + I_{\mathrm{B,Na\_Mfb}} + I_{\mathrm{Na\_Mfb}} + I_{\mathrm{MGC\_Mfb}}$$

Table 21. Parameter values

$[\mathrm{Na}^{+}]_{\mathrm{b}}$ = 130.0 mmol/L
$[\mathrm{K}^{+}]_{\mathrm{b}}$ = 5.4 mmol/L
$[\mathrm{Ca}^{2+}]_{\mathrm{b}}$ = 1.8 mmol/L
$[\mathrm{Mg}^{2+}]_{\mathrm{i}}$ = 2.5 mmol/L
$E_{\mathrm{Ca,app}}$ = 60.0 mV
k_{Ca} = 0.025 mmol/L
R = 8314.0 mJ/molK
T = 306.15 K
F = 96487.0 C/mol
$\mathrm{C}_{\mathrm{m,M}}$ = 0.05 nF
$\mathrm{Vol}_{\mathrm{i}}$ = 0.005884 nL
$\mathrm{Vol}_{\mathrm{c}}$ = 0.136$\mathrm{Vol}_{\mathrm{i}}$
$\mathrm{Vol}_{\mathrm{d}}$ = 0.02$\mathrm{Vol}_{\mathrm{i}}$
$\mathrm{Vol}_{\mathrm{rel}}$ = 0.0000441 nL
$\mathrm{Vol}_{\mathrm{up}}$ = 0.0003969 nL
τ_{Na} = 14.3 s
τ_{K} = 10.0 s
τ_{Ca} = 24.7 s

k_{CaP} = 0.0002 mmol/L
k_{NaCa} = 0.0374842 pA/(mmol/L)^{4}
γ = 0.45
d_{NaCa} = 0.0003 (mmol/L)$^{-4}$
$\bar{I}_{\mathrm{up}}$ = 2800.0 pA
k_{cyca} = 0.0003 mmol/L
K_{srca} = 0.5 mmol/L
K_{xcs} = 0.4
τ_{tr} = 0.01 s
α_{rel} = 200000.0 pA L/mmol
$k_{\mathrm{rel,i}}$ = 0.0003 mmol/L
$k_{\mathrm{rel,d}}$ = 0.003 mmol/L
r_{recov} = 0.815 s^{-1}
K_{SAC} = 100
α_{SAC} = 3
λ = 1.2
$\mathrm{C}_{\mathrm{m,Mfb}}$ = 6.3 pF
$\mathrm{Vol}_{\mathrm{i,Mfb}}$ = 0.00137 nL

τ_{dt} = 0.01 s

$\bar{I}_{NaK}$ = 68.55 pA

$k_{NaK,K}$ = 1.0 mmol/L

$k_{NaK,Na}$ = 11.0 mmol/L

$\bar{I}_{CaP}$ = 4.0 pA

$[Na^+]_{c,Mfb}$ = 130.011 mmol/L

$[K^+]_{c,Mfb}$ = 5.3581 mmol/L

k_{mK} = 1.0 mmol

k_{mNa} = 11.0 mmol

$\bar{I}_{NaK,Mfb}$ = 10.36 pA

Table 22. Maximum conductance values

P_{Na} = 0.0018 nL/s

$\bar{g}_{CaL}$ = 6.75 nS

$\bar{g}_{t}$ = 8.25 nS

$\bar{g}_{Kur}$ = 2.25 nS

$\bar{g}_{K,s}$ = 1.0 nS

$\bar{g}_{K,r}$ = 0.5 nS

$\bar{g}_{K1}$ = 3.1 nS

$\bar{g}_{B,Na}$ = 0.060599 nS

$\bar{g}_{B,Ca}$ = 0.078681 nS

G_{SAC} = 0.015 μm/s

$\bar{g}_{Kv,Mfb}$ = 1.575 nS

$\bar{g}_{K1,Mfb}$ = 3.038 nS

$\bar{g}_{B,Na,Mfb}$ = 0.05985 nS

$\bar{g}_{Na,Mfb}$ = 0.756 nS

$\bar{g}_{MGC,Mfb}$ = 0.043 nS

Table 23. Initial conditions

V_M = -74.2525 mV

$[Na^+]_c$ = 130.0221 mmol/L

$[K^+]_c$ = 5.5602 mmol/L

$[Ca^{2+}]_c$ = 1.8158 mmol/L

$[Na^+]_i$ = 8.5168 mmol/L

$[K^+]_i$ = 129.486 mmol/L

$[Ca^{2+}]_i = 6.5\times10^{-5}$ mmol/L

$[Ca^{2+}]_d = 7.1\times10^{-5}$ mmol/L

$[Ca^{2+}]_{up}$ = 0.6492 mmol/L

$[Ca^{2+}]_{rel}$ = 0.6326 mmol/L

$m = 3.289\times10^{-3}$

h_1 = 0.8772

h_2 = 0.8739

$d_L = 1.4\times10^{-5}$

f_{L1} = 0.9986

f_{L2} = 0.9986

$r = 1.089\times10^{-3}$

s = 0.9486

$r_{Kur} = 3.67\times10^{-4}$

s_{Kur} = 0.9673

$n = 4.374\times10^{-3}$

$p_a = 5.3\times10^{-5}$

F_1 = 0.4701

F_2 = 0.0028

O = 1.382

O_C = 0.0268

O_{Calse} = 0.4315

O_{TC} = 0.0129

O_{TMgC} = 0.1904

O_{TMgMg} = 0.7145

$[K^+]_{i,Mfb}$ = 129.4349 mmol/L

$[Na^+]_{i,Mfb}$ = 8.5547 mmol/L

V_{Mfb} = -47.75 mV

r_{Kv} = 0.0743

s_{Kv} = 0.9717

$m_{Mfb} = 3.0\times10^{-3}$

j_{Mfb} = 0.9989

Glossary

	Myocyte	Vol_i	Total cytosolic volume
I_{Na}	Na^+ current	Vol_d	Volume of the diffusion-restricted subsarcolemmal space
I_{CaL}	L-type Ca^{2+} current	Vol_{up}	Volume of the sarcoplasmic reticulum uptake compartment

I_t	Transient outward K^+ current
I_{Kur}	Sustained outward K^+ current
$I_{K,s}$	Slow delayed rectifier K^+ current
$I_{K,r}$	Rapid delayed rectifier K^+ current
I_{K1}	Inwardly rectifying K^+ current
$I_{B,Na}$	Background Na^+ current
$I_{B,Ca}$	Background Ca^{2+} current
I_{NaK}	Na^+-K^+ pump current
I_{CaP}	Sarcolemmal Ca^{2+} pump current
I_{NaCa}	Na^+-Ca^{2+} exchange current
I_{di}	Ca^{2+} diffusion current from the diffusion-restricted subsarcolemmal space to the cytosol
I_{up}	Sarcoplasmic reticulum Ca^{2+} uptake current
I_{tr}	Sarcoplasmic reticulum Ca^{2+} translocation current (from uptake to release compartment)
I_{rel}	Sarcoplasmic reticulum Ca^{2+} release current
$[Na^+]_b$	Na^+ concentration in bulk (bathing) medium
$[K^+]_b$	K^+ concentration in bulk (bathing) medium
$[Ca^{2+}]_b$	Ca^{2+} concentration in bulk (bathing) medium
$[Na^+]_c$	Na^+ concentration in the extracellular cleft space
$[K^+]_c$	K^+ concentration in the extracellular cleft space
$[Ca^{2+}]_c$	Ca^{2+} concentration in the extracellular cleft space
$[Na^+]_i$	Na^+ concentration in the intracellular medium
$[K^+]_i$	K^+ concentration in the intracellular medium
$[Ca^{2+}]_i$	Ca^{2+} concentration in the intracellular medium
$[Mg^{2+}]_i$	Mg^{2+} concentration in the intracellular medium
$[Ca^{2+}]_d$	Ca^{2+} concentration in the restricted subsarcolemmal space
$[Ca^{2+}]_{up}$	Ca^{2+} concentration in the sarcoplasmic reticulum uptake compartment
$[Ca^{2+}]_{rel}$	Ca^{2+} concentration in the sarcoplasmic reticulum release compartment
E_{Na}	Equilibrium (Nernst) potential for Na^+
E_K	Equilibrium (Nernst) potential for K^+
E_{Ca}	Equilibrium (Nernst) potential for Ca^{2+}
$E_{Ca,app}$	Apparent reversal potential for I_{CaL}
P_{Na}	Permeability for I_{Na}
$\bar{g}_{CaL}$	Maximum conductance for I_{CaL}
$\bar{g}_t$	Maximum conductance for I_t
$\bar{g}_{Kur}$	Maximum conductance for I_{Kur}
$\bar{g}_{K,s}$	Maximum conductance for $I_{K,s}$
$\bar{g}_{K,r}$	Maximum conductance for $I_{K,r}$

Vol_{rel}	Volume of the sarcoplasmic reticulum release compartment
τ_{Na}, τ_K, τ_{Ca},	Time constant of diffusion of Na^+, K^+, and Ca^{2+} from the bulk medium to the extracellular cleft space
τ_{di}	Time constant of diffusion from the restricted subsarcolemmal space to the cytosol
$\bar{I}_{NaK}$	Maximum Na^+-K^+ pump current
$k_{NaK,K}$	Half-maximum K^+ binding concentration for I_{NaK}
$k_{NaK,Na}$	Half-maximum Na^+ binding concentration for I_{NaK}
$\bar{I}_{CaP}$	Half-maximum Ca2+ binding concentration for I_{CaP}
k_{NaCa}	Scaling factor for I_{NaCa}
γ	Position of energy barrier controlling voltage dependence of I_{NaCa}
d_{NaCa}	Denominator constant for I_{NaCa}
$\bar{I}_{up}$	Maximum sarcoplasmic reticulum uptake current
k_{cyca}	Half-maximum binding concentration for $[Ca^{2+}]_i$ to I_{up}
k_{srca}	Half-maximum binding concentration for $[Ca^{2+}]_{up}$ to I_{up}
K_{xcs}	Ratio of forward to back reactions for I_{up}
τ_{tr}	Time constant of diffusion of Ca^{2+} from sarcoplasmic reticulum uptake to release compartment
α_{rel}	Scaling factor for I_{rel}
$k_{rel,i}$	Half-activation $[Ca^{2+}]_i$ for I_{rel}
$k_{rel,d}$	Half-activation $[Ca^{2+}]_d$ for I_{rel}
k_{recov}	Recovery rate constant for the sarcoplasmic reticulum release channel
I_{SAC}	Stretch-activated current
$I_{SAC,Na}$	Na^+ contributes to I_{sac}
$I_{SAC,K}$	K^+ contributes to I_{sac}
$I_{SAC,Ca}$	Ca^{2+} contributes to I_{sac}
$\bar{P}_{Na}$	Relative permeability to Na^+
$\bar{P}_K$	Relative permeability to K^+
$\bar{P}_{Ca}$	Relative permeability to Ca^{2+}
z_{Na}	Na^+ valence
z_K	K^+ valence
z_{Ca}	Ca^{2+} valence
g_{SAC}	Conductance for I_{sac}
G_{SAC}	Maximum conductance for I_{sac}
K_{SAC}	Parameter to define the amount of current when the cell is not stretched
α_{SAC}	Parameter to describe the sensitivity to stretch
λ	Stretch ratio
	Myofibroblast
I_{Kv_Mfb}	Time- and voltage-dependent K^+ current
I_{K1_Mfb}	Inward-rectifying K^+ current

$\bar{g}_{\mathrm{K1}}$	Maximum conductance for I_{K1}
$\bar{g}_{\mathrm{B,Na}}$	Maximum conductance for $I_{\mathrm{B,Na}}$
$\bar{g}_{\mathrm{B,Ca}}$	Maximum conductance for $I_{\mathrm{B,Ca}}$
m	Activation gating variable for I_{Na}
h_1, h_2	Fast and slow inactivation gating variables for I_{Na}
d_{L}	Activation gating variable for I_{CaL}
f_{L1}, f_{L2}	Fast and slow inactivation gating variables for I_{CaL}
f_{Ca}	$[\mathrm{Ca}^{2+}]_{\mathrm{d}}$-dependent ratio of fast (f_{L1}) to slow (f_{L2}) inactivation of I_{CaL}
k_{Ca}	Half-maximum Ca^{2+} binding concentration for f_{Ca}
r	Activation gating variable for I_{t}
s	Inactivation gating variable for I_{t}
s_1, s_2	Rapidly and slowly recovering inactivation gating variables for I_{t}
r_{Kur}	Activation gating variable for I_{Kur}
s_{Kur}	Inactivation gating variable for I_{Kur}
n	Activation gating variable for $I_{\mathrm{K,s}}$
p_{a}	Activation gating variable for $I_{\mathrm{K,r}}$
p_{i}	Inactivation gating variable (instantaneous) for $I_{\mathrm{K.r}}$
$\bar{m}, \bar{h}_1, \cdots$	Steady-state value of m, h_1, etc
F_1	Relative amount of “inactive precursor” in the I_{rel} formulation
F_2	Relative amount of “activator” in the I_{rel} formulation
τ_{m}	Activation time constant for I_{Na}
τ_{h_1}, τ_{h_2}	Fast and slow inactivation time constants for I_{Na}
$\tau_{d_{\mathrm{L}}}$	Activation time constant for I_{CaL}
$\tau_{f_{\mathrm{L1}}}, \tau_{f_{\mathrm{L2}}}$	Fast and slow inactivation time constants for I_{CaL}
τ_{r}	Activation time constant for I_{t}
τ_{s}	Inactivation time constant for I_{t}
$\tau_{r_{\mathrm{Kur}}}$	Activation time constant for I_{Kur}
$\tau_{s_{\mathrm{Kur}}}$	Inactivation time constant for I_{Kur}
τ_{n}	Activation time constant for $I_{\mathrm{K,s}}$
$\tau_{p_{\mathrm{a}}}$	Activation time constant for $I_{\mathrm{K,r}}$
O	Buffer occupancy
O_{C}	Fractional occupancy of the calmodulin buffer by Ca^{2+}
O_{TC}	Fractional occupancy of the troponin-Ca^{2+} buffer by Ca^{2+}
O_{TMgC}	Fractional occupancy of the troponin-Mg^{2+} buffer by Ca^{2+}
O_{TMgMg}	Fractional occupancy of the troponin-Mg^{2+} buffer by Mg^{2+}
O_{Calse}	Fractional occupancy of the calsequestrin buffer (in the sarcoplasmic reticulum release compartment) by Ca^{2+}
R	Universal gas constant
T	Absolute temperature
F	Faraday’s constant
$\mathrm{C}_{\mathrm{m,M}}$	Membrane capacitance

$I_{\mathrm{NaK\_Mfb}}$	Na^{+}-K^{+} pump current
$I_{\mathrm{B,Na\_Mfb}}$	Background Na^{+} current
$I_{\mathrm{Na\_Mfb}}$	Na^{+} current
$I_{\mathrm{MGC\_Mfb}}$	Mechano-gated current
$[\mathrm{Na}^{+}]_{\mathrm{c,Mfb}}$	Na^{+} concentration in the extracellular cleft space
$[\mathrm{K}^{+}]_{\mathrm{c,Mfb}}$	K^{+} concentration in the extracellular cleft space
$[\mathrm{Na}^{+}]_{\mathrm{i,Mfb}}$	Na^{+} concentration in the intracellular medium
$[\mathrm{K}^{+}]_{\mathrm{i,Mfb}}$	K^{+} concentration in the intracellular medium
$E_{\mathrm{Na,Mfb}}$	Equilibrium (Nernst) potential for Na^{+}
$E_{\mathrm{K,Mfb}}$	Equilibrium (Nernst) potential for K^{+}
$E_{\mathrm{MGC,Mfb}}$	Equilibrium (Nernst) potential for ion through mechano-gate channels
$\bar{g}_{\mathrm{Kv,Mfb}}$	Maximum conductance for $I_{\mathrm{Kv\_Mfb}}$
$\bar{g}_{\mathrm{K1,Mfb}}$	Maximum conductance for $I_{\mathrm{K1\_Mfb}}$
$\bar{g}_{\mathrm{B,Na,Mfb}}$	Maximum conductance for $I_{\mathrm{b,Na\_Mfb}}$
$\bar{g}_{\mathrm{Na,Mfb}}$	Maximum conductance for $I_{\mathrm{Na\_Mfb}}$
$\bar{g}_{\mathrm{MGC,Mfb}}$	Maximum conductance for $I_{\mathrm{MGC\_Mfb}}$
r_{Kv}	Activation gating variable for $I_{\mathrm{Kv\_Mfb}}$
S_{Kv}	Inactivation gating variable for $I_{\mathrm{Kv\ Mfb}}$
$\tau_{r_{\mathrm{Kv}}}$	Activation time constant for $I_{\mathrm{Kv\_Mfb}}$
$\tau_{s_{\mathrm{Kv}}}$	Inactivation time constant for $I_{\mathrm{Kv\_Mfb}}$
$\alpha_{\mathrm{K1}}, \beta_{\mathrm{K1}}$	Fractional open probability of the $I_{\mathrm{K1\_Mfb}}$ channel
$\bar{I}_{\mathrm{NaK,max}}$	Maximum Na^{+}-K^{+} pump current
k_{mK}	Half-maximum K^{+} binding concentration for I_{NaK}
k_{mNa}	Half-maximum Na^{+} binding concentration for I_{NaK}
m_{Mfb}	Activation gating variable for $I_{\mathrm{Na\_Mfb}}$
j_{Mfb}	Inactivation gating variable for $I_{\mathrm{Na\ Mfb}}$
$\tau_{m_{\mathrm{Mfb}}}$	Activation time constant for $I_{\mathrm{Na\_Mfb}}$
$\tau_{j_{\mathrm{Mfb}}}$	Inactivation time constant for $I_{\mathrm{Na\_Mfb}}$
$\alpha_{m_{\mathrm{Mfb}}}, \alpha_{j_{\mathrm{Mfb}}}, \beta_{m_{\mathrm{Mfb}}}, \beta_{j_{\mathrm{Mfb}}}$	Extrapolated rate coefficients
$E_{\mathrm{Na,Mfb}}$	Equilibrium (Nernst) potential for Na^{+}
$E_{\mathrm{K.Mfb}}$	Equilibrium (Nernst) potential for K^{+}
$E_{\mathrm{MGC,Mfb}}$	Equilibrium (Nernst) potential for ion through mechano-gate channels
$\bar{r}_{Kv}, \bar{s}_{Kv}, \cdots$	Steady-state value of r_{Kv}, s_{Kv}, etc
$\mathrm{C}_{\mathrm{m,Mfb}}$	Membrane capacitance
V_{Mfb}	Membrane voltage

Mfb-M coupling

G_{gap}	Gap junctional conductance between Mfb and myocyte
n	Number of Mfbs per myocyte
I_{M}	Net membrane current of the myocyte
I_{Mfb}	Net membrane current of the Mfb

V_M	Membrane voltage
Vol_c	Volume of the extracellular cleft space

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