S1 Text: Neurone Model

The core of the neuronal model utilised in the work consists of the biophysical Hodgkin and Huxley (HH) type model. All parameter values for the model can be found in supplementary material S2 Table.

Membrane voltage

The membrane potential of the neuron is described by:

$$C_m \frac{dV_{Neu}}{dt} = -g_{NaNeu} m^3 h (V_{Neu} - E_{NaNeu}) - g_{KNeu} n^4 (V_{Neu} - E_{KNeu}) - g_{LNeu} (V_{Neu} - E_{LNeu}) \quad (1)$$

Where C_m is the membrane capacitance, g_{NaNeu} is the Na^+ channel conductance, g_{KNeu} is the K^+ channel conductance, g_{LNeu} is the leak channel conductance, V_{Neu} is the neuron membrane voltage with an initial condition of -0.01 volts, E_{NaNeu}, E_{KNeu} and E_{LNeu} are the Na^+ channel, K^+ channel and Leak channel reversal potential respectively and m, n and h are channel gating variables.

The Na^+ activation variable is given by:

$$\frac{dm}{dt} = \alpha_m (1 - m) - \beta_m m \quad (2)$$

where

$$\alpha_m = 0.1 \frac{V_{Neu} + 40}{1 - \exp\left(-\left(\frac{V_{Neu} + 40}{10}\right)\right)} \quad (3)$$

and

$$\beta_m = 4 \exp\left(-\left(\frac{V_{Neu} + 65}{18}\right)\right) \quad (4)$$

The Na^+ inactivation variable is given by:

$$\frac{dh}{dt} = \alpha_{mh} (1 - h) - \beta_h h \quad (5)$$

where

$$\alpha_h = 0.07\exp\left(-\left(\frac{V_{Neu}+65}{20}\right)\right) \quad (6)$$

and

$$\beta_h = 0.1\frac{1}{\exp\left(-\left(\frac{V_{Neu}+35}{10}\right)\right)+1} \quad (7)$$

The K^+ activation variable is given by

$$\frac{dn}{dt} = \alpha_n(1-n) - \beta_n n \quad (8)$$

where

$$\alpha_n = 0.01\frac{V_{Neu}+55}{1-\exp\left(-\left(\frac{V_{Neu}+55}{10}\right)\right)} \quad (9)$$

and

$$\beta_n = 0.125\exp\left(-\left(\frac{V_{Neu}+65}{80}\right)\right) \quad (10)$$

Neuron Potassium Channel (K_{Neu})

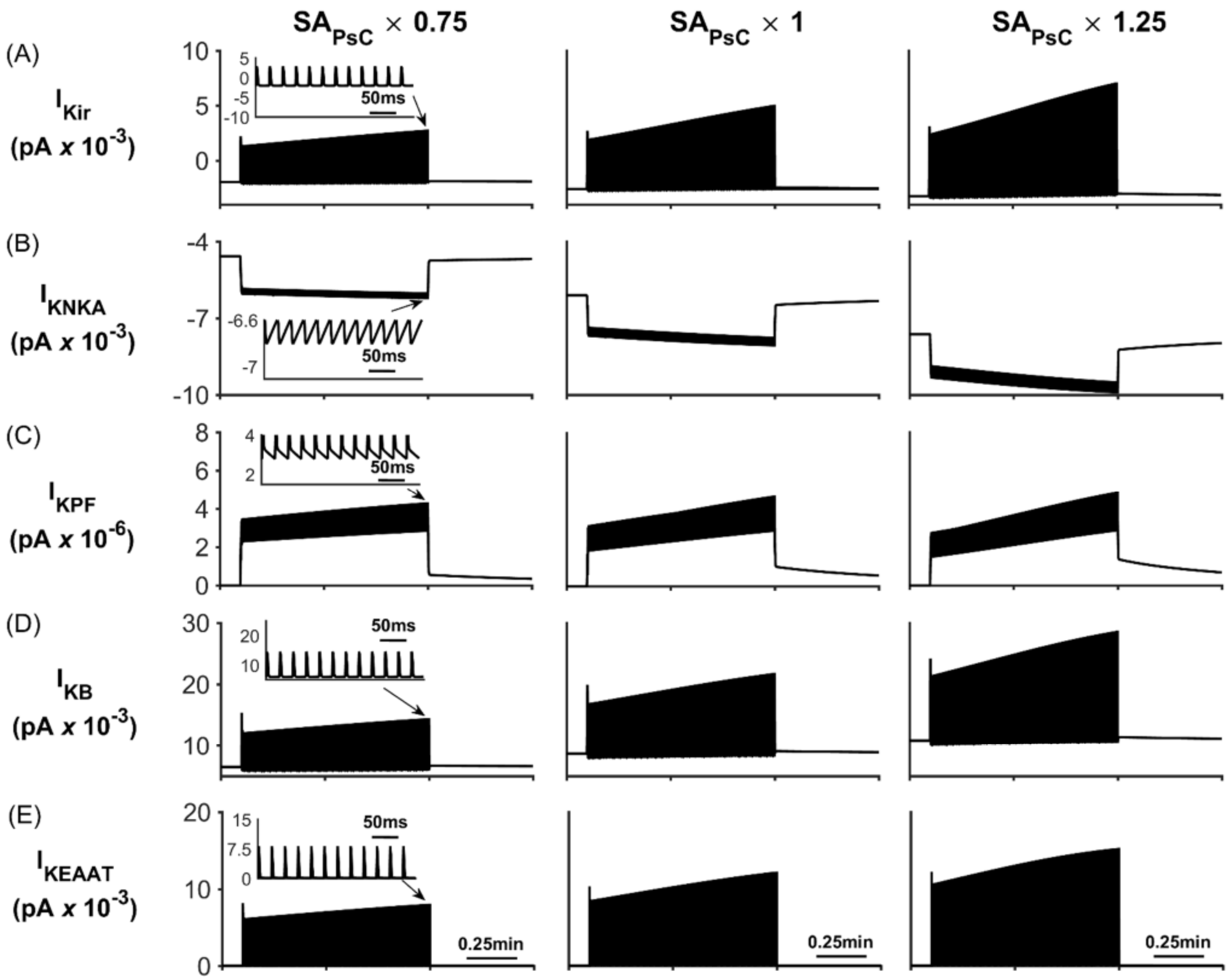
The HH model simulates current flow of K^+ through a voltage gated channel, therefore the current flow of K^+ from the neuron can be modelled as:

$$I_{KNeu} = -g_{KNeu}n^4(V_{Neu} - E_{KNeu})SA_{Syn} \quad (11)$$

where SA_{syn} is the surface area of the synapse.

S1 Table: Neurone Parameters

Parameter	Value	Units	Description
g_{KNeu}	360	S/m^2	Maximum K^+ channel conductance
g_{NaNeu}	1200	S/m^2	Maximum Na^+ channel conductance
g_{LNeu}	3	S/m^2	Maximum leak channel conductance
E_{KNeu}	-0.12	V	K^+ channel reversal potential
E_{NaNeu}	0.115	V	Na^+ channel reversal potential
E_{LNeu}	0.010613	V	Leak channel reversal potential
C_m	0.01	F/m^2	Membrane capacitance



S1 Fig. Sensitivity to PsC surface area, Perisynaptic K^+ currents. (A) K^+ K_{ir} current. (B) K^+ NKA current. (C) K^+ current along the process. (D) Background K^+ current. (E) K^+ EAAT current.