version1pt1

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1 Envy-You Version 1.1

This most recent version 1.1 of the envy-you code is based on the previous version envy-you 1.0 the main changes being:

1.1 Implemented astrocyte equations

The calcium concentration in the cytosol, c_k: J_{IP_3}

$$\frac{dc_k}{dt} = B_{\mathrm{cyt}}(J_{\mathrm{IP}_3} - J_{\mathrm{pump}} + J_{\mathrm{ER_leak}}) \tag{1}$$

The calcium concentration in the endoplasmatic reticulum (ER) s_k:

$$\frac{ds_k}{dt} = \frac{1}{VR_{\mathrm{ER_{cyt}}}}(\frac{dc_k}{dt}) \tag{2}$$

Here J_{IP_3} describes the calcium flux from the ER to the cytosol,

$$J_{\mathrm{IP}_3} = J_{\max}[(\frac{i_k}{i_k + K_i})(\frac{c_k}{c_k + K_{\mathrm{act}}})h_k]^3 \times [1 - \frac{c_k}{s_k}] \tag{3}$$

$J_{\mathrm{ER_leak}}$ describes the leakage flux from the ER to the cytosol

$$J_{\mathrm{ER_leak}} = P_L(1 - \frac{c_k}{s_k}) \tag{4}$$

and J_{pump} describes the ATP dependent pump flux from the cytoplasm to the ER

$$J_{\mathrm{pump}} = V_{\max}\frac{c_k^2}{c_k^2 + k_pump^2} \tag{5}$$

The inactivation variable of the IP_3 receptors, h_k, is modelled as being dynamic accroding to

$$\frac{dh_k}{dt} = k_{\mathrm{on}}[K_{\mathrm{inh}} - (c_k + K_{\mathrm{inh}})h_k] \tag{6}$$

The IP_3 concentration is calculated by

$$\frac{di_k}{dt} = r_h G - k_{\deg} i_k \tag{7}$$

with G being the ratio of active to total G-protein.

$$G = \frac{\rho + \delta}{K_G + \rho + \delta} \tag{8}$$

Here ρ is the ratio of bound to total glutamate receptors, and is described by a smooth pulse function with a baseline of 0.1 and amplitude 0.7