SBML Model Report

Model name: "Golomb2006-_SomaticBursting_nonzero[Ca]"

May 6, 2016

1 General Overview

This is a document in SBML Level 2 Version 1 format. This model was created by Enuo He[1] at June sixth 2007 at 2:28 p. m. and last time modified at July fifth 2012 at 2:38 p. m. Table 1 provides an overview of the quantities of all components of this model.

Table 1: Number of components in this model, which are described in the following sections.

Element	Quantity	Element	Quantity
compartment types	0	compartments	1
species types	0	species	1
events	0	constraints	0
reactions	1	function definitions	2
global parameters	69	unit definitions	2
rules	20	initial assignments	0

Model Notes

Model is according to the paper *Contribution of Persistent Na+ Current and M-Type K+ Current to Somatic Bursting in CA1 Pyramidal Cell: Combined Experimental.* This is the second model from this paper for the non-zero [Ca2+] initial value, parameters and the kinetics quations from Table2 in the paper. Figure9Aa has been reproduced by MathSBML. The original model from ModelDB. http://senselab.med.yale.edu/modeldb/

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To cite BioModels Database, please use: Li C, Donizelli M, Rodriguez N, Dharuri H, Endler L, Chelliah V, Li L, He E, Henry A, Stefan MI, Snoep JL, Hucka M, Le Novre N, Laibe C (2010) BioModels Database: An enhanced, curated and annotated resource for published quantitative kinetic models. BMC Syst Biol., 4:92.

2 Unit Definitions

This is an overview of six unit definitions of which four are predefined by SBML and not mentioned in the model.

2.1 Unit `time`

Name ms

Definition ms

2.2 Unit `mV`

Definition mV

2.3 Unit `substance`

Notes Mole is the predefined SBML unit for `substance`.

Definition mol

2.4 Unit `volume`

Notes Litre is the predefined SBML unit for `volume`.

Definition l

2.5 Unit `area`

Notes Square metre is the predefined SBML unit for `area` since SBML Level 2 Version 1.

Definition m^2

2.6 Unit length

Notes Metre is the predefined SBML unit for length since SBML Level 2 Version 1.

Definition m

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
compartment_0000001			3	1	litre	☑	

3.1 Compartment compartment_0000001

This is a three dimensional compartment with a constant size of one litre.

4 Species

This model contains one species. Section 9 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
Ca		compartment_0000001	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟

5 Parameters

This model contains 69 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
Cm			1.000		☑
pms			3.000		☑
pns			4.000		☑
VNa			55.000		☑
t_tauh			−40.500		☑
t_taun			−27.000		☑
thetaa			−50.000		☑
sigmaa			20.000		☑
thetab			−80.000		☑
sigmab			−6.000		☑
tauBs			15.000		☑
sigmam			9.500		☑
sigmah			−7.000		☑
sigman			10.000		☑
sigmaz			5.000		☑
gNa			35.000		☑
gKdr			6.000		☑
gL			0.050		☑
Iapp			1.000		☑
gA			1.400		☑
gNaP			0.200		☑
gZ			1.000		☑
thetaz			−39.000		☑
tauZs			75.000		☑
phi			10.000		☑
thetah			−45.000		☑
thetam			−30.000		☑
thetan			−35.000		☑
thetap			−41.000		☑
sigmap			3.000		☑
VK			−90.000		☑
VL			−70.000		☑
INa			0.000		⊟
INaP			0.000		⊟
IKdr			0.000		⊟
IA			0.000		⊟
Iz			0.000		⊟

Id	Name	SBO	Value	Unit	Constant
Minfs			0.000		☐
Pinfs			0.000		☐
Ainfs			0.000		☐
zzs			0.001		☐
bbs			0.208		☐
nns			0.024		☐
hhs			0.979		☐
V	VVs		−71.962		☐
rrs			0.006		☐
ccs			0.002		☐
qqs			0.000		☐
thetar			−20.000		☑
VCa			120.000		☑
sigmar			10.000		☑
sigmac			7.000		☑
thetac			−30.000		☑
pwrc			1.000		☑
pwrq			4.000		☑
gCa			0.080		☑
gKCa			10.000		☑
gKAHP			5.000		☑
tauRs			1.000		☑
aq			2.000		☑
ac			6.000		☑
tauq			450.000		☑
tauCa			13.000		☑
uuCa			0.130		☑
tauKc			2.000		☑
mKCa			0.000		☐
ICa			0.000		☐
IAHP			0.000		☐
IKC			0.000		☐

6 Function definitions

This is an overview of two function definitions.

6.1 Function definition GAMMAF

Arguments VV, theta, sigma

Mathematical Expression

$$\frac{1}{1+\exp\left(\frac{(\mathrm{VV}-\mathrm{theta})}{\mathrm{sigma}}\right)} \tag{1}$$

6.2 Function definition ZFUNC

Arguments AA, CA, zz

Mathematical Expression

$$\frac{1}{1+\frac{\mathrm{AA}^{zz}}{\mathrm{CA}^{zz}}} \tag{2}$$

7 Rules

This is an overview of 20 rules.

7.1 Rule Minfs

Rule Minfs is an assignment rule for parameter Minfs:

$$\mathrm{Minfs} = \mathrm{GAMMAF}(\mathrm{V}, \mathrm{thetam}, \mathrm{sigmam}) \tag{3}$$

7.2 Rule Pinfs

Rule Pinfs is an assignment rule for parameter Pinfs:

$$\mathrm{Pinfs} = \mathrm{GAMMAF}(\mathrm{V}, \mathrm{thetap}, \mathrm{sigmap}) \tag{4}$$

7.3 Rule Ainfs

Rule Ainfs is an assignment rule for parameter Ainfs:

$$\mathrm{Ainfs} = \mathrm{GAMMAF}(\mathrm{V}, \mathrm{thetaa}, \mathrm{sigmaa}) \tag{5}$$

7.4 Rule IA

Rule IA is an assignment rule for parameter IA:

$$\mathrm{IA} = \mathrm{gA} \cdot \mathrm{Ainfs}^3 \cdot \mathrm{bbs} \cdot (\mathrm{V} - \mathrm{VK}) \tag{6}$$

7.5 Rule Iz

Rule Iz is an assignment rule for parameter Iz:

$$\mathrm{Iz} = \mathrm{gZ} \cdot \mathrm{zzs} \cdot (\mathrm{V} - \mathrm{VK}) \tag{7}$$

7.6 Rule INa

Rule INa is an assignment rule for parameter INa:

$$\mathrm{INa} = \mathrm{gNa} \cdot \mathrm{Minfs}^{\mathrm{pms}} \cdot \mathrm{hhs} \cdot (\mathrm{V} - \mathrm{VNa}) \tag{8}$$

7.7 Rule INaP

Rule INaP is an assignment rule for parameter INaP:

$$\mathrm{INaP} = \mathrm{gNaP} \cdot \mathrm{Pinfs} \cdot (\mathrm{V} - \mathrm{VNa}) \tag{9}$$

7.8 Rule IKdr

Rule IKdr is an assignment rule for parameter IKdr:

$$\mathrm{IKdr} = \mathrm{gKdr} \cdot \mathrm{nns}^{\mathrm{pns}} \cdot (\mathrm{V} - \mathrm{VK}) \tag{10}$$

7.9 Rule zzs

Rule zzs is a rate rule for parameter zzs:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{zzs} = \frac{\mathrm{GAMMAF}(\mathrm{V}, \mathrm{thetaz}, \mathrm{sigmaz}) - \mathrm{zzs}}{\mathrm{tauZs}} \tag{11}$$

7.10 Rule bbs

Rule bbs is a rate rule for parameter bbs:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{bbs} = \frac{\mathrm{GAMMAF}(\mathrm{V}, \mathrm{thetab}, \mathrm{sigmab}) - \mathrm{bbs}}{\mathrm{tauBs}} \tag{12}$$

7.11 Rule hhs

Rule hhs is a rate rule for parameter hhs:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{hhs} = \frac{\mathrm{phi} \cdot (\mathrm{GAMMAF}(\mathrm{V}, \mathrm{thetah}, \mathrm{sigmah}) - \mathrm{hhs})}{1 + 7.5 \cdot \mathrm{GAMMAF}(\mathrm{V}, \mathrm{t\_tauh}, -6)} \tag{13}$$

7.12 Rule nns

Rule nns is a rate rule for parameter nns:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{nns} = \frac{\mathrm{phi} \cdot (\mathrm{GAMMAF}(\mathrm{V}, \mathrm{thetan}, \mathrm{sigman}) - \mathrm{nns})}{1 + 5 \cdot \mathrm{GAMMAF}(\mathrm{V}, \mathrm{t\_taun}, -15)} \tag{14}$$

7.13 Rule mKCa

Rule mKCa is an assignment rule for parameter mKCa:

$$\mathrm{mKCa} = \mathrm{ZFUNC}(\mathrm{ac}, [\mathrm{Ca}], \mathrm{pwrc}) \tag{15}$$

7.14 Rule ICa

Rule ICa is an assignment rule for parameter ICa:

$$\mathrm{ICa} = \mathrm{gCa} \cdot \mathrm{rrs}^2 \cdot (\mathrm{V} - \mathrm{VCa}) \tag{16}$$

7.15 Rule IKC

Rule IKC is an assignment rule for parameter IKC:

$$\mathrm{IKC} = \mathrm{gKCa} \cdot \mathrm{mKCa} \cdot \mathrm{ccs} \cdot (\mathrm{V} - \mathrm{VK}) \tag{17}$$

7.16 Rule IAHP

Rule IAHP is an assignment rule for parameter IAHP:

$$\mathrm{IAHP} = \mathrm{gKAHP} \cdot \mathrm{qqs} \cdot (\mathrm{V} - \mathrm{VK}) \tag{18}$$

7.17 Rule rrs

Rule rrs is a rate rule for parameter rrs:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{rrs} = \frac{\mathrm{GAMMAF}(\mathrm{V}, \mathrm{thetar}, \mathrm{sigmar}) - \mathrm{rrs}}{\mathrm{tauRs}} \tag{19}$$

7.18 Rule ccs

Rule ccs is a rate rule for parameter ccs:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ccs} = \frac{\mathrm{GAMMAF}(\mathrm{V}, \mathrm{thetac}, \mathrm{sigmac}) - \mathrm{ccs}}{\mathrm{tauKc}} \tag{20}$$

7.19 Rule qqs

Rule qqs is a rate rule for parameter qqs:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{qqs} = \frac{\mathrm{ZFUNC}(\mathrm{aq}, [\mathrm{Ca}], \mathrm{pwrq}) - \mathrm{qqs}}{\mathrm{tauq}} \tag{21}$$

7.20 Rule V

Rule V is a rate rule for parameter V:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{V} = \frac{\mathrm{gL} \cdot (\mathrm{V} - \mathrm{VL}) - \mathrm{INa} - \mathrm{INaP} - \mathrm{IKdr} - \mathrm{IA} - \mathrm{Iz} - \mathrm{ICa} - \mathrm{IKC} - \mathrm{IAHP} + \mathrm{Iapp}}{\mathrm{Cm}} \tag{22}$$

8 Reaction

This model contains one reaction. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 5: Overview of all reactions

№	Id	Name	Reaction Equation	SBO
1	reaction_0000001		$\emptyset \longrightarrow$ Ca	

8.1 Reaction reaction_0000001

This is an irreversible reaction of no reactant forming one product.

Reaction equation

$$\emptyset \longrightarrow \mathrm{Ca} \tag{23}$$

Product

Table 6: Properties of each product.

Id	Name	SBO
Ca		

Kinetic Law

Derived unit contains undeclared units

$$v_1 = \frac{\mathrm{vol}\left(\mathrm{compartment\_0000001}\right) \cdot \left(\mathrm{uuCa} \cdot \mathrm{ICa} - [\mathrm{Ca}]\right)}{\mathrm{tauCa}} \tag{24}$$

9 Derived Rate Equation

When interpreted as an ordinary differential equation framework, this model implies the following equation for the rate of change of the following species.

Identifiers for kinetic laws highlighted in gray cannot be verified to evaluate to units of SBML `substance` per `time`. As a result, some SBML interpreters may not be able to verify the consistency of the units on quantities in the model. Please check if

- parameters without an unit definition are involved or
- volume correction is necessary because the `hasOnlySubstanceUnits` flag may be set to `false` and `spacialDimensions`> 0 for certain species.

9.1 Species Ca

Initial concentration $7.87 \cdot 10^{-4}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in one reaction (as a product in reaction_0000001).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Ca} = v_1 \tag{25}$$

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