# **Equations and parameters**

The model neuron is described by two differential equations, the membrane potential (*V*) and the fraction of activated delayed rectifier K+ channels (*n*):

|  |  |
| --- | --- |
|  | (1) |
|  |  |
|  | (2) |
|  |  |
|  | (3) |
|  |  |
|  | (4) |

The neuron diversity activity is established in the population by randomly choosing the applied current parameter, *Iapp*, from a uniform distribution over the range -10 to 5

The Na+ current is simplified and assumes instantaneous activation as in Rinzel (1985):

|  |  |
| --- | --- |
|  | (5) |

The K+ and leakage currents are, respectively:

|  |  |
| --- | --- |
|  | (6) |
|  |  |
|  | (7) |

A subgroup of the *N* neurons in the population are inhibitory (*Ni* neurons), while the remainder are excitatory (*Ne* neurons). The synaptic currents have the form

|  |  |
| --- | --- |
|  | (8) |
|  |  |
|  | (9) |

where the excitatory and inhibitory synaptic conductances are:

|  |  |
| --- | --- |
|  | (10) |
|  |  |
|  | (11) |

The maximum strength of any one synapse is . The sums are over all neurons except for the postsynaptic neuron itself (shown by the subtraction term ). Both synaptic conductances terms drive the voltage of the actual neuron (Equation 1).

For each of N neurons, the neuron activity and efficacy are described by:

|  |  |
| --- | --- |
|  | (12) |
|  |  |
|  | (13) |

The function reflects synaptic release when the presynaptic voltage depolarizes above during an action potential. The average network activity and synaptic efficacy are and , respectively.

Network model parameters are shown in Table 1.

Table 1 Parameters of the network model using Hodgkin-Huxley-type neurons

|  |  |  |
| --- | --- | --- |
| Parameter | Description | Value |
| *gl* | Leak conductance | 0.1 S/cm2 |
| *Vl* | Leak reversal potential | -10.6 mV |
| *gNa* | Sodium conductance | 36 mS/cm2 |
| *VNa* | Sodium reversal potential | 115 mV |
| *gk* | Potassium conductance | 12 mS/cm2 |
| *Vk* | Potassium reversal potential | -12 mV |
|  | Max. synaptic conductance | 3.6 mS/cm2 |
| *Vexc* | Excitatory reversal potential | 70 mV |
| *Vinh* | Inhibitory reversal potential | 70 to -12 mV |
| *Iapp* | Input or applied current | -10 to 5 μA/cm2 |
| *αa* | Synaptic activation rate | 1 ms-1 |
| *βa* | Synaptic decay rate | 0.1 ms-1 |
| *αs* | Synaptic recovery rate | 0.0015 ms-1 |
| *βs* | Synaptic depression rate | 0.12 ms-1 |
| *Vth* | Threshold for activation/depression | 40 mV |