**General form of the model**

We simulated layer 4 (L4) using a network of integrate-and-fire neurons, constructed based on measured anatomy and physiological parameters. The L4 network consists of excitatory, regular-spiking spiny-stellate neurons (ss) and inhibitory, fast-spiking neurons (fs). Here we ignore the so-called low-threshold neurons (ls).

For one neuron, the equation governing the membrane potential dynamics, *V*, are:

 (1)

*τm* is the membrane time constant in the absence of synaptic input. *cm* is the specific membrane capacitance (~ 1 μF / cm2 for all neurons). *EL* is the resting potential of the cell, *ESk* is the reversal potential of the *k*th synaptic conductance, of strength *gs,k*.

For all conductances, including glutamatergic and GABAergic, but excepting NMDA-Rs, we model synaptic dynamics as



Immediately after an action potential we make the replacement:



In other words, synaptic conductances increase instantaneously and decay exponentially.

For NMDA-Rs we use the form



where

.

*τ*r and *τ*f are the rise times and fall times of the NMDA-R conductance, respectively.

**Estimating synaptic conductances**

Equation 1 can also be rewritten as:

 (2)

In this more commonly used parametrization the conductance is expressed in units of specific capacitance (μF / cm2).

We estimate unitary conductance from measurements of psps. A conductance change after a spike at time *t* = 0 can be written as:



We assume small psps, so that



where the driving force is



From Equation 2 (assuming V measured from rest)



This gives



This gives the shape of the psp. The psps amplitude is the extreme value of the psps.



Let



This factor is on the order of 1. We then obtain



In other words, the synaptic conductance can be parametrized using this equation by measuring psp amplitude (*Vex*).

**Parameters of the model**

Parameters of the model were assembled across half a dozen brain slice studies in mouse and rat.

Cell counts:

L4 spiny stellate (ss) cells – 1600 ([Lefort et al., 2009](#_ENREF_4));

L4 fast spiking (fs) neurons – 100 (140 GABAergic neurons) ([Lefort et al., 2009](#_ENREF_4));

VPM neurons - 200

Intrinsic parameters:

L4 ss cells; resting potential, -66 mV; action potential threshold, -40 mV; membrane time constant (without synaptic input), 20 ms([Beierlein et al., 2003](#_ENREF_1)).

L4 fs cells; resting potential, -64 mV; action potential threshold, -40 mV; membrane time constant (without synaptic input), 10 ms ([Beierlein et al., 2003](#_ENREF_1)).

Synaptic parameters:

VPM 🡪 ss; connection probability, 0.5 ([Bruno and Sakmann, 2006](#_ENREF_2)); synaptic conductance, 0.04 μF/cm2; decay time, 3 ms; ([Beierlein et al., 2003](#_ENREF_1); [Cruikshank et al., 2007](#_ENREF_3))

VPM 🡪 fs; connection probability, 0.75; synaptic conductance, 0.10 μF/cm2; decay time, 3 ms ([Cruikshank et al., 2007](#_ENREF_3));

ss 🡪 ss; connection probability, 0.25; synaptic conductance, 0. 02 μF/cm2; decay time, 3 ms ([Beierlein et al., 2003](#_ENREF_1); [Lefort et al., 2009](#_ENREF_4));

ss 🡪 fs; connection probability, 0.5; synaptic conductance, 0.05 μF/cm2; decay time, 3 ms ([Beierlein et al., 2003](#_ENREF_1));

fs 🡪 ss; connection probability, 0.5; synaptic conductance, 0.06 μF/cm2; decay time, 3 ms ([Beierlein et al., 2003](#_ENREF_1); [Ma et al., 2012](#_ENREF_5));

fs 🡪 fs; connection probability, 0.5; synaptic conductance, 0.12 μF/cm2; decay time, 3 ms ([Ma et al., 2012](#_ENREF_5));

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