SI Text

Appendix 1. Modeling L4-to-L2/3 synaptic connection

The synaptic current was simulated as

$$I_{syn} = g_{syn}(t,V) * (V - E_{syn}) \ , \qquad [\mathbf{1}]$$

where $g_{syn}(t,V)$ is the synaptic conductance change, and E_{syn} is the reversal potential for the synaptic current.

The conductance change for both the AMPA and NMDA components is modeled as

$$g_{syn}(t,V) = B * g_{\max} * N * \left(\exp\left(-t/\tau_2\right) - \exp\left(-t/\tau_1\right)\right) , \qquad [\mathbf{2}]$$

where $g_{\max}$ is the peak conductance, and N is a normalization factor given by

$$N = \frac{1}{\exp(-t_{peak}/\tau_2) - \exp(-t_{peak}/\tau_1)} \qquad [\mathbf{3}]$$

So that when $t = t_{peak}$, $g_{syn} = g_{max}$

t_{peak} (the time to peak of the synaptic conductance) is

$$t_{peak} = \frac{\tau_1 * \tau_2}{\tau_2 - \tau_1} * \log\frac{\tau_2}{\tau_1} \ , \qquad [\mathbf{4}]$$

for the AMPA component, B = 1, whereas for the NMDA component

$$B = \frac{1}{\left(1 + \exp 0.00062/mV * (-V)\right) * \left([Mg^{+2}]/3.57(mM)\right)} \ , \qquad [\mathbf{5}]$$

where [Mg^{2+}] is extracellular concentration of Mg^{2+} ions and was taken to be 1 mM (1, 2).

Appendix 2. Nonlinear properties of L2/3 modeled neurons

The Hodgkin and Huxley (3) formalism was used for describing the voltage-gated channels.

For the Ca^{2+}-dependent potassium channel, the change in intracellular calcium concentration $[Ca^{2+}]_i$ was modeled as

$$\frac{d[Ca^{2+}]}{dt} = \frac{I_{Ca}}{\tau_a} - \frac{[Ca^{2+}]}{\tau_b} , \qquad [\mathbf{1}]$$

where τ_a is the time constant for calcium buffering [τ_a = 21 in units of 1/(mM/ms/mA)], I_{Ca} is L-type calcium current, and τ_b is the time constant (τ_b = 107 ms) of Ca^{2+} diffusion.

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2. Zador A, Koch C, Brown TH (1990) *Proc Natl Acad Sci USA* 87:6718-22.

3. Hodgkin AL, Huxley AF (1952) *J Physiol* 117:500-44.