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NeuroNet: Linking Model Parameters to Experimental Quantities

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1 Neuron Types

- Excitatory (glutamatergic)
  - **p2/3** Pyramidal neurons in L2/3
  - **ss4(L4)** Spiny stellate neurons in L4 that project to L4
  - **SS4(L2/3)** Spiny stellate neurons in L4 that project to L2/3
  - **p4** Pyramidal neurons in L4
  - **p5(L2/3)** Pyramidal neurons in L5 that project to L2/3
  - **p5(L5/6)** Pyramidal neurons in L5 that project to L5/6
  - **p6(L4)** Pyramidal neurons in L6 that project to L4
  - **p6(L5/6)** Pyramidal neurons in L6 that project to L5/6
- Inhibitory (GABAergic)
  - **b** Basket interneuron, all layers
  - **nb** Non-basket interneuron, all layers

2 Types of Synapses

- Local excitatory
- Local inhibitory
- Global cortical
- Cortico-thalamic
- Thalamo-cortical
- Sensory input
- Brainstem Modulation
- Gap junction

3 Individual Neuron Dynamics

$$C\dot{v} = k(v - v_r)(v - v_t) - u + I \tag{1}$$

$$\dot{u} = a\{b(v - v_r) - u\} \tag{2}$$

- C - Membrane Capacitance
- v - Membrane potential (in mV)
- v_r - Resting potential
- v_t - instantaneous threshold
- u - Recovery variable (The different of all inward and outward voltage-gated currents)
- I - Dendritic and synaptic current in (pA)

$$I(t) = -I_{dendr} - I_{syn}$$

4 Short-term Synaptic Plasticity

$$\dot{x} = (1 - x)/\tau_x \quad \text{If presynaptic spike, then } x \leftarrow px. \tag{3}$$

- x - Scaler factor for synapse strength
- τ_x - Time constant with which x recovers back to 1.
- p - The parameter p ? 1 decreases x and results in short-termsynaptic depression, whereas p?1 results in short-term synaptic facilitation.

5 Long-term change in Synaptic Weight

6 Axonal Conductance Delay

Following are for corticocortical connections:

- Myelinated fibers: 1 m/s
- Non-myelinated fibers: 0.1 m/s

References