**Appendix S1-1. Growth model parameters.**

Besides the parameters given above, in methods (time step 1 day, number of somas 10000-50000, density 2000/mm2, culture radius 1.1-2.5 mm, lattice dimensions: 85000-430000 cells/edge 20 μm , soma radius 6.25 μm) , the following parameters were adopted/used from [13] and [20]..

Angular branching bounds [amin, amax] = -45; +45 degrees.

Ecitatory neurons (see [13], pages 202-204):

* Axonal growth parameters were F= 0.16 and ν0 = 45 μm/day. B∞=17.38, E=0.39; S=0; τ = 14 days (F is the competition strength parameter, ν0 the initial elongation rate, B∞ the asymptotic value of the time integral of branching rate function D(t), E the compettion parameter in branching, S the order dependency in branching and τ the time constant in the exponential function D(t) ).
* Dendritic growth parameters: F=0.39 and ν0 = 12 μm/day. B∞= 4.75, E=0.5; S=0; τ = 3.7 days.

Inhibitory neurons (see [20]):

* Axons: F= 0.16 and ν0 = 40 μm/day. B∞=17.38, E=0.39; S=0; τ = 14 days.
* Dendrites: F= 0.74 and ν0 = 8 μm/day. B∞=1.124, E=0.05; S=0; τ = 3.7 days.

**Appendix S1-2a Activity model parameters** *(see also [26])****.***

The neuronal model equation Izhikevich, [31] has the following form:

 (1)

with the auxiliary after-spike resetting

if *v* ≥ +30mV, then

*in which*

*v is the* membrane potential of the neuron;

*u is the* membrane recovery variable;

*a* describes the time scale of the recovery variable *u*;

*c* and *d* account for action of high-threshold voltage-gated currents activated during the spike.

This spiking model mimics the behavior of several types of cortical neurons. Excitatory neurons exhibited regular spiking (RS), intrinsically bursting(IB) and chattering (CH) behavior; and inhibitory neurons exhibited fast spiking (FS) and low-threshold spiking (LTS) dynamics. These dynamics correspond to the following settings: (*ai; bi*) = (0.02; 0.2); (*ci; di*) = (-65; 8) + (15;-6)*ri* ; and (*ai; bi*) = (0.02; 0.25) +(0.08;-0.05)*ri* (*ci; di*) = (-65; 2) were assigned to constants of excitatory and inhibitory neurons respectively, where *ri* is a random variable normally distributed on the interval [0,1], and *i* is the neuron index. This choice of *a, b, c* and *d* corresponds to a biologically plausible range, see Izhikevich, [31]. We modeled the intrinsic activation feature in ‘pacemaker’ neurons by setting b to values around 0.26.

**Appendix S1-2b Synapse model and parameters.**

In this simulation model we used dynamic (adapting) synapses. Thus, the synaptic weight range was allowed to vary according to the well known STP model of Gupta and Markram [32,33], which mimics short-term facilitation and depression between heterogeneous (excitatory (E) <->inhibitory (I) ) and homogeneous (E-E or I-I) synapses respectively

The dynamics of synapses over time are defined by

 (2)

where *I* is the synaptic current, which decays exponentially with time constant τ*syn* , except when a spike occurs in the pre-synaptic neuron at time *tsp*. The time constant τ*syn* ranged from 3 to 15 ms throughout different synapses.

Synapse adaptation dynamicswere modeled via the following set of equations:

 (3)

where the notation *wk* denotes one synaptic weight from W for the *k-th* spike, *y* is the running variable for synaptic utilization and Bis the running variable for synaptic availability, with *y* and B*=* [0, 1]. The constants *U*, ∆and F represent the release probability for the first spike, the depression time constant and facilitation time constant, respectively. We used experimental data for U, ∆ and F parameters from [32,33] for all four synapse types, see table 1 below. Authors have shown that these settings lead to biologically plausible synapse models.

*Table 1 E: excitatory, I: inhibitory*

|  |  |  |  |
| --- | --- | --- | --- |
|  | U | ∆ (sec) | F (sec) |
| EE | 0.59 | 0.813 | 0 |
| EI | 0.049 | 0.399 | 1.797 |
| IE | 0.16 | 0.045 | 0.376 |
| II | 0.25 | 0.706 | 0.021 |