|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value | Units | Description |
| N | 100 | - | Number of neurons per population |
| dt | 1 | ms | Integration time step |
| T | 50 | ms | Stimulus pulse duration |
| τstim | 50 | ms | Decay constant of stimulus |
| τw | 40 | ms | Time window for firing rate integration |
| pr | 30 | Hz | Rate of Poisson stimulus pulse |
|  | Ɲ (0,100) |  | Gaussian white noise at membrane |
| ρ | 1/7 | - | Fractional change of synaptic activation |
| τsE, τsI, τsinp | 80,10, 10 | ms | Time constant for synaptic activation for excitatory (EE and IE), inhibitory (EI), and input connections |
| gL | 10 | nS | Leak conductance |
| Cm | 200 | pF | Membrane capacitance |
| EL | -60 | mV | Leak reversal potential |
| EE, EI | -5,-70 | mV | Excitatory and inhibitory reversal potentials |
| vth, vthI | -55, -50 | mV | Spiking threshold potential (excitatory, inhibitory) |
| vrest | -60 | mV | Resting potential |
| vhold | -61 | mV | Reset potential |
| tref | 3 | ms | Absolute refractory period |
| τp, τd | 2000, 1000 | ms | LTP/LTD eligibility trace time constant, recurrent connections |
| Tpmax, Tdmax | 0.0033, 0.00345 | - | Saturation level, LTP/LTD eligibility trace, recurrent connections |
| ηp, ηd | 45 x 3500, 25 x 3500 | ms-1 | Activation rate, LTP/LTD eligibility trace, recurrent connections |
| τpFF, τdFF | 200, 800 | ms | LTP/LTD eligibility trace time constant, feed forward connections |
| Tpmax,FF | 0.0034 | - | Saturation level, LTP eligibility trace, feed forward connections |
| Tdmax,FF | 0.00345 (MARKOVIAN FF) 0.0045 (MARKOVIAN A2A) | - | Saturation level, LTD eligibility trace, feed forward connections |
| ηpFF | 20 x 3500 (MARKOVIAN FF)  8.8 x 3500 (MARKOVIAN A2A) | ms-1 | Activation rate, LTP eligibility trace, feed forward connections |
| ηdFF | 15 x 3500 (MARKOVIAN FF)  10 x 3500 (MARKOVIAN A2A) | ms-1 | Activation rate, LTD eligibility trace, feed forward connections |
| rth | 10 | Hz | Hebbian activation threshold (recurrent connections) |
| rthFF | 20 (MARKOVIAN FF)  30 (MARKOVIAN A2A) | Hz | Hebbian activation threshold (feed forward connections) |
| Treward | 25 | ms | Duration of neuromodulator presentation upon change in stimulus |
| Ttr | 25 | ms | Duration of refractory period for traces following neuromodulator presentation |
| dreward | 25 | ms | Novelty delay upon change in stimulus |
| η | 0.16(recurrent)  20 (feed-forward, MARKOVIAN FF)  32 (feed-forward, MARKOVIAN A2A) | ms-1 | Learning rates, recurrent and feed forward connections (note that these are scaled by the delay period, so are implemented in MATLAB as η = 2\*ηfixed / Treward). Slower learning rates will be more stable but take more trials to converge to fixed-points. |
| ϕ | 0.26 (0.3) | - | Sparsity of fixed connections, implemented in MATLAB as 0.3, which results in an effective sparsity of 0.26 because of random number generator oddities |
| WEEMT, WEIMT | 0.2, -70 | nS | Synaptic connection strength, Timer to Messenger excitatory to excitatory (EE) and inhibitory to excitatory (EI) connections |
| WEITT, WEIMM | -100, -100 | nS | Synaptic connection strength, intercolumnar Timer-Timer and Messenger-Messenger inhibitory to excitatory (EI) connections |
| WIETT, WIEMM | 0.2, 1 | nS | Synaptic connection strength, intracolumnar Timer-Timer and Messenger-Messenger excitatory to inhibitory (IE) connections |

**Supplementary File 1. Table of Main Model Parameters.** For full code, see http://modeldb.yale.edu/266774