
Functional synapse types via characterization of short-term synaptic plasticity: Supplemental Data

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1 Implementation of network model

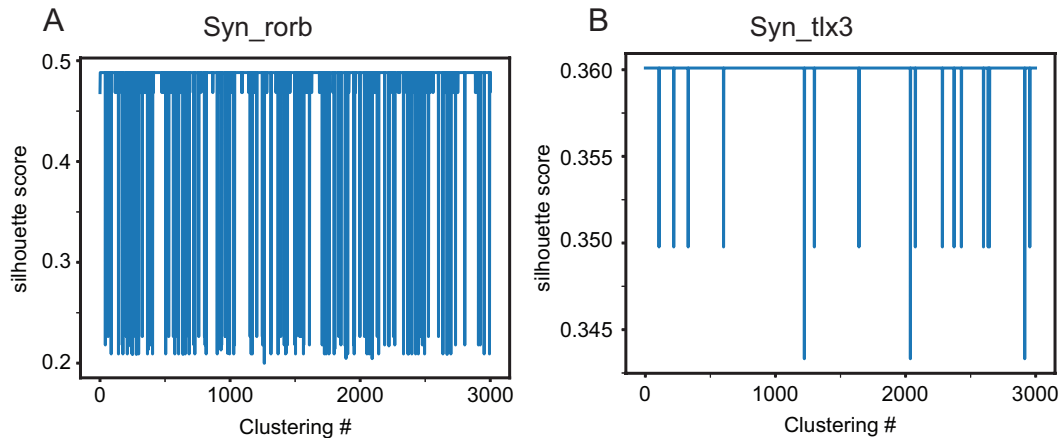
To better understand functions of STP, we use a network consisting of leaky integrate-and-fire (LIF) neurons. Inspired by an earlier modeling study [1] proposing that depressing synapses control the gain of neuron responses to afferent inputs, we examine how STP changes neurons' responses to afferent inputs modulating at 40 and 10 Hz, which have been thought to mediate bottom-up and top-down inputs [2, 3, 4, 6, 7], respectively. In doing so, we implement three populations PRJ_1 , PRJ_2 and REC in the network. The first two populations generate outputs varying over time and project them to the third population (REC). The outputs of PRJ_1 are rapidly modulating at 40 Hz, whereas the outputs of PRJ_2 are slowly modulating at 10 Hz.

We use NEST [5] to implement this network. REC consist of 80 LIF neurons, which are implemented using neuron module 'iaf_psc_exp' in the NEST [5]; all neuron parameters are the same as default values in the module. Both PRJ_1 and PRJ_2 consist of 20 neurons, each of which generates independent Poisson spikes modulating at 40 Hz or 10 Hz. Specifically, we implement these independent Poisson spike trains by connecting 'parrot' neurons to the 'sinusoidal_poisson_generator' in the NEST [5]. In the NEST, the poisson_generator generates independent spike trains and projects them to target neurons, and parrot neurons relay them to other neurons in the networks.

To generate both slow and fast modulating Poisson spike trains, we use two independent sinusoidal_poisson_generators in the network. The shared parameters of these two devices are 'rate'=100, 'amplitude'=50, but the first generator connected to PRJ_1 is set with 'frequency'=40, whereas the second generator connected to PRJ_2 is set with 'frequency'=10. During 2-second-long simulations, we measure spikes from all REC neurons and calculate the spectral power of outputs of REC using histogram of spikes from all REC neurons. The resolution of histogram is 1 ms and is smoothed with Gaussian kernel with 4 ms width. STP

connections are implemented using the extension module of NEST, which is available to the public at the github repository (https://github.com/AllenInstitute/AIBS_synapse).

2 Supplemental figure



Supplemental Figure 1: Silhouette scores for 3000 clustering with the optimal number of subclasses. The examples of silhouette scores are shown in (A) and (B).

References

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