Think of a title later

Ansel Blumers and Ankan Ganguly

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Abstract

Abstract goes here.

Contents

1 Introduction

Write an introduction here.

2 Methods

In this paper, we used the simulated Integrate and Burst model introduced in [1]. We then implemented STDP learning and Hebbian learning.

2.1 Integrate and Burst Model

Our integrate and burst model was based off of the same equations as used in [1]. There are N neurons connected in an all-to-all environment. Each neuron i bursts when its membrane potential, V_i, hits the threshold V_θ. We assume that every neuron bursts for T_{burst} time. While bursting, each neuron fires four times uniformly over the burst interval before resetting to V_{reset}.

When a neuron is not bursting, its potential is governed by a typical conductance based leaky integrate and fire model with built-in inhibition:

$$\tau_V \frac{\mathrm{d}V_i}{\mathrm{d}t} = -g^L(V - V^L) - g^E(V - V^E) - g^I(V - V^I) \tag{1}$$

The leak conductance, g^L, is assumed to be a homogeneous constant input, as is the leak potential V^L. Notice that in the absence of excitatory or inhibitory conductance, neuron i will tend to V^L. Therefore we can say that the leak potential is also equal to the rest potential.

The excitation potential, V^E, and the inhibition potential, V^I, act as

2.2 Learning

Introduction to what we did.

2.2.1 STDP Learning

Talk about STDP learning in this implementation.

2.2.2 Hebbian Learning

Talk about Hebbian learning here.

2.3 Parameter Choices

Talk about how we chose parameters here.

3 Results

Introduce the big idea and what we got.

3.1 Parameter Tuning

- 4000 Hz doesn't work! (Burst Plot)
- Mention annealing and our choice of r_{in}, η and ϵ. Name the two data sets we refer to for the remainder of the paper. (Scatter Error Function)
- Setting w_{max}. (Burst History)

3.2 Convergence and Stability

- Demonstrate the stability of our IB model by showing the firing rate plot and how it splits according to r_{in}.

../Code/PLOTS/Firing_Rate_Binsize_80ms-eps-converted-to.pdf

- Plot Weight and WW^T for 4000 and 6000 Hz to show some level of convergence.
- Plot error function over time from normal and from permutation matrix
- Describe why the error function converges away from 0.

3.3 Hebbian Learning versus STDP

- Introduce the idea of the refutation.
- Give a theoretical description why the type of learning should be relatively unimportant.
- Compare plots (WW^T, Error vs Time, Burst History).

4 Discussion

Further improvements that could be made to our model and where this research could be taken.

5 Summary

Quick summary of our results and everything.

References

[1] Ila R. Fiete, Walter Senn, Claude Z.H. Wang, and Richard H.R. Hahnloser. Spike-time-dependent plasticity and heterosynaptic competition organize networks to produce long scale-free sequences of neural activity. Neuron, 65(4):563 – 576, 2010.