Adaptive synapses and integrate-and-fire neurons for a multi-chip selective attention system

Author(s):
Chicca, Elisabetta; Indiveri, Giacomo; Douglas, Rodney James

Publication Date:
2001

Permanent Link:
https://doi.org/10.3929/ethz-a-004265928

Rights / License:
In Copyright - Non-Commercial Use Permitted
Adaptive Synapses and Integrate-and-Fire Neurons for a Multi-Chip Selective Attention System

Elisabetta Chicca, Giacomo Indiveri and Rodney J. Douglas

Institute of Neuroinformatics, UNIZH/ETH, Winterthurerstrasse 190, CH-8057 Zurich, Switzerland

Introduction

We present measurements from an analog VLSI (Very Large Scale Integrated) chip containing circuits implementing adaptive synapses and leaky Integrate-and-Fire (I&F) neurons. We focus on the behaviour of the synaptic circuit and the effect of the synaptic current on the postsynaptic depolarization.

Adaptive Synapses

Cortical synapses between pyramidal neurons exhibit two types of short-term adaptation mechanisms: facilitation and depression [1]. The mechanism we are interested in is synaptic depression, by which the synaptic strength is decreased in response to successive presynaptic action potentials. For constant input firing rate, the steady-state EPSP (excitatory postsynaptic potential) amplitude decreases as a function of the rate [2].

The Synaptic circuit

For Constant Input Firing Rate, the Steady-State EPSP Amplitude Decreases as a Function of the Rate

Synaptic depression leads to a loss of sensitivity to sustained rates and an increase in the sensitivity to abrupt changes in rate (dynamic gain control). This property can be used by a selective attention system to normalize the input coming from different sensory modalities and/or feature detection modules.

A new chip currently in fabrication will be used to build a multi-chip selective attention system. The inter and intra-chip connection will be managed using a custom PCI-AER (Peripheral Component Interconnect-Address Event Representation) board.

Future Work

References
