Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Devices and Circuits for Nanoelectronic Implementation of Artificial Neural Networks

By

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Biological neural networks perform complicated information processing tasks at speeds better than conventional computers based on conventional algorithms. This has inspired researchers to look into the way these networks function, and propose artificial networks that mimic their behavior. Unfortunately, most artificial neural networks, either software or hardware, do not provide either the speed or the complexity of a human brain. Nanoelectronics, with high density and low power dissipation that it provides, may be used in developing more efficient artificial neural networks.

This work consists of two major contributions in this direction. First is the proposal of the CMOL concept, hybrid CMOS-molecular hardware. CMOL may circumvent most of the problems posed by molecular devices, such as low yield, yet provide high active device density, $\sim 10^{12}$ cm^2.

The second contribution is CrossNets, artificial neural networks that are based on CMOL. We showed that CrossNets, with their fault tolerance, exceptional speed (~4 to 6 orders of magnitude faster than biological neural networks), can perform any task any artificial neural network can perform. Moreover, there is a hope that if their integration scale is increased to that of human cerebral cortex ($\sim 10^{10}$ neurons and $\sim 10^{14}$ synapses), they may be capable of performing more advanced tasks.

Date: July 24, 2007
Time: 3 pm
Place: Physics Building, Room B-131

Program: Physics and Astronomy
Dissertation Advisor: K. K. Likharev