



Kohno LAB.

[Silicon neuronal devices]

Center for International Research on MicroNano Mechatronics

<http://www.sat.t.u-tokyo.ac.jp/~kohno/>

Biomimetic Microsystems

Department of Electrical Engineering and Information Systems, Graduate School of Engineering

Department of Mathematical Engineering and Information Physics, Graduate School of Information Science and Technology

Silicon neuronal network circuits

Mimicking electrophysiological activities in the nerve system

The silicon neuronal network is a system comprised of silicon neuron and synapse circuits that reproduce the electrophysiological activities of neurons and synapses. It is designed to simulate the nerve system in real time or even faster. We realized silicon neurons and synapses with simple and very low-power-consuming circuit by applying mathematical techniques in the nonlinear dynamics.

Copying structures in the phase portraits and the bifurcation diagrams in the nerve models utilizing silicon-native curves. MOSFETs are operated in the subthreshold domain to realize ultra low-power-consumption under a few tens of nano watts.

A simple silicon neuronal network that mimics motion pattern generator neuronal networks in the peripheral nerve system is studied as a basis of our future silicon central nerve systems.

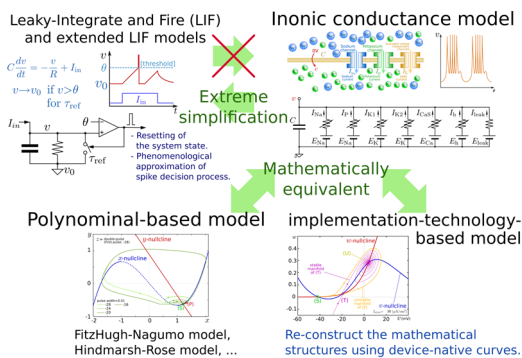


Fig.1 Mathematical-structure-based design method for silicon neurons

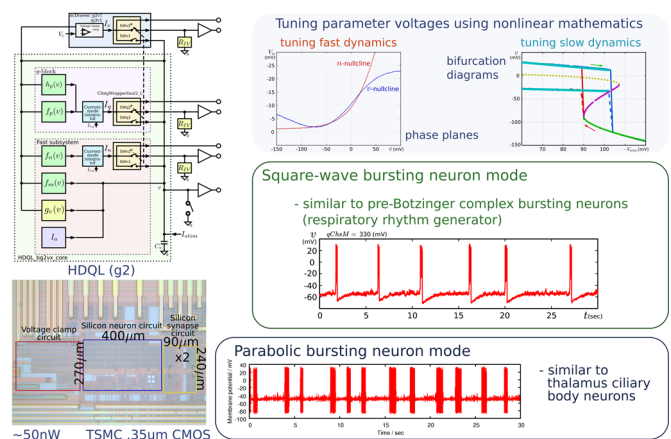


Fig.2 A 3-variable basic ultra-low power silicon neuron circuit

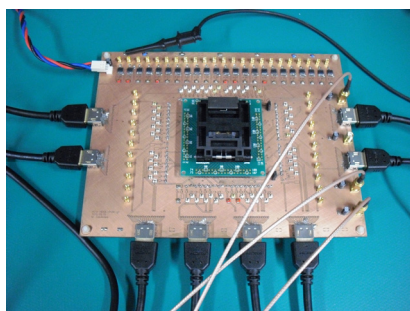


Fig.3 Silicon half-center oscillator chip (to be tested).

