



Kohno LAB.

[Silicon neuronal devices]



Center for International Research on MicroNano Mechatronics

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

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

Biomimetic Microsystems

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

Silicon neuron and synapse circuits

Mimicking neurophysiological activities in the nerve system

The silicon neuron is an electronic copy of the neuronal cells. There was difficulty, however, in realizing simple circuitry that simulates their real behavior. We proposed a solution to this problem that utilizes the mathematical techniques in the nonlinear dynamics. Our silicon neuron circuit provides an element in the silicon neural networks closer to the nerve system. We are working on a silicon peripheral nerve system as the first step towards our final goal, an artificial brain.

- ◆ 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.
- ◆ Our silicon peripheral nerve system are being applied to neuromorphic smart MEMS actuator devices.

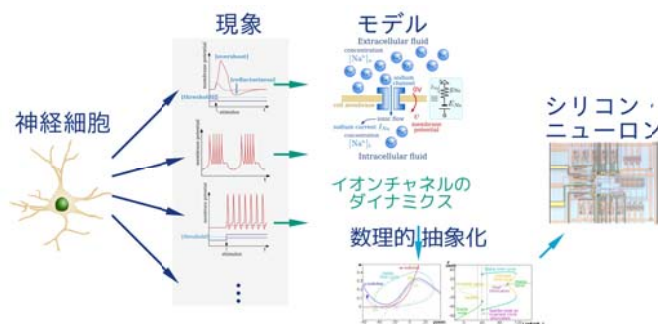


Fig.1 Mathematical-structure-based design method for silicon neurons

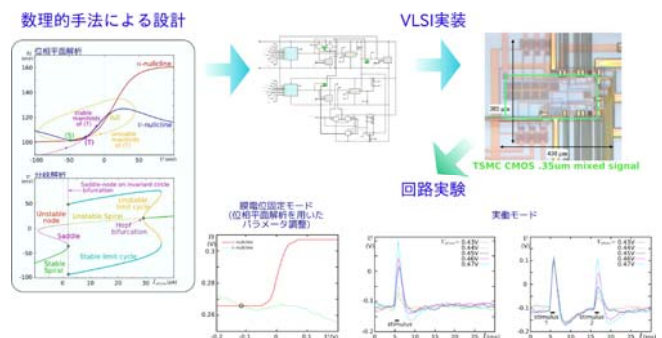


Fig.2 A 2-variable basic silicon neuron circuit (Class I, Class II)

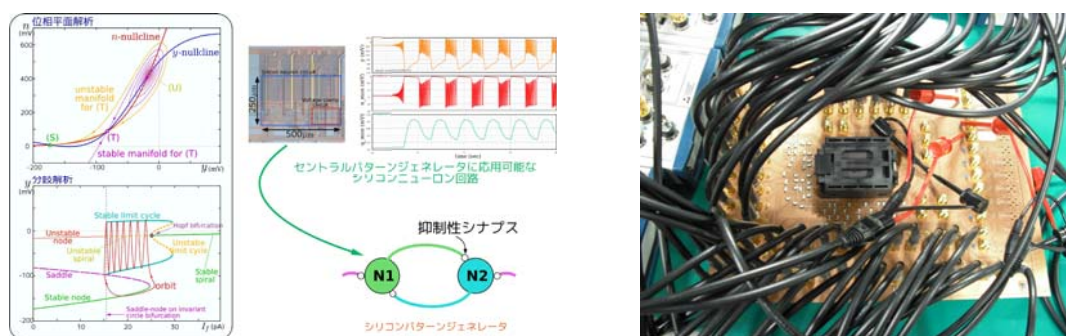


Fig.3 A 3-variable autonomous bursting silicon neuron circuit and its experimental board