

KOHNO LAB.

Mimic and Analyze the Brain



Department of Informatics and Electronics
LIMMS/CNRS-IIS (IRL2820) International Collaborative Research Center

Department of Electrical Engineering and Information Systems,
Graduate School of Engineering Department of Informatics,
Graduate School of Information Science and Technology

Neuromimetic Systems

<https://www.neumis.iis.u-tokyo.ac.jp>

Silicon Neuronal Networks (SiNNs)

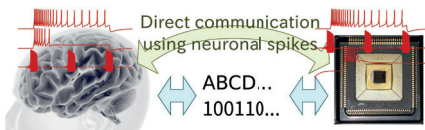
— Electronic circuit copies the nervous system —

Silicon neuronal network is an electronic circuit version of the brain neuronal network, which is built by silicon neuron and synapse circuits. The electrophysiological activity in the nervous system is reproduced in real-time or faster.

Final goal is to realize “Brain-compatible AI”

Features compared to current AI:

- ✓ Capable of direct communication with the brain without using symbols or languages.
- ✓ Efficient processing of non-linguistic information such as sensations and sense.
- ✓ Efficient learning with small amount of data similarly to the brain.
- ✓ Applicable to neuro-prosthesis devices



Analog SiNN circuit designed by the theory of nonlinear mathematics

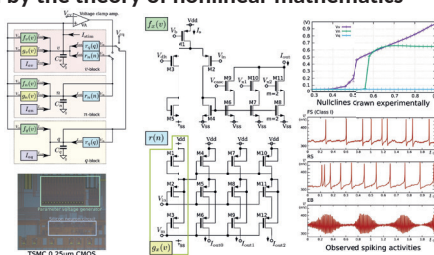
✓ Ultralow-power

7nW / neuron
2pW / synapse
0.25μm CMOS process

✓ Power supply voltage 1V

✓ Supports important brain cells:

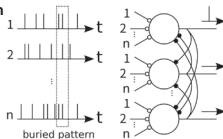
7 types of cells including
Regular Spiking cells
Fast Spiking cells
Elliptic Bursting cells



Towards reproduction of information processing in the brain microcircuits

- **Biologically realistic models** that differ from current AI models such as deep learning.

Masquelier's spatio-temporal pattern detection from noisy spike trains by single layer network with lateral inhibition



Insect olfactory network on low-power silicon Neuronal network

