Brain-Morphic AI to Resolve Social Issues

[Brain-Morphic AI]

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Social Cooperation Programs

https://www.iis.u-tokyo.ac.jp/en/research/department_center/social_ai/

Abstract

The purpose of this laboratory is to generate a novel type of computing systems including algorithms and devices, which can achieve very high performance of AI information processing with low power consumption like the brain to solve various social problems. For this sake, we develop novel fundamental technologies of the information processing based on mathematical analyses and neuromimetic circuit for the brain-morphic AI system which can execute fast intelligent-and-autonomous information processing with low energy.

Schematics of Our Project

Problems of the conventional AI implementation

Especially for edge-side usage, we need low power consumption to solve social issues.

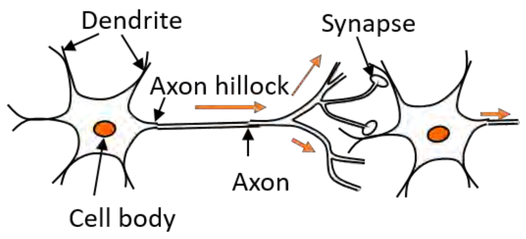
Our approach: Brain-Morphic AI

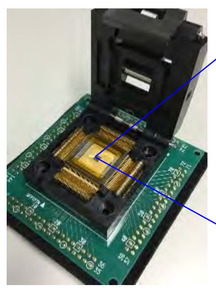
The Brain : Fast intelligent-and-autonomous information processing with low energy.

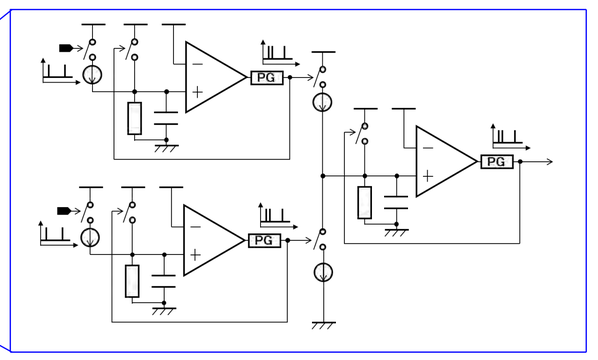
Brain-morphic circuits : implementation of AI information processing with low power consumption.

$$
\begin{aligned}
I &= C_m \frac{dV_m}{dt} + g_k n^4 (V_m - V_K) + g_{Na} m^3 h (V_m - V_{Na}) + g_l (V_m - V_l) \\
\frac{dn}{dt} &= \alpha_n(V_m)(1-n) - \beta_n(V_m) n \\
\frac{dm}{dt} &= \alpha_m(V_m)(1-m) - \beta_m(V_m) m \\
&\vdots
\end{aligned}
$$

(The Hodgkin–Huxley model)



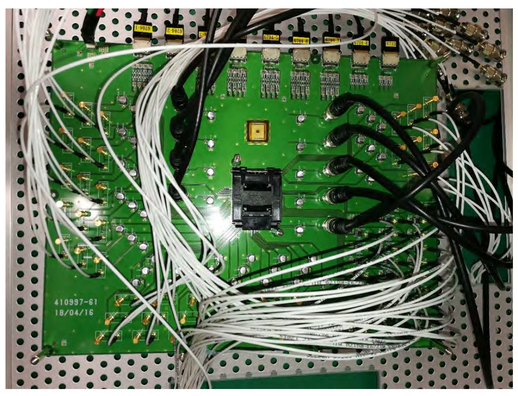




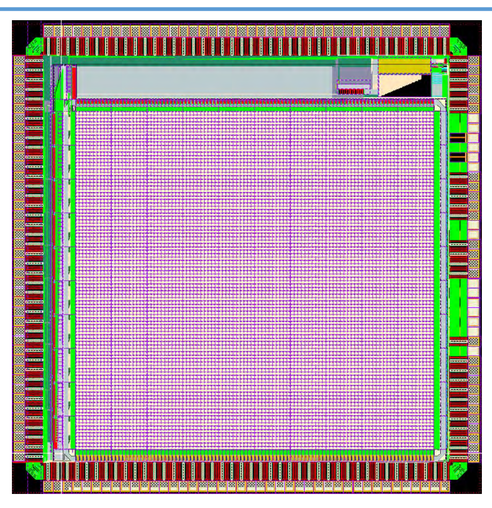
Novel fundamental technology of the information processing

1. Very high performance of AI information processing with low power consumption.
2. Solve various social problems.

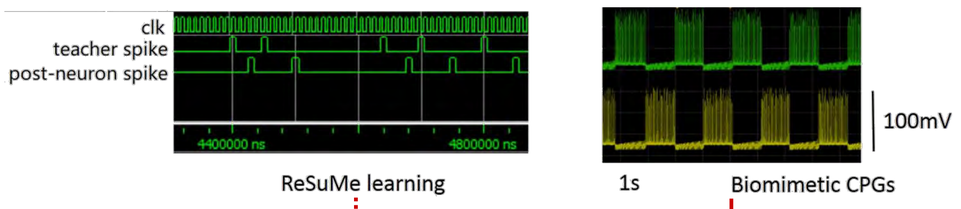
Recent Activities

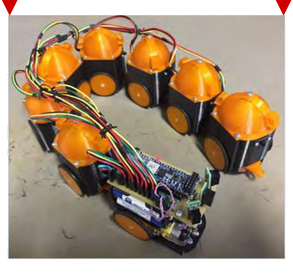


A fabricated analog integrated circuit that mimics stochastic behavior of the ion channel and generates pseudo-random numbers with low-power consumption and the measurement PCB.



Layout of an analog-digital mixed signal low power spiking neural network chip with on-chip learning.





Snake robot

Implementation in FPGA of ReSuMe learning (top Left), and biomimetic Central Pattern Generators (CPGs) (Top Right). The CPGs controls in real-time a snake robot (Bottom) and mimics the snake locomotion.

ReSuMe : Remote supervised method (F. Ponulak, 2005)