粘菌チップの世界最低速コンピュータが
目指すデバイス設計のパラダイムシフト

Installment 19:
Paradigm shift in device design sought by the world’s slowest
Amoeba chip computer

The computer today is challenging the limits of semiconductor integration and computation speed. Those limits may be solved by the Amoeba chip. We explore the possibilities of new computers in the 21st century.

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「粘着チップは、私たちが追求する科学の可能性を、技術の壁を乗り越えるための鍵を握る。」

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パラダイムのシフト

15年後のコンピュータ

By Haiz. In 1986, and became professor at Tokyo Institute of Technology at the same time. We visited him at his RIKEN lab in Wako City, Saitama Prefecture for this interview.

"I was doing research on fusion nanotechnology and biotech for over ten years, but I saw from trying to create devices with organic molecules and biological molecules that instability. They change forms, change characteristics at a titanic rate with time. A device that provides a consistent function seemed impossible."

His research reached a deadlock.

"I then tried from different angles. Why is it necessary to suppress fluctuation? Why not positively make use of the instability of organic molecules and living organisms since it is an essential nature?"

The computer is high-speed and absolutely accurate because it suppresses fluctuation. Things that fluctuate, however, accept fluctuations.

"When we compare a transistor and a living organism, a transistor turns on/off about one billion times every second, and a living creature about 1,000 times. The probability of a transistor making an error is one in 10 to the 80th power. But the probability of a living creature making an error is said to be once every 10,000 times. Since it oscillates 1,000 times per second, since every 10,000 times means it makes an error approximately every 10 seconds. This means that the human brain also does something strange every 10 seconds. How then is it that we survive? It's because we make use of fluctuation as a means for survival."

For the research, Haiz uses a microfabricated structure of the true slim mold. On a circular chip, 1.5 cm in diameter, used in the experiment, eight grooves are etched radially in a circular pattern. The mold is placed in the center so it can stretch its branches into the eight grooves.

At first it grows in a concentric fashion, but since it grows while oscillating minutely there is no telling into which grooves it will stretch its branches first. Once a branch is detected in a groove, a simple rule to assign the slim mold a task is established.

"Light is irradiated into two adjacent grooves adjacent to the groove in which the slim mold entered. Since slim mold avoids light, it is prevented from entering the two adjacent grooves. It is therefore prevented from spreading into the starburst form and looks for either of the ten possible patterns it can settle in, such as the "X" or "Y" shaped patterns."

This chosen pattern is considered to be the state in which the slim mold has reached an answer.

However, although the slim mold stands for a while in the answer state, it suddenly changes into places it is supposed to dislike, where light is irradiated; it struggles to reach an answer, but after a while it gives up and starts to search for another answer again.