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■ Aiming to artificially recreate natural intelligence

As computers become more sophisticated, artificial intelligence is developing at an astounding pace. In particular, there has been incredible growth in generative AI, which produces new data and information based on data that the computer has learned, and generative AI is increasingly being used as a handy tool in everyday life. Compared to living things, including humans, computers can calculate faster and recognize images and sounds more accurately, so it may seem like they can handle anything; but in fact, there are many problems that computers cannot handle. For example, if a part of a computer fails due to a power outage or deterioration, it cannot repair itself. One reason is that human-made objects do not have the natural healing ability of living organisms; but another major reason is that artificial intelligence does not have a “body”. Having a “body” would allow artificial intelligence to experience the world in an active way, perhaps even becoming able to respond to major errors or damage, such as faults. Looking at the natural world, we find that insects, which have much smaller nervous systems than mammals, are still able to walk after losing a leg, so they can survive and thrive. I think the strength of living organisms lies in this flexibility and robustness. In my research, I am exploring how to artificially recreate the natural intelligence of living organisms.

■ Learning from insects in robot design

As the first step towards artificially recreating natural intelligence, I am researching insects. My particular focus is on moths and their excellent sense of smell. The challenge is to see whether we can artificially recreate their intelligence.

Many living organisms, not just moths, use scent for communication and space perception. This could partly be because their sense of sight is not as good as humans, but because odor is not carried by waves, it is highly dispersible and durable, which means information remains within a given space. The source of an odor can be identified by tracing it through that space, but in reality, the diffusion of an odor is extremely complicated, as it is affected by both wind and obstacles. Therefore, existing robots and artificial intelligence are unable to handle all the possible situations. This is one of the issues that is difficult to overcome with artificial systems, and is also why there has not been much progress in research into equipping robots with a sense of smell. However, as I mentioned earlier, moths deal with this issue in real time by skillfully sensing the environment using their bodies, consolidating information from multiple sensory organs, and deciding and adapting their behavior to the situation. If we can

extract this intelligence from living organisms and reproduce it artificially, I believe it will help to make robots more useful in a wider range of applications.

■ Could robots ever surpass living things?

I don’t know how long it will take, but I want to develop robots that are equal to or better than living organisms, and I believe this should be possible. The important thing is to look beneath the surface. I believe there are always reasons for what “nature” does, and it is worth exploring these reasons. For example, silk moths have wings, but they cannot fly. At first glance, this might seem pointless or an inefficient use of energy. Yet, by visualizing the airflow around a silk moth, we find that by flapping its wings, the moth attracts odors, which contributes to its efficient odor tracking ability. Thus, what we can see with our eyes is only part of the story; many of the reasons are hidden, and the discovery of these reasons is important. In my research, I conduct experiments with actual living organisms from the perspectives of morphology, behavior, and physiology, searching for where the essence of their natural intelligence is hidden. Deciphering this essence will enable us to reconstruct it artificially, which could make it possible to construct robots with the flexibility and robustness of living organisms. When artificially reproducing natural intelligence, we do not necessarily need to copy the physical structure or number of sensory organs of the living organism. All we have to do is to artificially reconstruct adaptability and robustness equivalent to or better than that of living organisms. We are pursuing this research, envisioning that it will be possible to create robots that can function even better than living organisms.

Researchmap https://researchmap.jp/sshigaki?lang=en

Written by SHIGAKI Shunsuke, translated by FORTE Science Communications.
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