

It is a great honor and responsibility to be here, to be chosen as the recipient of the Okawa Prize. I am especially humbled to receive it following the steps of several distinguished scientists who I deeply admire, such as Takeo Kanada and Adi Shamir.

I am also very happy to receive it together with my younger colleague and friend, Professor Mitsuo Kawato, whose work I have admired for a long time. I would like to thank the president and the chairman of the Okawa Foundation, the chairman of the selection committee, and all the members of the selection committee.

I would like now to tell you a little bit about my field of research, which is truly interdisciplinary, between computer science and neuroscience. A name for it is computational neuroscience. And I would also like to speak about its future directions and its role in society.

It is now 2010. I started to work in scientific research at the Max Planck Institute in Tuebingen, Germany in 1971. I started to work with Werner Reichardt on the brain of the fly – the fly's visual system – and with David Marr at MIT on computer vision, more precisely on the problem of stereo vision. You may have seen Avatar, the movie, and you know what stereo vision is.

Why? Well, since my childhood I have always been interested, deeply interested, in the problem of intelligence. What is the mind? How does the brain generate the mind? What made Einstein such a unique scientist? Could we add circuits to our brain and make it more intelligent? Those were the really big questions that fascinated me.

The problem of intelligence – the nature of it, how the brain generates it, how it could be replicated in machines – is, one could argue, the deepest and most important problem in science today. Philosophers have studied intelligence for centuries, but it is only in the last fifty years or so that key developments in a range of scientific disciplines from computer science to neuroscience have transformed the problem from philosophy into a scientific problem, opened to scientific methods such as to experiments with computers in addition to experiments with neuroscience techniques.

Starting with the 1950s but really with the 1970s or so, it has become possible to ask questions such as, How does the mind process sensory information to produce intelligent behavior? How do circuits of the brain work? How could a machine develop intelligence like a baby does, learning from experience?

In the 1950s, Shannon, Wiener, McCulloch and Pitts developed the seeds of information sciences and computational neuroscience at MIT. And artificial intelligence was started in the 60s by Minsky and McCarthy, and in the 70s the work of David Marr was part of the beginning of computational neuroscience. Those were the years of the first attack to the problem of intelligence and of the brain.

In the 80s Neural Networks represented a second wave of attack to the problem of intelligence. I came to Japan then, when the enthusiasm was high for developing intelligent machines and

robots. I love Japan and its technology, rooted in centuries of tradition and sophisticated craftsmanship, and I came back often to Japan after the first time, to visit Japanese universities and Japanese companies such as Honda and Sony; and I mostly came to visit ATR, where I often met with Dr. Kawato and where I was always welcomed with great hospitality and state-of-the-art research. In fact, for several years we organized every January an ATR-MIT mini-workshop in computational neuroscience at ATR.

The Neural Network attempt in the 1980s did not solve the problem of intelligence, of course; but much progress was made, though we tend to overlook this progress. The Internet, Google and so on are all products of efforts based on the research of the 60s and the 80s.

There are now good reasons to believe that the time has come for a new, fresh attack on these problems related to intelligence. And this attack would be driven by computational neuroscience and by the integration of neuroscience and computer science. And I expect MIT and Japan to play a key role in this new wave of research on brains and computers, and on the key problem of learning from data and learning from experience.

Beyond being a great scientific and intellectual adventure, the understanding of the origins of intelligence, the building of more intelligent systems and improving mechanisms for collective decisions in our society will be critical for the future prosperity, education, health and security of our society. This new wave of research, however, like the first one, is not likely to fully solve the problem of intelligence; but I am sure that there will be many new substantial advances that will come from it.

I believe, and I know, that Mitsuo Kawato shares this belief with me, that computational neuroscience is at the forefront of the research on intelligence that is starting now. Our understanding of the brain computations has advanced considerably and is now beginning to provide new approaches to computer science; and in fact in my talk yesterday I described some examples of this in computer vision and in machine learning.

So I am proud to have been involved in the field of computational neuroscience from the beginning, to have contributed to its foundation. It is an important field, because it deals with the basic problems of how the brain works, and so with the question of what we are; and it deals with the problem of how to make computers that can think and reason, and so with the question of the next step in the evolution of Mankind. Our science and our future depend on the answers to it.

Thank you.