ATTACHMENT 1: Profile and Detailed Achievements of the Group A Recipient of the 2017 C&C Prize

Dr. Mitsuo Kawato

Current positions:

Director, ATR Fellow, ATR Brain Information Communication Research Laboratory Group, Advanced Telecommunications Research Institute International

Personal History (born in 1953):

1976 BS, The University of Tokyo
1981 PhD, Osaka University
1981 Specific areas encouragement researcher, The Japan Society for the Promotion of Science
1981 Research Associate, Osaka University, (87 Lecturer)
1988 Senior researcher, ATR Auditory and Visual Perception Research Laboratories
1992 Head of department, Department 3, ATR Human Information Processing Research Laboratories
2003 Director, ATR Computational Neuroscience Laboratories
2004 ATR Fellow
2010- Director, ATR Brain Information Communication Research Laboratory Group

1996 JST ERATO Dynamic Brain, Project Director, jointly appointed
2004 JST ICORP Computational Brain, Project Director, jointly appointed
2008 JST PRESTO Decoding and controlling brain information, Project Director, jointly appointed
2008 Strategic Research Program for Brain Sciences, Director of BMI research hub, jointly appointed
2016 The RIKEN Center for Advanced Intelligence Project, Special advisor, jointly appointed

Major Awards:

1991 Best Paper Award, The Institute of Electronics, Information and Communication Engineers
1991 Yonezawa Memorial Paper Award, IEICE
1992 Sawaragi memorial paper award, The Institute of Systems, Control and Information Engineers
1992 Outstanding Research Award, International Neural Network Society
1993 Science and Technology Agency Award
1993 Osaka Science Prize

1996 Nakaakira Tsukahara Memorial Award
2001 Toshihiko Tokizane Memorial Award
2005 Chunichi Cultural Award
2006 Asahi Prize
2008 Gabor Award, International Neural Network Society
2009 Information-Communications Promotion Month Ministerial Commendations
2009 Okawa Prize
2012 Tateisi Prize, Grand Award
2013 Medal with Purple Ribbon
2017 Member, Science Council of Japan

Achievements

Remarkable progress has been made in neuroscientific research to elucidate the structure and functions of the brain over the past fifty years. This research remains important today as we seek a deeper understanding of neuronal functions, such as information representation and processing in the brain. Illuminating the brain's functions allows us to better understand advanced cognitive operations, such as information processing based on attention and consciousness, dexterous motion control, and natural language processing. This in turn accelerates research in computational neuroscience, leading to the creation of machines and computer programs that operate on the same principles as our brains. We anticipate that many new findings will be made through the integration of psychiatry, neuroscience, and information engineering to help resolve pressing social issues such as maintenance and recovery of the cognitive functions in the elderly and precise, personalized medicine in the diagnosis and treatment of mental illnesses.

Dr. Mitsuo Kawato has been leading the development of original brain machine interface (BMI) technologies for many years. His remarkable contributions include elucidating, through computational theory, brain mechanisms such as motor command generation, motor learning, and hierarchical visual processing; enabling the noninvasive measurement of brain activity; and applying his extensive knowledge to the development of robot control technologies. His research and development activities have contributed greatly to the integration and advancement of the neuroscience, information engineering, and robotics fields. His achievements have found application in such diverse areas as medicine, welfare, and information and communications. Today, BMIs are being looked at not only as a way for humans to control robots and computers, but also as a new means of helping people regain motor or cognitive functions that have been compromised by disease or accident. With the goal of finding new applications for their discoveries, Dr. Kawato and his

colleagues work on ways of diagnosing and treating psychiatric disorders through the integration of neuroscience and artificial intelligence. They also work on developing innovative medical therapies based on new definitions of psychiatric disorders discovered through neuroscientific research.

Dr. Kawato has presented many innovative research findings as a leading expert in the field of computational neuroscience—a fundamental discipline of neuroscience. His findings in the area of cerebellar internal model theory and visual interactive theory, which he demonstrated using a humanoid robot as a test bed, are particularly well known. In 2009, he succeeded in developing a highly accurate information extraction technology by using both an electroencephalograph that measures potential changes on the scalp and a near infrared spectroscopy measurement device that measures blood flow changes. This information extraction technology was applied to a BMI to enable brain information to be detected from outside the brain and used to operate a robot, leading to the development by Dr. Kawato of a breakthrough technology for operating equipment through thought that has resonated around the world.

Dr. Kawato has also been conducting research and development of BMI technologies in medical and welfare fields to help people regain lost functions, providing exercise assistance for people undergoing physical rehabilitation, and enabling physically impaired people to control computers through brain activity by using exoskeleton robots. In recent years, Dr. Kawato has worked on new diagnostic methods and therapies for psychiatric disorders through the integration of neuroscience and artificial intelligence.

Currently, psychiatric disorders such as depression are diagnosed and treated based entirely on symptoms exhibited by the patient. It is said that this makes it extremely difficult to develop new therapies and innovative medicines. While it is true that in the past ten years the United States has been moving forward with research programs aimed at redefining disorders by using biological dimensions such as diagnostic imaging and genetic information, this research is still far from being put to practical use due in part to concerns that it might cause confusion in existing insurance and health care systems. In view of this situation, Dr. Kawato and his colleagues launched in 2008 a neuroscience-based research and development program aimed at developing new diagnostic methods and therapies that are compatible with conventional diagnosis and treatment systems and that can be used harmoniously with them. The researchers started by cooperating with nine universities and institutions in Japan to build the world's first brain activity database

consisting of data collected from 2,200 people with psychiatric disorders. The researchers then parcellated the brains anatomically and investigated their functional connections. They developed an original artificial intelligence machine learning algorithm that incorporates models of sparseness and data acquisition disturbance factors that can also operate with a small number of patient samples. The result was the establishment of a classifier which, for the first time in the world, generalized depression, autism, and other psychiatric disorders into completely independent validation cohorts—the first step to redefining mental illnesses based on neuroscience. Dr. Kawato and his colleagues also developed an experimental method of controlling brain circuits using techniques such as functional magnetic resonance imaging (fMRI) decoded neurofeedback, and functional connectivity neurofeedback, and succeeded in creating innovative therapies for repairing functional circuits presumed to be abnormal. These achievements have opened the door to the development of new treatments for many psychiatric disorders for which drug therapies are unavailable or ineffective.

Dr. Kawato's groundbreaking achievement of integrating neuroscience and information engineering to elucidate the information processing mechanisms in the brain with artificial intelligence technologies has been instrumental in expanding the application of computational neuroscience to the field of psychiatry. Dr. Kawato has also been involved in developing the innovative diagnostic techniques of using fMRI to classify brain circuits and utilizing fMRI neurofeedback as a therapeutic tool. His achievements have set the course for psychiatry to be transformed into a precise, personalized medicine that enables treatment of patients who, for example, do not respond to drug therapies. With more than 30,000 citations of his works by researchers across the globe, Dr. Kawato is one of the world's leading experts in the integration and development of neuroscience, information engineering, and artificial intelligence. In consideration of his pioneering work in tackling some of the most pressing issues facing the world today by applying innovative BMI-based information processing technologies, Dr. Kawato highly deserves as the C&C Prize.