Editorial

Special issue section on
Brain-like Computing and Applications

It is our great pleasure to present our readers with this special issue of the *JAMRIS (Journal of Automation, Mobile Robotics & Intelligent Systems)* on Brain-like Computing and Applications.

Today's advanced information technology based on high-performance and inexpensive digital computers make our daily life convenient. Moreover it facilitates a high-speed and complicated calculation and handling of a huge amount of data. On the other hand, it can not perform tasks easy for a human being, such as, recognizing facial expressions, distinguishing an animal from a human, grasping a soft material, etc. Researchers are now facing to the limitations of system intellectualization.

To cope with this limitation, engineering applications of crucial functions of the biological brain have drawn great attention of researchers and developers. Collaborations among different fields are necessary for accomplishing the break through.

We promoted the brain-inspired information technology (Brain-IT) under the Kyutech 21st century COE program (2003-2008) entitled, "*World of brain computing interwoven out of animals and robots*", (Project leader: Takeshi Yamakawa), which has been driven by the department of Brain Science and Engineering, Graduate School of Life Science and Systems Engineering, Kyushu Institute of Technology. We think that developing the brain-inspired system demands for facilitating cross-disciplinary researches. Five research fields, namely Physiology, Psychology, Theory and Models, Devices, and Robotics, are indispensable to realize a true brain-inspired information system. The Kyutech 21st century COE program produced the several interdisciplinary technology fusions which becomes a base of brain-inspired information technology. Each core technology is new approach brought by conjunction of research results in plural different fields. As one of the results of the Brain-IT, we organized the special session on "Brain-like Computing: Theory and Applications" in the SCIS & ISIS 2008, Joint 4th International Conference on Soft Computing and Intelligent Systems and 9th International Symposium on advanced Intelligent Systems, held on Nagoya, Japan, during 17th-21st September 2008 and had deep and fruitful discussions on this impressive topics.

The papers in this issue are mainly the extended and revised version of papers that have been selected from submissions to the special session and the related research results of the 21st Kyutech COE program.

The first paper by G. Ogata, K. Natsume, S. Ishizuka, and H. Hayashi is focused on the spike-timing-dependent plasticity (STDP) in Hippocampus. Readers of this journal are familiar with computational models but not neuroscience ones. The editors venture to put the neuroscience paper at the top of this special section. We believe that the research results of neuroscience will give suggestive information to researchers in engineering field and promote researches on brain-inspired systems. The STDP function, described in this paper, is known as relating to sequential learning in brain, which is shown by computational studies but not yet neurophysiological experiments. In this paper, experiments on STDP phenomena were performed in rat. The dentate gyrus (DG) in the hippocampus binds or integrates spatial and non-spatial information in parallel. We hope this topic give a new impression to readers.

In the second paper, T. Miki, H. Hayashi, Y. Goto, M. Watanabe, and T. Inoue present a practical simple local navigation system inspired Hippocampal function. The authors develop a human-like local navigation using a sequence of landmarks with a simple model easy to implement. The proposed method adapts to a slight change of landmark in the real world. Mechanisms for storing, recalling, and updating the landmark sequence are described. The validity of the proposed system is confirmed using an autonomous mobile robot with the proposed navigation mechanism.

The third paper, by K. Tokunaga and T. Furukawa, deals with a new effective method for building an environmental map in a self-organizing manner which is based on a Higher Rank of Self-Organizing Map (SOM2). This is an important and great interest topic in mobile robot researches. The proposed method creates an environmental map in a self-organizing manner from visual information obtained with a camera on a mobile robot. The effectiveness is shown by simulation results.

The fourth paper by S. Sonoh, S. Aou, K. Horio, H. Tamukoh, T. Koga, and T. Yamakawa is focused on emotional expressions on robots. Usage of emotions in robotics is one of the attractive themes. The authors proposed an Emotional expression Model of the Amygdala (EMA), which realizes both recognition of sensory inputs and a classical conditioning of emotional inputs. The EMA was developed with a massively parallel architecture by using an FPGA, and the effectiveness is confirmed by demonstrations of a human-robot interaction with the emotions.

The fifth paper by T. Matsuo, T. Yokoyama, D. Ueno, and K. Ishii deals with a robot motion control system using Central Pattern Generator (CPG) which exists in nervous system of animals and generates rhythmical motion pattern. The authors propose a robot motion control system using CPG and applied it to an amphibious multi-link mobile robot. The proposed system adapts dynamically to an environmental change by switching a controller due to environment and robot of state. The effectiveness is confirmed by segmental results.

In the last paper, T. Sonoda, Y. Nishida, A. Nassiraei, and K. Ishii present a unique actuator which is a new antagonistic joint mechanism using kinematic transmission mechanism (KTM). The proposed model gives a solution for problems that are difficulties in control caused by complex and nonlinear properties, downsizing of actuator, and response time of articular compliance. The performance of KTM is evaluated through stiffness and position control simulations and experiments.

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