New Human Interface based on the Biological Signals

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Biomechatronics is the interdisciplinary study of biology, mechanics, and electronics. Biomechanics is the one of the research and analysis of Biomechatronics and include the investigation of the forces that act on limbs, such as kinesiology of human. In order to realize the human like function, Mechatoronics is the combination of mechanical engineering, electronic engineering, and software engineering. One of the purpose of this engineering field is the robotics. In Japan, especially, industrial robots are developed and used for large-scale production. Recently, the computer become downsizing and speeding up, humanoid robot is also developed.

The mechanical development is novel, such as smoothness, precision, speed, and so on. However, it is still difficult to control the robot as human-like behavior. For example, ASIMO humanoid robot has the ability to pursue key tasks in a real-life environment, but these tasks are preprogramed and limited for unexpected interaction. Even though the robot is maneuvered by joystick in real time, the command is limited such as going forward, backward, turning left or right.

How can we manipulate many degrees of freedoms of the robot in real time? One possibility is to give the intelligence which is similar to the human in the robot. Another possibility is that the human control a robot as if a robot is a part of their body, that is bionic man. If we can extract the brain activities, those signals can be translated the intention to move into the actual movement of a robotic device. In this study, it is developed a brain machine interface (BMI) system to predict arm-reaching movements and posture controls in 3D space from neuron activities of the motor area in Macaque monkey. First, we reconstructed the Electromyography (EMG) signals from neuron activities using a linear regression model. Next, we reconstructed the joint angles from the reconstructed EMG signals with an artificial neural network model. These two steps are based on knowledge obtained by Biomechanics research.

Keyword:
Brain Machine Interface (BMI): BMI is a collaboration in which a brain accepts and controls a mechanical device as a natural part of its representation of the body. By reading signals from an array of neurons and using computer chips and programs to translate the signals into action.

Artificial neural network (ANN): An artificial neural networks are non-linear statistical data modeling tools. They can be used to model complex relationships between inputs and outputs or to find patterns in data.

Electromyographic Signals (EMG): Electromyography (EMG) is a medical technique for measuring muscle activities from electrode.