

## Mutual Adaptation among Human and Machines (Prof. H. Yokoi and Prof. T. Arai)

Surface electromyogram (EMG) is an electrical action potential of muscle detected on the skin surface and it can be recorded by a non-invasive electric measurement. EMG is a bio-signal which includes the information of the motion dynamics, so it is used to estimate the motion intention of an amputee for controls of the prosthetic hand. However, there are several problems on using EMG: High nonlinearity, individual variation and non-stationary. In order to solve these problems, we have proposed a control method for multi-D.O.F prosthetic hand using adaptive learning as information processing. These methods succeeded to recognize many hand motion patterns. In the field of this study, we aim to clarify the aspect of mutual adaptation among human and machines by investigating adaptive human action.

**Adaptable Control for Individual Characteristics:** Using concept of machine learning, the method for acquiring mapping between EMG and hands motion pattern is effective. We called this method “Adaptable control for individual characteristics” (Fig.1) and have developed. In the present research, by using the self organization clustering way of thinking, we analyze the human adaptation process. We propose an adaptive learning method to maintain the fingers movement identification performance when using EMG signal dynamical patterns.

### Brain function analysis for investigating human adaptation process to EMG prosthetic hand:

In this research, we analyzed the human adaptation process to EMG prosthetic hand using f-MRI. Through the previous research, it is clear that amputee’s activation of primary motor area (M1) and primary somatosensory area (S1) were widely growth after sufficient training (Fig. 2). This fact means that “the more strongly subjects recognize that motions of prosthetic hand are hand motions of their own, the more strongly the activation of M1 and S1 is”.

*Keywords:* EMG, Adaptable Control for Individual Characteristics

### References

- 1) Ryu Kato, Hiroshi Yokoi, and Tamio Arai: Competitive Learning Method for Robust EMG-to-Motion Classifier, Intelligent Autonomous Systems 9, IOS Press, ISBN 1-58603-595-9, pp.946-953, 2005
- 2) T. Fujita, R. Kato, A. H. Arieta, H. Yokoi and T. Arai: “SOM based Analysis of Prosthetics Application for Mutual Adaptation,” Proceedings of The Second International Workshop on Man-Machine Symbiotic Systems, pp.231-240, 2004.

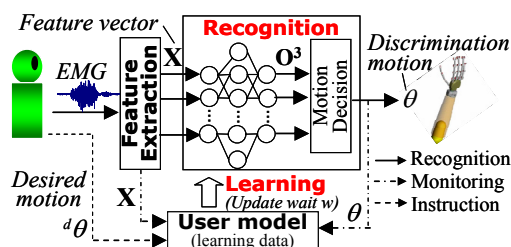


Fig.1 Overview of proposed adaptable EMG-to-motion classifier for Individual characteristics.

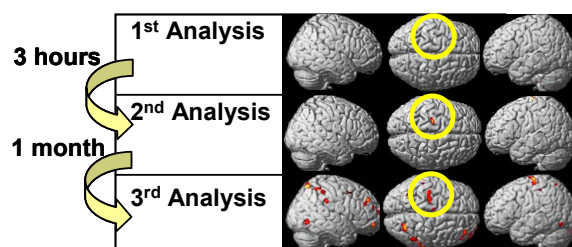


Fig.2 Brain activities for amputee in adaptation process  
(yellow circle shows M1 and S1 area of right hand)