Mutual Adaptation among Human and Machines

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In this study we estimate the motion intention using the motion dynamics information included in bio-signals. However, there are several problems when using bio-signals: high nonlinearity, individual variation and non-stationary. In order to solve these problems, we have proposed control methods for a multi-D.O.F prosthetic hand using adaptive learning. These methods can recognize many hand motion patterns using electromyographic signals (EMG). Also we investigate adaptive human action and clarify the mutual adaptation among human and machines.

Adaptable Control for Individual Characteristics: It is an effective method to acquire the mapping between EMG and hand motion pattern using machine learning. This method is called "Adaptable control for individual characteristics". We propose two kinds of methods for pattern identification. First, we analyze the human adaptation process using the self organization clustering, and propose the adaptive learning method that can maintain high performance pattern identification despite EMG's temporal changes (Fig. 1). On the other hand, to identify motion using EMG, generally we measure EMG and instruct user's desired motion to the system directly, and training data is generated. But it's difficult to identify an exact motion with this method when the number of motions is increased, because the feature space of each motion's training data will be overlapped. Therefore, we propose the method that generates training data from EMG autonomously using self-organized clustering to solve that problem (Fig. 2).

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

We analyzed the human adaptation process to EMG controlled prosthetic hand using f-MRI. As results, it is clear that amputee's activation of primary motor area (M1) and primary somatosensory area (S1) were widely growth after sufficient training. This fact means that "the more strongly subjects recognize that the motions of prosthetic hand are motions of their own hand, the more strongly the activation of M1 and S1 is".

Keywords: EMG, Adaptable Control for Individual Characteristics

References

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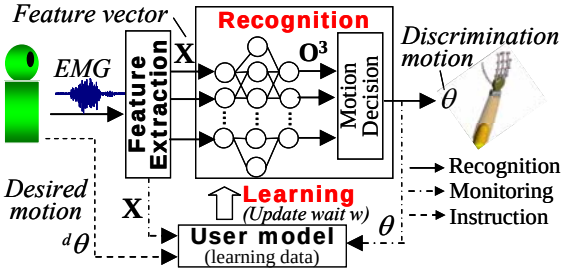

Fig.1 Overview of proposed adaptable EMG-to-motion classifier for Individual characteristics.

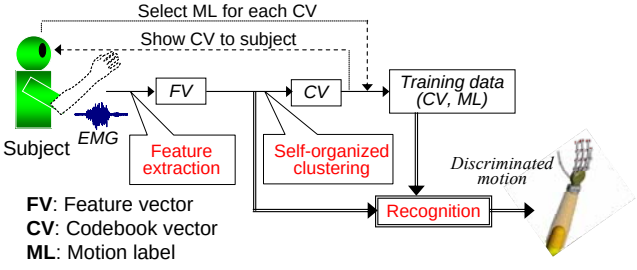

Fig.2 Overview of proposed self-organized clustering method for EMG-to-motion classification.