SEM G for Human Computer Interface Using Ann to Navigate Wheel Chair

V. Rajesh, Sir C.R.R.C.O.E, Eluru, A.P, India
P. Rajesh Kumar, Andhra University, India

ABSTRACT

This paper presents an approach to identify hand gestures with muscle activity separated from electromyogram (EMG) using Back Propagation analysis with the goal of using hand gestures for human-computer interaction. While there are a number of previous reported works where EMG has been used to identify movement, the limitation of these works is that the systems are suitable for gross actions and when there is one prime-mover muscle involved. This paper reports overcoming the difficulty by using independent component analysis to separate muscle activity from different muscles and classified using back propagation neural networks. The experimental results show that the system was accurately able to identify the hand gesture using this technique (95%). The advantage of this system is that it is easy to train one to use it and can easily be implemented in real time.

Keywords: Back Propagation Analysis, Human-Computer Interaction, Muscle Activity, Root Mean Square (RMS), Surface Electromyography (SEMG)

1 INTRODUCTION

In recent years, hand gesture recognition has become a very active research theme because of its potential use in human-computer interaction (HCI). Identification of hand gesture has numerous human computer interface (HCI) applications related to controlling machines and computers. Some of the commonly employed modalities include vision based systems, mechanical sensors, and the use of electromyogram, an indicator of muscle activity. Surface Electromyogram has an advantage of being easy to record, and is non-invasive. Surface Electromyogram (SEMG) is a result of the spatial and temporal integration of the motor unit action potential (MUAP) originating from different motor units. It can be recorded non-invasively and used for dynamic measurement of muscular function. It is typically the only in vivo functional examination of muscle activity used in the clinical environment. The analysis of EMG can be broadly categorized into two:

• Gross and global parameters.
• Decomposition of EMG into MUAP.
Hand movement is a result of complex combination of multiple muscles. While previous research have reported success in the use of multiple channels SEMG recording for the purpose, but the system is sensitive to the location of the electrodes and suitable for five discrete movements only (Rajesh & Kumar, 2009a). The cross-talk that exists due to multiple overlapping muscles in the forearm makes the system sensitive to the inter-subject variability and this problem is more significant when the muscle activation is relatively weak. To identify the movement and gesture of the hand more precisely, it is important to identify the muscle activity of each of the muscles responsible for the action. Similarity in the spectrum and other properties of the activity from the different muscles makes the separation of these difficult. There is a need to separate the muscle activity originating from different muscles. With little or no prior information of the muscle activity from the different muscles, this is a blind source separation (BSS) task.

Independent component analysis (ICA) is an iterative BSS technique that has been found to be very successful in audio and bio-signal applications. ICA has been proposed for unsupervised cross talk removal from SEMG recordings of the muscles of the hand. Re-search that isolates MUAP originating from different muscles and motor units has been reported in 2004. A denoising method using ICA and high-pass filler banks has been used to suppress the interference of electrocardiogram (ECG) in EMG recorded from trunk muscles. Muscle activity originating from different muscles can be considered to be independent, and this gives an argument to the use of ICA for separation of muscle activity originating from the different muscles. This paper proposes the use of ICA (Greco, Costantino, Morabito, & Ver-Saci, 2003) for separation of muscle activity from the different muscles in the fore- arm to identify the hand action.

ICA is an iterative technique where the only approach is the model based approach that provides a well defined muscle activity pattern. The difficulty with this approach is the need for well defined location of the electrodes.

2. HAND GESTURE IDENTIFICATION FOR HCI

In our daily lives we interact with other people and objects to perform a variety of actions that are important to us. Computers and computerized machines have become a new element of our society. They increasingly influence many aspects of our lives (Rajesh & Kumar, 2009d). Human-computer interaction is an area concerned with the design, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. The use of hand gesture provides an attractive alternative to cumbersome interface devices for human computer interaction applications. Human hand gestures are a mean of non verbal interactions among people. They range from simple actions of pointing at objects and moving them around to the more complex ones that express our feelings or allow us to communicate with others. The HCI interpretation of gestures requires dynamic and or/static configurations. Of the human hand, arm and sometimes, body be measurable by the machine. Hand gestures are a new mode for HCI. Visual interpretation of hand/arm movements carries a tremendous advantage over other techniques that require the use of mechanical transducers. It is not obstructive. Numerous approaches have been applied to the problem of visual interpretation of gestures for HCI. Many of those approaches have been chosen and implemented so that they focus on one particular aspect of gestures: Hand tracking, pose classification, or hand posture interpretations.

Recently a number of approaches based on hand gesture identification have been proposed for human computer interaction. Wheeler et al. demonstrated (Rajesh & Kumar, 2009c) that neuro electric joy sticks and key boards can be used for HCI. Trejo et al. developed a technique for multi modal neuroelectric interface. The
Towards a Telehomecare in Algeria: Case of Diabetes Measurement and Remote Monitoring
www.igi-global.com/article/towards-a-telehomecare-in-algeria/187056?camid=4v1a