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Analysis of Surface Electromyogram Signals during Human Finger Movements

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Abstract—*In this paper we study the method to detect the Electromyogram signals for different hand movements as flexion/extension, adduction/abduction. The software used independently to note the different position of fingers and thumb in Lab View using NI-cRIO (National Instrumet Compaq Reconfigure Input/output).*

Keywords—*Surface Electromyogram (SEMG),* ***Muscle activity; Finger flexure movement, Flexor Carpi Ulnaris, Palmaris Longus, Extensor Digitorum.***

I. INTRODUCTION

In the anatomy of the human hand, the hand is distal to the forearm, and its includes the carpus or wrist. The wrist is used for the distal end of the forearm, a wrist-watch being worn over the lower ends of the radius and ulna. The fingers (or digits of the hand) are numbered from one to five, beginning with the thumb. The fingers should be identified by name rather than by number: thumb (pollex), and index, middle, ring, and little fingers. The thenar and hypothenar are adjectives referring to the thumb and little finger, respectively. The finger of the hand are movable in four direction Flexion (bending), Extension (straightening), abduction (moving sideways from the body), adduction (moving sideways towards the body). [3]

The paper consists study of joints and muscles that are required for the movements of hand. Movement of the hand is carried out by several groups of muscles. The muscles that flex the fingers, primarily flexor digitorum superficialis and flexor digitorum profundus, are located in the palmar aspect of the forearm. The muscles that extend the finger, primarily the extensor digitorum, are located in the dorsal aspect of the forearm. The most technological advanced and common method employed for prosthesis control is based on Electromyogram signal processing; to my electrically controlled a Dexterous prosthesis. It is necessary to map Electromyogram signal corresponding to different muscle contraction of different finger movements.

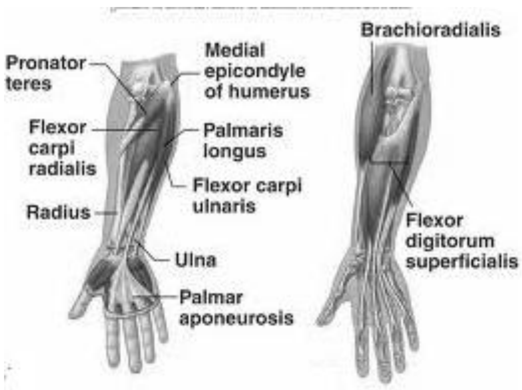


Fig.1 Muscles of forearm

II. MATERIAL AND METHOD

A. Surface Electromyogram(SEMG)

The movement of the hand, either the thumb faces the other fingers, or all the fingers move independently. The muscles that operate the fingers have complicated structure. The muscles operating the joints of different fingers are normally generated from the arm or hand. Three kinds of muscles that generated from the arm participate in flexure of fingers. They are flexure digitorum superficialis muscle, flexure digitorum profundus muscle and flexure pollicis longus muscle. The flexure pollicis longus muscle participates in flexure of the thumb, where as flexure digitorum superficialis muscle and flexure digitorum profundus muscles participate in flexure of the index finger, middle finger, ring finger and small finger. With the surface EMG from the forearm portion; it is possible to recognize the flexure operation of the finger. The SEMG signal is recorded from the forearm muscles. The SEMG is recorded non-invasively by surface electrodes. The muscle for finger adduction/abduction are laying inside the hand, so they are not detectable directly, but their response is measureable in the muscles of the lower arm, so adduction/abduction of different finger is distinguished with the combination of all Electromyogram signals.[1]

B. Method

In this paper the data was collected from five subjects and the Surface Electromyogram signal were acquired using an in-house built amplification and acquisition system cRIO (Compaq reconfigure input/output) .A custom-built Lab View application was used to store and record the data. Surface Electrode were used, the electrode were placed at different muscle sites so as to take the different finger movements [5]. Four forearm muscles were identified as suitable candidates for classification through a trade-off experimental procedure. The four selected muscles were Flexor Carpi Ulnaris (FCU), Palmaris Longus (PL), Extensor Digitorum (ED) and Extensor Carpi Radialis (ECR). In this paper the different finger movements were analyzed. The position of electrodes placement is shown in figure below.

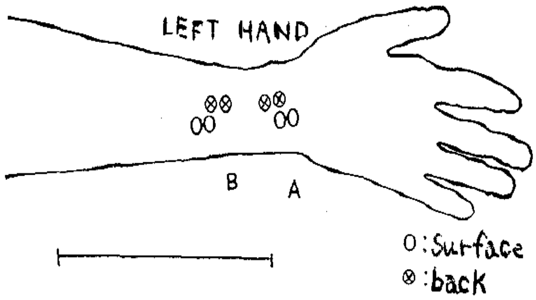


Fig.2 Position of electrodes placement

III. RESUTS AND DISCUSSION

The result consists of flexion and extension of the index and middle finger individually as well as thumb and a hand at rest. These movements would account for individual control of each digit of a multifingered and helping for recording Surface Electromyogram signals. The results for different movements of finger and thumb are shown below:

1) The below graph shows the hand position when it is completely in rest.

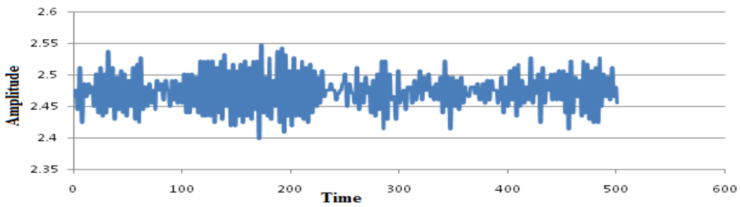


Fig.3 Hand is in resting position

2) The below graph shows the hand position when it is closed.

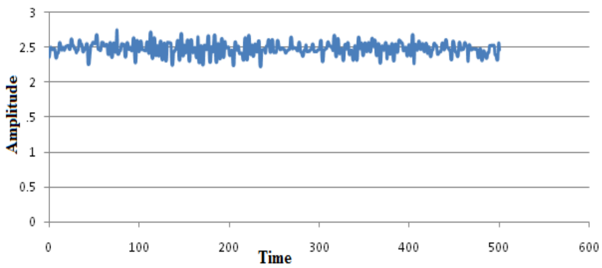
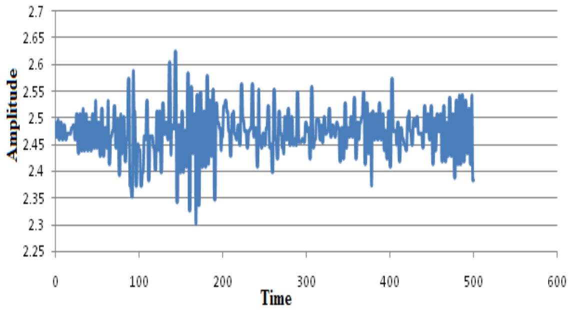
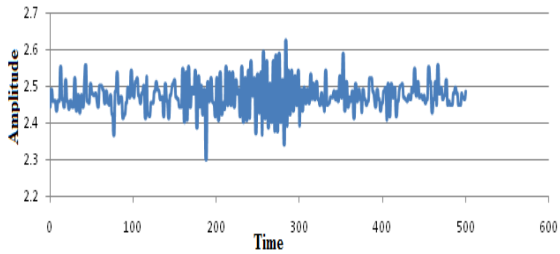


Fig.4 Hand is in closing position

3) The below graph shows the movement of fingers and thumb when it is flexed.



a)



b)

Fig.5 a) Finger movement b) Thumb movement

By comparing the outcome of different movement of hand and fingers it can be noted that there is a little to no change in the waveform. It is noticed that the finger movements are largely controlled by two muscles system. The first system, the Flexor Digitorium system, is located in the upper part of the forearm near the elbow. The second system, Extensors Digitorium muscles are used to straighten the finger and knuckle joints, opening the hand. These muscles and their tendons run from the elbow, over the wrist and the back of the hand to connect with the knuckle and finger joints via the Extensor Expansion sheet that extends over the back of each finger.

IV. CONCLUSIONS

This briefly constitutes the anatomical basis of finger mechanism, from which it can be seen that normal hand function is the result only of highly complex and versatile structural arrangement. It is possible to continuously decode finger position from SEMG signals collected from a generalized electrode placement. When the fingers are moved independently it is possible to distinguish finger movements. The waveforms obtained in LabView are nondetermistic. In future, working on prosthetic forearm will be the great achievement in this software.

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