Myoelectric Dynamic Orthosis for the Elbow

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***Abstract* - This project aims to develop a dynamic elbow orthosis controlled by myoelectric signal. The mechanical system was constructed based on a 3D printer concept, with a linear actuator performing elbow flexion/extension movements according to user's intention. The direction of the movement is detected through myoelectric signal analysis. The hardware to acquire and pre-process the signal from biceps and triceps is a custom-made active electrode based system. Actual results are satisfactory. However, clinical tests must be done for real evaluation.**

I. Introduction

Most of active upper limb othosis are bulk, heavy and used only for training, physical therapy and research purposes. Few projects are developed in the line of this research, achieving a a functional, useful in daily use for the elderly or people with weak muscles.

Kiguchi et al. (2008) developed an exoskeleton fixed to a wheelchair, based on 8 channel myoelectric signal analysis to perform the flexion / extension movements of the shoulder and the elbow with just 3 degrees of freedom. However, Kiguchi and Hayashi (2012) increased the number of monitored muscles up to 16, developing an exoskeleton with 7 degrees of freedom capable of performing. Lenzi et al. (2012) developed a system mechanically more complex than others, but which was able to apply a torque proportional to the user's muscle activation intensity. The arm flexion/extension movement control is based on the myoelectric signal monitored indicating muscle effort.

The purpose of this project is to develop a dynamic orthosis, able to carry out artificially arm extension / flexion movements via a servo motor coupled. The system follows user's motion intention based on myoelectric signal analysis.

II. Methodology

Myoelectrical signal acquisition is done with a custom-made system based on active surface electrodes concept. Two muscles are monitored: biceps and triceps. The reference electrode, were positioned on the olecranon. The custom-made active electrode system use a INA121P instrumentation amplifier with gain 1000, chosen for having high input impedance and high common mode rejection, features that keeps the signal to noise ratio satisfactory. Furthermore, a notch 60 Hz filter circuit is implemented with the UAF42, and a band pass from 20 to 200 Hz, is implemented with the same component.

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At the same time, myoelectric signals are monitored and after processing, they indicate the user's intention to move. The output control signal to the actuator extension or retraction is applied resulting in arm extension or flexion, respectively.

The mechanical system is constructed based on a 3D printer concept, with the linear actuator performing elbow/extension movements according to user's intention (figure 1).

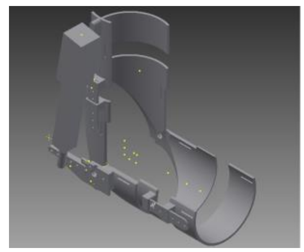

Figure 1 – 3D printer orthosis project concept.

III. Results And Conclusions

The system has been made and successfully tested the pre-processing circuit, the movement intention analysis algorithm, and its integration to the orthosis, further experiments must be performed with patients who will be the real users.

Compared to others devices, the one presented in this work points to a portable, useful orthosis for the day-by-day with no extra weight or size problems. The orthosis itself is made by lightweight material, small size and battery powered. Everything is coupled directly on the server without any external components attached by wires.

Actual results are satisfactory however for a usable and useful operating, would be interesting that the circuit was developed in SMD technology for size reduction, clinical test must be done for real evaluation.

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