UNIVERSITY OF BRESCIA

PhD Program
in
TECHNOLOGY FOR HEALTH

NEW TECHNOLOGY FOR EVALUATION OF NEUROMUSCULAR FUNCTION: NEW TECHNIQUES OF BIOLOGICAL SIGNAL PROCESSING

PhD Candidate: Marta Cogliati

Email: m.cogliati@unibs.it

XXXI Cycle

Tutor: Prof. Claudio ORIZIO; Prof. Corrado PAGANELLI

Background

The neuromuscular system function is to produce the adequate torque through the joint in order to create the movement of the bone segments. The dynamic or static contraction depends on the prevalence of the torque over the resistance. The intensity of contraction is influenced from two factors: 1. the flow of motor commands from the central nervous system (CNS) towards the motor units (MU) and 2. the efficiency of the muscle fibres (MF) contraction. Therefore, the development of force is influenced by the model of activation of the MUs and the neuro mechanical characteristics of the transducer; a possible output deficit could be caused both from central or peripheral dysfunctions. The electromyogram (EMG) is a biological signal, detectable at the muscle surface, generated by the summation electrical activity of the recruited motor units. Amplitude and frequency content of the EMG signal provide information about MU activation strategy; that enables to collect information about the muscle electromechanical efficiency and motor control properties

Objectives

The aim of the neuromuscular function evaluation through the EMG signal analysis is to get inside into the CNS muscle motor control and to identify the biomechanical properties of the muscle-tendon joint unit. The Phd project will therefore include specific experimental designs for these two objectives

Methodologies

The representation of the EMG is usually monodimensional (Fig.1). In recent years, a new signal detection technique has been made available with electrode arrays (64, 128, 256) termed “high density EMG” (HD-EMG). Using a novel decomposition technique for HD-EMG recordings it can be possible to get information about CNS MU activation strategy (Fig.2). The use of these electromyographic analysis can be integrated in the clinical setting activity together with other evaluation systems such as kinematic movement analysis (Fig.3) or robotic systems for rehabilitation (Gloreha)

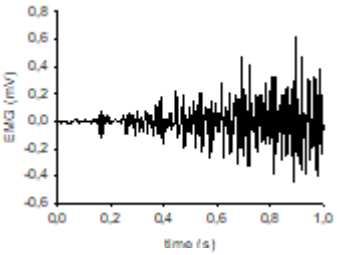

Figure.1 EMG Signal

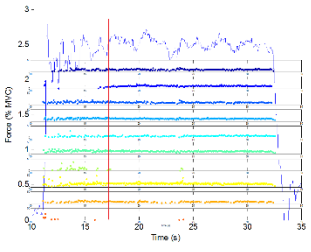

Figure.2 Mu Activation Strategy

Figure.3 Kinematic Analysis

Expected Results and Impact

The combined analysis of the HD-EMG, torque signal and kinematic data will provide a qualitative and quantitative evaluation of CNS motor control features and its efficiency in the generation of a proper mechanical output for daily life activities. The motor control in healthy subjects, patients with neurodegenerative diseases, strokes or spinal cord injuries will be evaluated