UNIVERSITY OF BRESCIA

PhD Program
in
TECHNOLOGY FOR HEALTH

DEVELOPMENT OF INNOVATIVE EXPERIMENTAL PROTOCOLS AND COMPUTATIONAL TOOLS FOR ASSESSING NEURAL CONNECTIVITY IN ARM AND SHOULDER MUSCLES

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Background

The shoulder is one of the joints with greatest capability of movement and, for this reason, it is also one of the most complex biomechanically. There are several muscles connected to this joint and each of them, with their different roles, participates synergistically in movement generation, which is ensured by the coordinated interaction between the neural and musculoskeletal systems.

The motor units are the common final pathway of these integrated systems and, thus, the analysis of their behaviour is an effective window on the neural commands responsible for movement generation. This can be reached with the decomposition of high-density surface electromyograms using advanced blind source separation methods.

Therefore, it could be of considerable interest to use these advanced techniques to investigate the control and behaviour of motor units during the movement of arm and shoulder muscles and, in particular, how this control changes in response to certain stimuli (neuroplasticity).

Objectives

The aim of the project is to characterize the neural control of upper limb muscles, in healthy and pathological subjects, and to assess neural plasticity induced by voluntary contractions and electrical stimulation through the decomposition of surface electromyograms.

Methodologies

Step 1: Development of protocols for assessing the neural control of the upper limb at different degrees of freedom during submaximal isometric contractions with and without peripheral sensory stimulation.

Step 2: Application of the protocol on a sample of healthy and pathological subjects, associated with the recording of myoelectric signals of the muscles involved in shoulder movements.

Step 3: Assessment of motoneuronal connectivity and neuroplasticity.

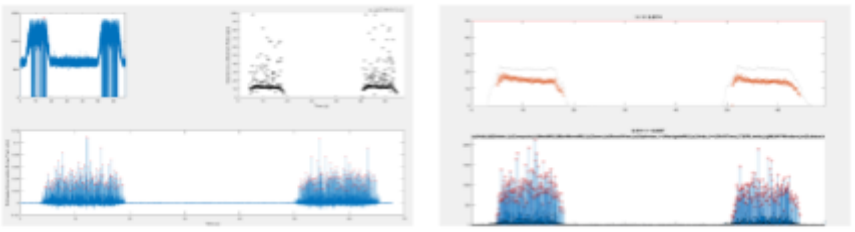

Fig.1 Signal decomposition and improvement

Expected Results and Impact

Expanding knowledge about mechanisms related to neuroplasticity in healthy and pathological subjects with the future goal of developing effective rehabilitation protocols.