Method to Estimate the Muscle Activation Pattern from MRI and EMG

In the study of neuromuscular degenerative disease and in the development of rehabilitation therapies to treat them, monitoring the activity of muscles is crucial to better understand the nature of the impairment and to have a feedback about the changes occurring after applied treatments. As a consequence of pathological conditions, it is also not so uncommon to observe changes occurring in the physical structure and in the behavior of muscles of impaired individuals. It is, therefore, crucial to have a full vision that simultaneously encloses the underlying morphology and the muscle activation behavior, in order to have a full understanding of the impairment status. At the state of the art, the gold standard method to depict morphological information is Magnetic Resonance Imaging (MRI), a diagnostic imaging technique that is used to represent the anatomy and physiological processes happening in the body. For the acquisition of time-related information about the muscle state instead, the most popular technique is electromyography(EMG) is a medical signal acquisition technique that read the potential variation caused by contracting muscles. State of the art method using EMG allow the estimation muscle activity up to motor unit level, but the estimation of deep muscles still remain a challenging problem.

Our group recently proposed a solution to merge the morphology obtained with MRI and the dynamic information from EMG to provide a direct estimation of deep and superficial muscles activities. The method exploits the morphological information contained in the MRI scan to build an electrical lumped model of the conductive volume that is then solved as an inverse problem using the sEMG collected from with a High density EMG electrodes wrapper around the forearm.

We believe that this method can be a valid way to overcome the limitations of the state of the art methods, allowing the estimation of muscle activation with temporal resolution of EMG, potentially improving the information quality for clinicians in the diagnostic process. In particular, we believe that the proposed method can make an important contribution in the field of rehabilitation allowing to track muscle activation pattern on impaired subject during rehabilitative cycles.

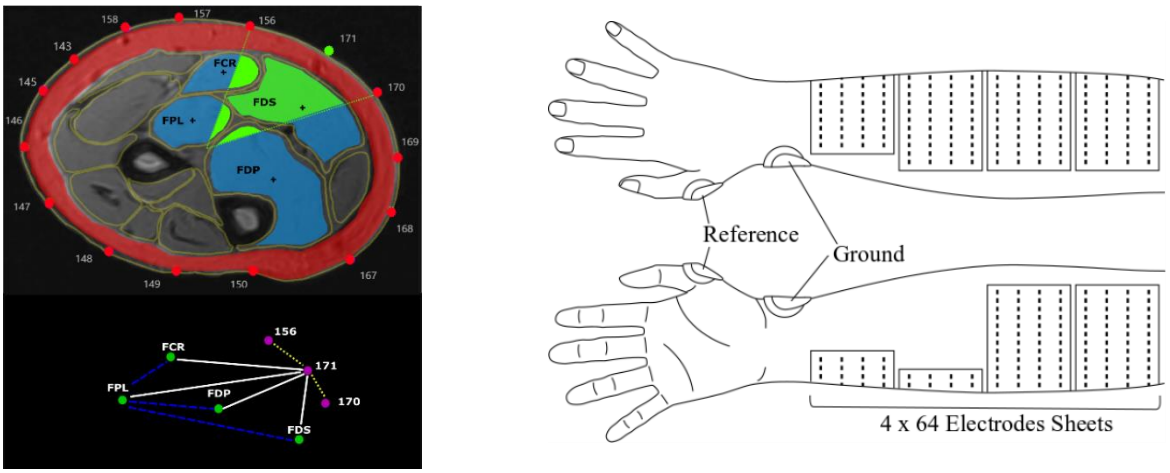

Figure 1. Left : Example of electric circuit construction from the morphological information of the MRI. Top: positioning of the electrodes on the arm.

Keywords: Neuromuscular control, electromyography, MRI, HD-sEMG, human machine interface

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