**Bachelor’s / Master’s Thesis**

# Analysis of the EMG-Force Relationship of the Biceps Brachii

**Project Background**

**Electromyography (EMG) denotes the measurement of the electric potentials generated by muscles during their activation. Surface EMG measurements provide a non-invasive measure of muscle activity by means of electrodes located on the skin above the muscles of interest. Surface EMG measurements are useful to a number of clinical applications including automatic control of prostheses, personalized rehabilitation and diagnosis of neuromuscular illness. For a number of these applications, it is desirable to understand the relationship between the measured EMG signal and the generated muscular force in detail. However, this relationship is nontrivial and depends on a number of factors. The relationship is influenced by the positioning of the electrodes, the current length of the muscle during a contraction and the contraction velocity, among others. The situation is further complicated since measurements of the generated muscular force are usually not available *in vivo* and can only be estimated themselves.**

**Broad Research Question: *How can the generated muscular force of the Biceps Brachii be estimated from measurements of the surface EMG signal?***

**Specific Research Questions:**

* ***How does the EMG-Force relationship depend on the muscle activation level?***
* ***How does the EMG-Force relationship depend on the muscle length?***
* ***How does the EMG-Force relationship depend on the contraction velocity?***
* ***How subject-specific is the EMG-Force relationship?***

**Project Description**

**In this thesis project, the EMG-Force relationship of the human Biceps Brachii shall be analyzed *in vivo*. In particular, the influence of muscle length and contraction velocity is to be assessed and modeled mathematically. To this end, an experimental apparatus consisting of a force sensor and an EMG measurement device is readily available at the institute. Experiments that allow for the analysis of the influence of the different parameters on the generated force are to be conceived, and a study with a small number of subjects is to be performed, in order to quantify the inter-subject differences. The parameters of the mathematical model shall then be estimated for each subject, and if necessary, the model is to be adjusted for further observed effects. The results should then be analyzed statistically to answer the posed research questions quantitatively.**

**Keywords:** Electromyography, Neurophysiology, Musculoskeletal Physiology, Mathematical Modelling, Parameter Estimation, Signal Processing

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