UNIVERSITÄT ZU LÜBECK
INSTITUT FÜR
MEDIZINISCHE ELEKTROTECHNIK

Bachelor's / Master's Thesis

Analysis of the EMG-Pdi Relationship of the Human Diaphragm

Figure 1: In this thesis, the electro-mechanical parameters of the human diaphragm shall be anlyzed. The estimation procedures are to be implemented on a Dräger medical ventilator.

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.

EMG measurements are useful to a number of clinical applications, one of which is mechanical ventilation. In this application, it is desired to estimate the amount of pressure that is generated by the respiratory muscles while breathing. In particular, the pressure Pdi generated by the main respiratory muscle, the diaphragm, is to be estimated.

In order to estimate the generated Pdi from surface EMG measurements of the diaphragm, the relationship between the two must be fully understood. However, this relationship is nontrivial and depends on a number of factors. The relationship is influenced by the positioning of the electrodes; by the gas volume currently present in the lungs; by the magnitude of the inspiratory air flow; and

others. The situation is further complicated since measurements of Pdi are usually not available and can only be estimated themselves.

Project Description

In this thesis project, the EMG-Pdi relationship of the human diaphragm shall be analyzed. In particular, the influence of inspiratory air flow and lung volume is to be assessed and modeled mathematically. To this end, an experimental apparatus consisting of a medical ventilator and an EMG measurement device is readily available at the institute. Parameters of a mathematical model are to be estimated, and if necessary, the model is to be adjusted for further observed effects. Effective means of validation of the proposed estimation of Pdi must be found. Finally, if time permits, multiple algorithms for the estimation of the required parameters may be compared.

Keywords: Electromyography, Mechanical Ventilation, Mathematical Modelling, Parameter Estimation, Signal Processing

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