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Master's thesis

Bayesian Methods for Source Separation of Surface Electromyographic Measurements

Project Background

Surface Electromyography (sEMG) denotes the measurement of the electric potentials invoked by contracting muscle fibers at the skin surface. The measured signal consists of the summation of the contributions of all nearby muscle fibers, hence possibly representing a mixture of activity from different muscles. For a number of diagnostic and medical engineering applications, it is desirable to be able to separate the contributions of the different muscles to the measured signals, in order to obtain reliable measures of individual muscle activity.

Bayesian data analysis denotes a group of extremely powerful statistical methods that allow to draw inferences about state and parameters of a measured process from measured data and assumed models of the underlying processes, while always taking uncertainty on models, parameters and data into account [1]. It has enjoyed tremendous success in the machine learning community in the past several decades and has been employed to solve a host of problems, including EEG and MEG signal processing [2]. Bayesian modeling can also be used to solve source separation problems, i.e., to recover the individual contributions of several underlying sources from measures of mixtures of these sources [1,3]. There have been first attempts to apply Bayesian methods to the problem of separating muscle sources in EMG measurements [4], using the factor graph framework for graphical representation of Bayesian probabilistic models and algorithms [5].

Project Description

In this thesis project, the applicability of Bayesian modeling to the sEMG source separation problem shall be investigated. A formulation and solution of this problem in the factor graph framework for graphical modeling will be of particular interest. Algorithmic performance is to be assessed using an existing numerical simulation of respiratory EMG measurements.

Keywords

Probabilistic Modeling, Stochastic Inference, Source Separation, Electromyography (EMG)

References

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