

# Crosstalk Analysis of Electromyographic Signals

Subject: Communication Technologies

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**Electromyography (EMG)** is a technique for recording the electrical activity of skeletal muscles. This project focusses on EMG based pelvic floor muscle (PFM) activity, which is important in rehabilitation therapies to treat female stress urinary incontinence. Intravaginal probe based PFM signals are affected by interfering electrical (IM) activities from adjacent muscles, the so-called crosstalk. A program for the crosstalk analysis for PFM signals was developed.

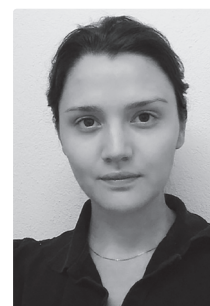
## Signals and Methods

IM-signals were recorded on the lower abdominals and upper leg muscles using surface EMG. PFM activity was recorded using an intravaginal probe. Three main protocols were conducted on 3 subjects: 1) maximal voluntary contraction of PFM and each IM group separately, 2) drop jumps, and 3) treadmill jogging. Crosstalk was assessed using different Digital Signal Processing methods. In a first approach the cross correlation coefficient was processed between PFM and each group of IM signals. In order to obtain a more accurate information of the crosstalk with respect to specific frequency ranges, the coherence function in physiological bands ULF=0...15Hz, LF=15...60Hz, HF=60...250Hz) was evaluated. In a third approach, taking into account the particular shape of EMG-bursts occurring during muscle contraction activities, the Discrete Wavelet Transform (DWT) was used to process the cross-correlation in the physiological sub-bands.

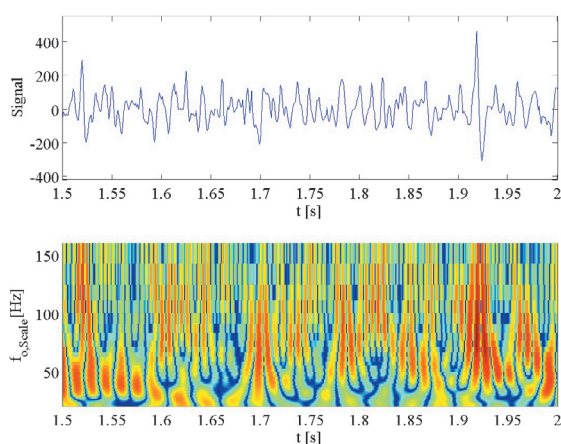
## Results and Discussions

A graphic user interface (GUI) was developed in such a way, that a user can select a given protocol. Results

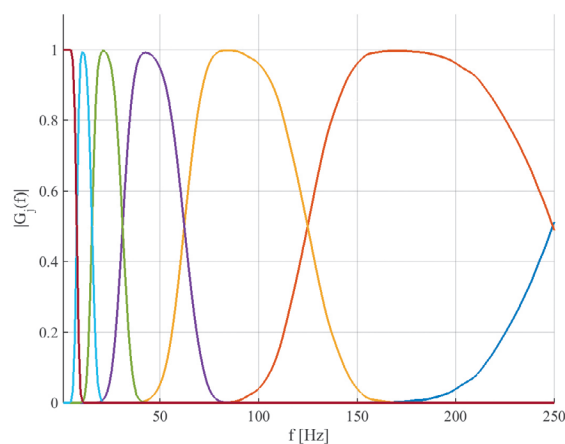
of cross-correlation coefficients, coherence and sub-band cross-correlation coefficients are automatically processed and reported in Excel documents. These documents are at disposal of physiologists for further studies. For the 3 subjects we obtained crosstalk estimations by means of the absolute value of the cross-correlation coefficient lower than 26%. Further investigations using the magnitude squared coherence function highlighted that the crosstalk occurred mainly in the ULF-frequency band with a maximum of 29%. In the LF and HF-band the maximum crosstalk amounted to 6.3% and 5.9% respectively. The fact that crosstalk occurs mainly in the ULF-band constitutes a promising result for experimental physiologists. Indeed, it has been shown in previous studies that relevant features of PFM signals, which may be used to assess pathological issues related to urinary incontinence, are to be extracted from the LF and HF-band. Since the crosstalk in these upper bands is relatively low, sub-band based intravaginal probe PFM-signal analysis has a high relevance for the study and assessments of pathological issues related to urinary stress incontinence.



Aida Ghassemi



EMG of intravaginal probe based PFM-signal (top) and its Wavelet Transform (bottom) from a healthy subject



Frequency response of different scales of the applied discrete Wavelet Transform