

Postgraduate student: **Eftaxias Konstantinos**

Thesis Title:

EEG Signal Processing using Kernel Methods

Abstract:

Biomedical signals are generally contaminated with artifacts and noise which makes the analysis of events of interest quite difficult. Specifically electroencephalographic signals are contaminated by artifacts such as eye movements and blinks or muscle activity. In this thesis we look at the effect of ocular activity in the EEG signal and our aim is to remove it without the loss of important information from the EEG.

The method we are using is kernel principal component analysis. In this method we need to map our data from input space to a Hilbert space with a nonlinear mapping. Using kernel functions we can avoid the actual nonlinear mapping which is computationally costly and compute only the dot products in the feature space using only the data from the input space. Any method that can be expressed by dot products can be transformed to nonlinear using kernel functions. Also important is the transformation of the data from the feature space to the input space which is known as the pre-image problem. We are using an iterative method in order to find an approximate solution to the problem as the real solution may not exist. To apply the method to EEG signals we transform the vector containing the signal obtained by an electrode to a matrix of lagged vectors.

For testing these methods we use EEG signals with artifacts of eye blinks. For optimal artifact removal and preservation of the EEG information we need to choose carefully the method's parameters. The assumptions we can draw from the experiments are very useful. Depending on these experiments we can claim that the performance of kernel principal component analysis in EEG denoising overcomes the non kernel version.

Examining Committee

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