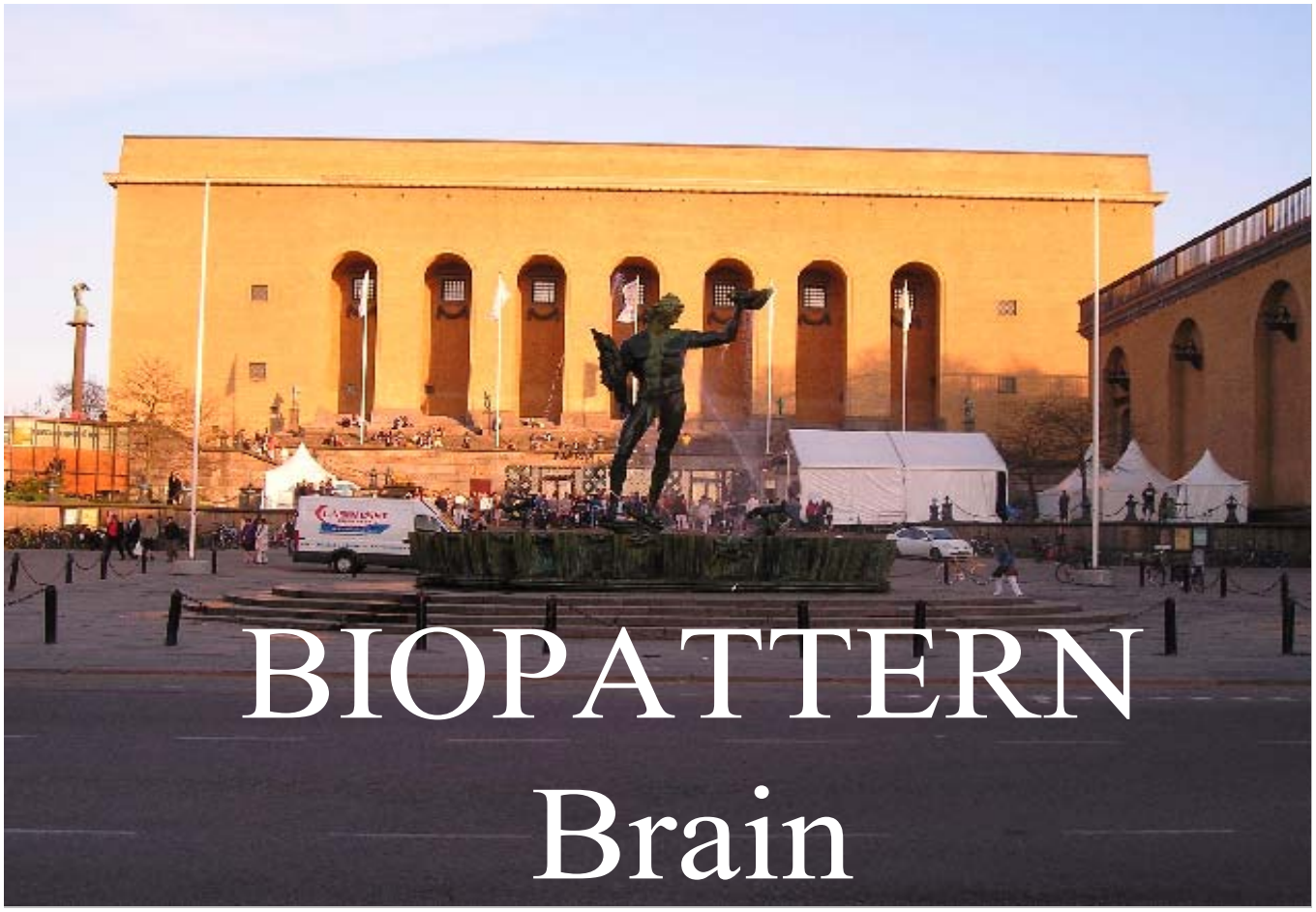

BIOPATTERN Brain

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EEG signal pre-processing for segmentation into significant regions, major artefacts removal, and uncertainty reduction in epileptic seizure characterization

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INTRODUCTION

EEG analysis is widely used for clinical investigations of several neurological disorders. As EEG signal is normally a low amplitude (microvolts) signal and recording is multichannel, with epochs lasting from several minutes to hours depending on the test focus, difficulties can arise due to artefacts contaminating the data and also due to the presence of various events in the signal that could occur frequently.
This is why, in order to improve the accuracy of clinical conclusions based on EEG analysis, it is important to provide the scientific research and then the clinical routine with EEG prepocessing methods aiming to remove major artefacts, perform suitable segmentation of EEG for further analysis and for accurate characterisation of events detected in segmented epochs such as the epileptic seizure event reducing the uncertainty in clinical analysis. Here we describe several methods for that goal.

Methods

As there have been various artefact specific attempts for artefact cancellation, our focus here is targeted only on major artefacts removal trying not to remove any useful information. To do it, we apply time-frequency analysis using continuous wavelet transform for segmentation of the signal into different significant regions to be evaluated by expert clinicians. Throughout this paper the evaluation of the results of artifact removal is addressed.

As our main goal is to identify preprocessing methods to reduce uncertainty in epileptic seizure characterization, the comparison and evaluation of various preprocessing methods is shown and discussed in this paper. Mostly time-frequency based but also other specific defined measures is carried out and described.
Various time-frequency approaches are as follows:
−Wavelet Transform analysis;
- Empirical Mode Decomposition;
- Time-frequency Compressed Spectral Array by polynomial modeling decomposition;
- applying phase space time-frequency analysis.
Although this analysis is performed on a single channel basis, they can be combined on a multi-channel analysis by computing the cross-correlation and determining the inter-channel lags that were also performed

Other EEG preprocessing approaches includes:
- applying Navona descriptor to distinguish between epileptic seizure and other kind of events (artefacts) in EEG.
- performing source localization of the seizure, focussing the dipoles from dipole localisation map and reconstructing the EEG trace as a measure for pre-processing.

RESULTS & CONCLUSION

With these methods we are able to characterize both the normal EEG and the epileptic seizure.
The Figure of Merit used is the percentage of True/False detection (characterization) of seizure from segments of EEG signal (that might include also other kind of events).
The results from each method can be further improved by results fusion, which should lead to a reduction in uncertainty of seizure characterization.

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