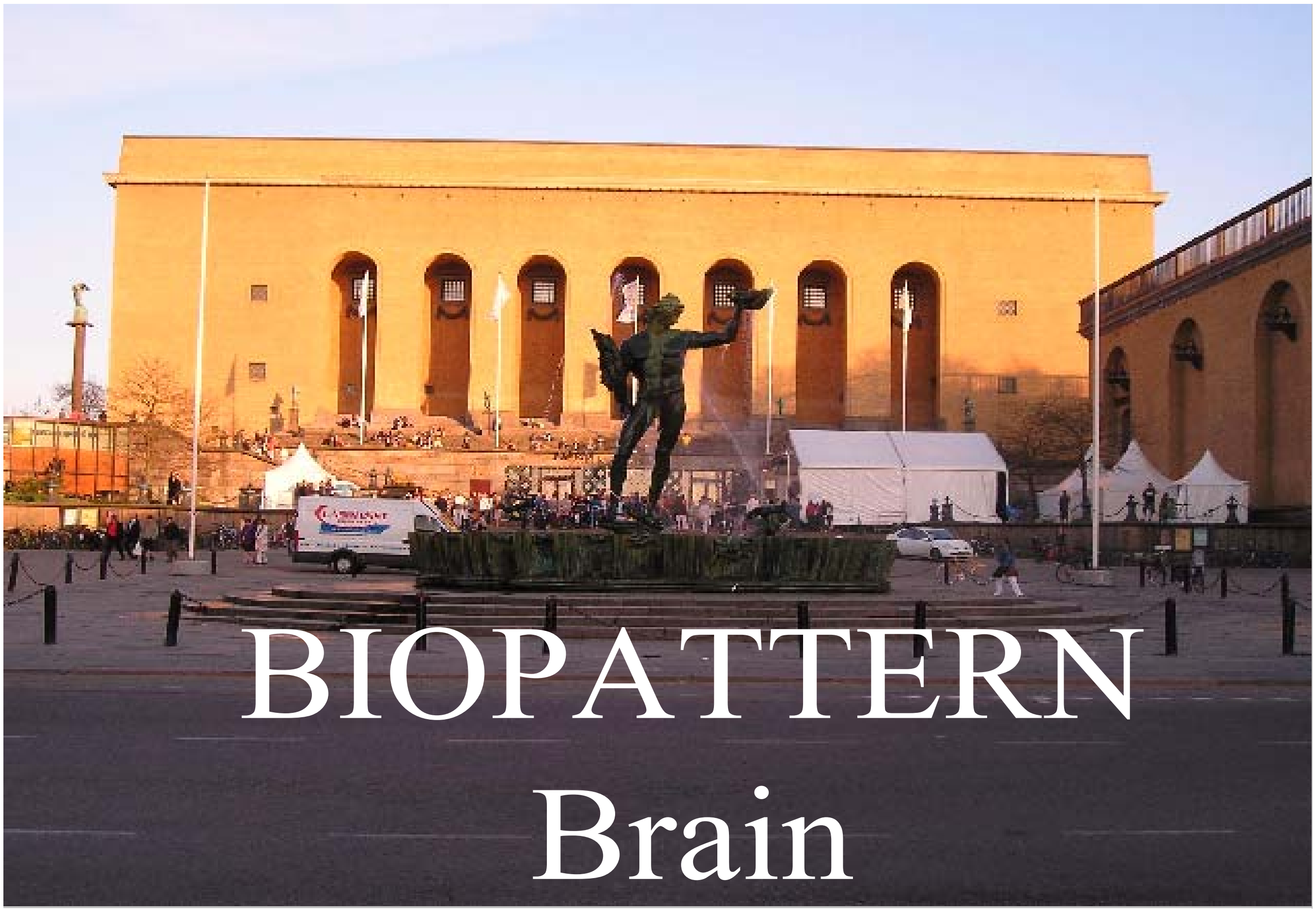

BIOPATTERN Brain

Information Society Technologies

Workshop
Göteborg
18-19 May 2006

BIOPATTERN NETWORK of EXCELLENCE

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EEG Dipole Source Localization – A comparative analysis

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INTRODUCTION

An electroencephalogram (EEG) plots the scalp potentials, recorded non-invasively from electrodes connected to the scalp, as a function of time. The information extracted from these brain potentials is significantly important to the diagnoses of neurological diseases, including epilepsy [1]. Of particular interest is the localization of the sources which generate the recorded brain waves. EEG source localization concerns the estimation of the location of these sources.

Method

Neural activity can be modeled as currents generated by current dipoles. In the forward problem, the first step of EEG dipole source localization, a number of dipoles are placed inside the head and the scalp potentials generated by this current distribution are recorded. In a three shell spherical head model, an analytical expression exists to solve this forward problem. In conjunction with the actual EEG data recorded at electrodes on the scalp, the result of the forward problem is then used to solve the inverse problem. This involves the estimation of the strength, orientation and position of sources within the brain given a set of potential recordings.

The focus here is on the comparison of different approaches used to solve the inverse problem. In particular, four of the most recently-developed and well established imaging methods have been implemented. These are the weighted minimum norm [2], LORETA [2], sLORETA [3] and Shrinking LORETA-FOCUSS [4], which is a combination of the LORETA and FOCUSS algorithms and makes iterative adjustments to the solution space. In the literature, these inverse solutions have been successfully applied on synthetic data and shown to give good source localization results.

In this analysis we apply these inverse solutions to real EEG data for which clinical information about the expected location of the sources is available. A comparative analysis of the solutions together with their clinical relevance is carried out. A three layer spherical head model is assumed in each of the inverse solutions.

DISCUSSION

When the above mentioned inverse solutions are applied to synthetic data, the Shrinking LORETA-FOCUSS method gives the best solution in terms of the smallest dipole localization error for both noiseless and noisy scalp signal cases. In this paper, these inverse solution methods are applied to real EEG data and the solutions obtained by the different inverse solutions are discussed, identifying the strengths and weaknesses of these dipole localization methods with respect to clinical evidence.

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