Ad-hoc Gaussian Dictionaries for Sparse Representation of Evoked Related Potentials

Victoria Peterson*, Hugo Leonardo Rufiner*†, Rubén Daniel Spies††

* Instituto de Investigación en Señales, Sistemas e Inteligencia Computacional, Facultad de Ingeniería y Ciencias Hídricas, Universidad Nacional del Litoral (sinc(i)-FICH-UNL-CONICET).
Ruta Nac. No 168, km 472.4 (3000), Santa Fe – Argentina
vpeterson@santafe-conicet.gov.ar

† Facultad de Ingeniería, Universidad Nacional de Entre Ríos (FI-UNER)
Ruta Prov. 11 Km.10 Oro Verde (Dpto. Paraná) - Entre Ríos Argentina
lrufiner@fich.unl.edu.ar

†† Instituto de Matemática Aplicada del Litoral (IMAL-CONICET-UNL), Ruta Nac. No 168, Paraje El Pozo (3000), Santa Fe, Argentina and Facultad de Ingeniería Química, Universidad Nacional del Litoral, Consejo Nacional de Investigaciones Científicas y Técnicas (FIQ-UNL), Santiago del Estero 2829 , (3000) Santa Fe, Argentina.
rspies@santafe-conicet.gov.ar

ABSTRACT

Scalp electroencephalography (EEG) measures electrical activity produced by post-synaptic potentials of large neuronal assemblies. By using only brain activity a BCI is a system which provides direct communication between the mind of a person and the outside world [1]. A common EEG BCI paradigm is based on the so called event-related potentials (ERP) which are responses of the brain to some external stimuli. In this context, the innermost part of a BCI is a pattern recognition stage whose aim is to detect the presence of ERPs with high accuracy [2].
In recent years there has been a growing interest in the study of sparse representation of signals [3]. Using a dictionary composed of prototype atoms, signals are written as linear combinations of just a few of those atoms. This sparse representation is found to be appropriate for posterior classification purposes. One of the main components of ERP signals is the so called P300 wave, which is an ongoing positive deflection occurring about 300 ms after a corresponding stimulus is presented. In this work we propose a sparse representation and posterior classification of ERPs signals by means of an *ad-hoc* spatio-temporal dictionary composed of bidimensional gaussian atoms. The construction of the dictionary is aimed to capture both the main variation of the P300 wave and the variation of those records without P300 over a range between 0.2s and 0.6s in the space-time domain. One dictionary per subject is constructed. Two open-access P300 data base are used [4], [5]. Based on the sparse representation, different classifiers are designed by solving an associated inverse problem with different penalizers. The performances of those classifiers are compared both among them and with state of the art results.

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