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Special Issue of Neurocomputing on Advances in Blind Signal Processing

In the last decade, we have witnessed several new technologies becoming part of everyday life, such as those in biomedicine (fMRI, EEG, MEG), multimedia (teleconferencing, distance learning), data/sensor fusion (smart rooms, smart hospital wards) and communications (mobile, CDMA, OFDM), to mention just a few. These have brought to light problems where nonlinearity, uncertainty, noise, and cross-channel mixing play major roles. This has also generated problems where the shear amount of data makes the standard estimation techniques ill equipped for practical applications. To deal with these issues, and with the very limited knowledge available about the data production mechanisms (e.g. for brain signals we cannot calculate a transfer function between, say, the EEG data and the picture shown to a subject), there has been a huge ongoing effort in the international research community directed towards developing techniques suitable for processing of the data in some unsupervised and automated fashion.

In particular Blind Source Separation (BSS), Blind Source Extraction (BSE), and Independent Component Analysis (ICA) have become main research directions spanning the broad areas of Signal Processing, Neural Networks, Machine Learning, Data/Sensor Fusion and Communications. The underlying idea there is to obtain as accurate as possible knowledge about the sources, whose linear or nonlinear, instantaneous or convolutive mixtures are observed via a number of sensors and in the presence of noise. Due to the fact that we can rely on only the measured (rather than source) data, mathematical descriptions of signal generation processes, and models of physical transmission channels are totally or partially unknown. To obtain feasible practical algorithms, and at the same time to allow for mathematical tractability, a variety of assumptions regarding the nature of the sources and mixing processes have been imposed onto the BSS/ICA problem, for instance statistical independence and linearity.

More specifically, for linear instantaneous mixtures of statistically independent sources, ICA has been extensively studied and a wealth of successful solutions exists in the open literature. The ICA concept has found a variety of very important applications in the areas such as speech and acoustic signal processing (cocktail party effect), biomedical signal processing (cardiac activity analysis, neural activity imaging), bioinformatics (gene expression), and astrophysical signal processing. While the independent component analysis problem enjoyed such widespread attention and interest, there has been relatively little research effort focusing on settings, which involve more realistic situations, such as convolutive and nonlinear mixtures and intermittent nature of sources.

Blind source separation and ICA are already maturing and well understood, but also have their limitations due to the underlying assumptions of statistical independence and non-Gaussianity of the sources. The purpose of this special issue “Advances in Blind Signal Processing” is therefore to give the international research community a comprehensive account of the remaining open problems in the field, together with a proposal of novel theoretical, computational and practical solutions. These will help to overcome some of the limitations associated with standard BSS/ICA and give new important research directions. Special emphasis will be on important emerging issues within the BSS/ICA framework, such as dealing with nonlinear and convolutive mixtures, other physically inspired mixture models, and alternative statistical assumptions. These include, for instance, sparsity, non-negativity, and predictability. Extraordinary theoretical contributions and BSS/ICA applications dealing with the standard linear instantaneous mixture model will also be considered, however submissions based on incremental algorithmic approaches will not be encouraged.

The topics of interest to this special issue include, but are not limited to the following blind signal processing paradigms:

- Nonlinear blind signal processing
- Convolutive BSS/ICA
- Exploiting sparseness within the BSS/ICA framework
- Nonnegative matrix factorization
- Separation and extraction of sources based on their fundamental properties and distinct statistical behaviors, such as their linear/nonlinear predictability
- Information theoretic and higher order statistical methods for blind signal processing

- Nonparametric and robust estimators for information theoretic and higher order statistical measures
- Theoretical and computable performance bounds and margins on blind signal processing algorithms
- Novel applications of blind signal processing

The submissions will be handled through the Electronic Editorial System of Elsevier. Prospective authors are invited to register at http://ees.elsevier.com/neucom/ and submit their papers electronically in a format consistent with the author submission guidelines of Neurocomputing. When submitting, please indicate that your manuscript is a *Special Issue Paper* and select the topic *Blind Signal Processing* when prompted by the system. The special issue is scheduled for publication in the fall of 2007. Submission deadline for manuscripts is **August 28th, 2006**. For questions regarding submissions to the special issue, please contact one of the guest editors. For technical questions regarding the submission website, please contact the support office at Elsevier.

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