Preface

Signal Processing has always played a critical role in science, technology and development of new systems such as computer tomography, (PET, fMRI, EEG/MEG, optical recordings), wireless communications, digital cameras, HDTV, etc. As demand for high quality and reliability in recording and visualization systems increases, signal processing has an even more important role to play.

Blind Signal Processing (BSP) is now one of the hottest and emerging areas in Signal Processing with solid theoretical foundations and many potential applications. In fact, BSP has become a very important topic of research and development in many areas, especially biomedical engineering, medical imaging, speech enhancement, remote sensing, communication systems, exploration seismology, geophysics, econometrics, data mining, etc. The blind signal processing techniques principally do not use any training data and do not assume *a priori* knowledge about parameters of convolutive, filtering and mixing systems. BSP includes three major areas: Blind Signal Separation and Extraction, Independent Component Analysis (ICA), and Multichannel Blind Deconvolution and Equalization which are the main subjects of the book. Recent research in these areas is a fascinating blend of heuristic concepts and ideas and rigorous theories and experiments.

Researchers from various fields are interested in different, usually very diverse aspects of BSP. For example, neuroscientists and biologists are interested in the development of biologically plausible neural network models with unsupervised learning. On the other hand, they need reliable methods and techniques which will be able to extract or separate useful information from superimposed biomedical source signals corrupted by huge noise and interferences, for example, by using non-invasive recordings of human brain activities, (e.g., by using EEG or MEG) in order to understand the ability of the brain to sense, recognize,

store and recall patterns as well as crucial elements of learning: association, abstraction and generalization. A second group of researchers: engineers and computer scientists are fundamentally interested in possibly simple models which can be implemented in hardware in available VLSI technology and in the computational approach, where the aim is to develop flexible and efficient algorithms for specific practical engineering and scientific applications. The third group of researchers: mathematicians and physicists, have an interest in the development of fundamental theory to understand mechanisms, properties and abilities of developed algorithms and in their generalizations to more complex and sophisticated models. The interactions among the groups make real progress in this very interdisciplinary research devoted to BSP and each group benefits from the others.

The theory built up around BSP present so extensive and applications are so numerous that we are, of course, not able to cover all of them. Our selection and treatment of materials reflects our background and our own research interest and results in this area during the last 10 years. We prefer to complement other books on the subject of BSP rather than to compete with them. The book provides wide coverage of adaptive blind signal processing techniques and algorithms both from the theoretical and practical point of view. The main objective is to derive and present efficient and simple adaptive algorithms that work well in practice for real-world data. In fact, most of the algorithms discussed in the book have been implemented in MATLAB and extensively tested. We attempt to present concepts, models and algorithms in possibly general or flexible forms to stimulate the reader to be creative in visualizing new approaches and adopt methods or algorithms for his/her specific applications.

The book is partly a textbook and partly a monograph. It is a textbook because it gives a detailed introduction to BSP basic models and algorithms. It is simultaneously a monograph because it presents several new results and ideas and further developments and explanation of existing algorithms which are brought together and published in the book for the first time. Furthermore, the research results previously scattered in many scientific journals and conference papers worldwide, are methodically collected and presented in the book in a unified form. As a result of its twofold character the book is likely to be of interest to graduate and postgraduate students, engineers and scientists working in the field of biomedical engineering, communications, electronics, computer science, finance, economics, optimization, geophysics, and neural networks. Furthermore, the book may also be of interest to researchers working in different areas of science, because a number of results and concepts have been included which may be advantageous for their further research. One can read this book through sequentially but it is not necessary since each chapter is essentially self-contained, with as few cross references as possible. So, browsing is encouraged.

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