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Editorial

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Recent progress in digital wireless communication systems has led to broad research interest in multiuser detection and blind estimation techniques and their applications. In fact, the fundamental concept of multiuser detection and blind estimation has transformed into a main-stream research area. Next generation wireless telecommunication systems will be dominated by CDMA and OFDM that can benefit tremendously from the use of multiuser detection. By utilizing blind estimation approaches, packet-based wireless systems can also be designed to maximize system throughput. In addition to applications in communication systems, the future of multimedia signal processing must cope with multiple data channels and multiple interfering signal sources under unknown channel distortions. Blind channel estimation and signal recovery in the context of multiuser interface will find strong applications in various multimedia environment.

The challenges of multiuser detection and blind signal recovery include unknown channels, lack of synchronization information, near-far problems, and unknown number of active sources. These problems represent some of the most important and interesting research issues in applied signal processing. In this special issue, we are pleased to present a number of new developments and results that tackle some of these basic problems. A total of fifteen contributions are featured here with the help of our diligent reviewers from a number of excellent submissions. As editors, here we would like to assist our readers by providing a succinct summary to cover the various topics in these works and their connections.

The first two papers address the problem of CDMA multiuser reception in adverse channel environment through the deployment of transmit diversities such as space-time coding. The work by Jayaweera and Poor integrates the zero-forcing concept into an MMSE detector to suppress multiple access interference and that of RAKE combining for bit error rate optimization. Downlink under space-time block coded modulation is included as the transmitter strategy. Similarly, the paper by Sun and Li presents solutions to the problems of blind channel identification and detection for space-time coded multicarrier CDMA systems under slowly fading channels. Several alternative approaches are presented by jointly utilizing Alamouti space-time coding, subspace decomposition, and detection strategies such as maximal-ratio combining, equal-gain combining, and MMSE.

The next two papers focus on multipath fading channels that are frequency selective. The study by Reynolds, Host-Madsen, and Wang investigates the use of adaptive precoding at the transmitter end for downlink transmission of a time-division duplex CDMA systems. Well-designed precoding at the transmitter is shown to allow the use of a simple matched filter at the receiver end. In addition, the issue of channel estimation is also addressed, and a blind adaptive implementation of the system is proposed and assessed. Along a similar line, the paper by Kadous and Sayeed considers the problem of MMSE detection for both DS-CDMA and multicarrier CDMA operating on doubly dispersive channels. A unified approach is presented and conditions for the equivalence between the two transmission systems are given, supported by comprehensive performance analysis.

The focus on CDMA communication systems is further strengthened by four additional works on CDMA multiuser detection under adverse conditions. The investigation by Zha and Blostein integrates the principle of delay tracking in time-varying environment into a successive interference cancellation CDMA detector. Error signal feedback is proposed for delay estimation of different users. The reduced-rank detector presented by Cai, Ge, and Akansu is developed under the MMSE principle while maintaining low complexity. It is shown to be related to the minimum output energy (MOE) detector which is also studied by Xu in the paper that follows. The MOE modification by Xu aims to improve the MOE receiver. In particular, these two papers address the issue of a possible imprecise covariance estimate. To provide a rigorous and clear overview, the tutorial paper by Burykh and Abed-Meraim shows that several multiuser detection and adaptive array algorithms in the literature can be stated as reduced-rank adaptive filtering in a Krylow subspace context.

Unlike the linear approach taken by previous authors, two additional CDMA papers resort to nonlinear multiuser detection algorithms. The first in order is the study of Jeney, Levendovszhy, Pap, and van der Meulen, who propose an adaptive multiuser detection algorithm that can perform near optimal detection with unknown channel characteristics. Their method is based on recently developed neural network techniques including stochastic Hopefield net, hysteretic neural net, and self-organizing feature map. The noncoherent detector by Sinha, Yener, and Yates is designed for nonlinear modulation of nonorthogonal signals. Its use of selective filtering, that exploits a priori information on the user signals, offers improved performance over existing approaches. The implementation can be either deterministic or adaptive.

The fundamental problem of blind channel and signal estimation also attracted significant in-depth coverage. Without confining to a particular communication modulation format, the three contributions featured here attack related problems under various practical constraints. The blind channel estimation problem is addressed in two papers. The use of higher-order statistics by Liang and Ding offers a simple but robust channel estimation method which does not require the exact knowledge of dynamic FIR channel length. This noniterative algorithm requires relaxed channel identifiability conditions. The iterative algorithm for maximum likelihood estimation by Rousseaux, Leus, and Moonen focuses on obtaining the initial channel estimate as it seriously affects the convergence of many iterative schemes. This work relies on known information from symbol padding and cyclic prefix for accurate initial channel estimation. The blind equalization work by Destro-Filho that follows also adopts the approach of joint channel and symbol estimation. At its heart is a simple test for assessing the quality of the equalizer output in order to correct possible local convergence.

Concluding this special issue are two contributions that adopt the popular viewpoint of blind source separation. The work by Gannot and Yeredor tackles the issue of noise cancellation from its instantaneous mixing with a nonstationary signal of interest. It offers two approaches based on second-order statistics of the output noisy signal. The paper by Erdogmus, Rao, Hild, and Principe develops a blind adaptive multiuser detector based on a new principle component analysis (PCA) method. This simultaneous principal component extraction is a gradient-based approach. A convergence analysis is given and applications of this algorithm in other areas, such as estimation of direction of arrivals as well as subspace tracking, are also given.

It is clear from this summary that the special issue includes a plethora of excellent contributions to the important subject of multiuser detection and blind estimation. The full impact of these works can only be understood by carefully reading these contributed articles. As editors of the special issue, we strongly feel that the important contributions that we present to the readers represent another important step toward providing a better understanding of and more practical solutions to this important subject area.

In closing, we wish to thank all the authors for their excellent contributions. We are deeply indebted to all the reviewers for their diligent efforts in the evaluation of all the submitted manuscripts. We would not have been able to put together this special issue without their hardwork and timely responses. Last but not least, we wish to offer our thanks to the editorial board for their encouragement and helpful comments and, in particular, to the Editor-in-Chief, Professor Ray Liu, for his outstanding leadership in the transformation of this journal into its elevated status.

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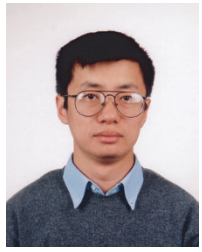

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