EURASIP Journal on Wireless Communications and Networking 2004:1, 1–3

Editorial

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This editorial reflects the emerging system design and signal detection methods for next-generation digital cellular CDMA system. In CDMA system, in addition to intersymbol interference (ISI) caused by multipath propagation, simultaneous transmission also introduces multiuser interference (MUI). The receiver is, therefore, required to separate and recover the information signal of the desired user(s). Compared to the conventional single-user detectors where interfering users are modeled as noise, significant improvement can be obtained with multiuser detectors where MUI is explicitly part of the signal model.

In literature, if the spreading sequences are periodic and repeat every information symbol, the system is referred to as short-code CDMA, and if the spreading sequences are aperiodic or essentially pseudo-random, it is known as long-code CDMA. Since multiuser detection relies on the cyclostationarity of the received signal, which is significantly complicated by the time-varying modeling of the long-code system, research on blind multiuser detection has largely been limited to short-code CDMA. On the other hand, long-code is widely used in virtually all operational and commercially proposed CDMA systems due to its performance stability in frequency fading environment and better information security. More recently, researchers have been targeting on effective and efficient multiuser detectors for long-code CDMA systems as well. Furthermore, combination of CDMA and OFDM is attracting more and more attention in order to take the advantages of both schemes.

In this special issue, novel techniques on spreading sequences design, space diversity (multiple transmit and receive antennas), time diversity (channel coding, interleaving), and combination of CDMA and OFDM, in conjunction with new channel estimation and signal extraction approaches, are intensively investigated to achieve good system performance while improving system capacity for broadband multimedia wireless communications.

This special issue contains the following five topics.

Spreading sequence design

Spreading sequence design is essential in synchronization, channel estimation, effective MUI suppression, and communication security. On this topic, (i) Cotae addresses the problem for an overloaded synchronous DS-CDMA system in a multicell environment. A promising algorithm has been derived to design orthogonal generalized WBE sequence sets for any processing gain. (ii) Ren proposes an efficient and flexible approach to construct pseudo-random sequences with long period, large complexity, balance statistics, and low correlation properties from addition of M-sequences with pairwise-prime linear spans. (iii) Fan gives a nice survey on the recent trends and results on generalized orthogonal and quasiorthogonal sequences design and theoretical limits.

Space-time signal processing

As a relatively new member in space-time signal processing, transmit antenna diversity is gaining increasing popularity

in communication system design and signal extraction. On this topic, (i) Dai, Mailaender, and Poor study the algorithm choice in CDMA cellular downlink transmission with transmit antenna arrays over multipath fading channels. They conclude that, in general, maximum SNR beamforming is the best choice for circuit-switched systems, whereas for packet-switched systems, maximum SINR beamforming is the best choice. (ii) W. Li and Gulliver introduce a novel successive interference cancellation (SIC) technique for DS-CDMA systems employing space-time block codes (STBC) at the transmit side. Both hard- and soft-decision-based cancellation schemes are analyzed and simulated.

Multicarrier CDMA

Due to its strong capability in combating frequency-selective fading and tracking the time-varying channels, multicarrier CDMA (MC-CDMA), which is the combination of CDMA and OFDM, is a promising candidate for broadband communication systems. On this topic, (i) Rahman, Sesay, and Hefnawi consider a two-stage ML-based detector for a multitone CDMA system. In the first stage, the channel is estimated using a given symbol, while in the second stage, the estimated channel is used to detect the next symbol. The theoretical model is validated with simulation results for Rayleigh fading environments. (ii) Preequalization techniques are derived by Silva and Gameiro for downlink TDD MC-CDMA system using space-frequency algorithms. The approaches effectively reduce multiple access interference at the base station, enabling low-cost terminal designs without sacrificing the system performance. (iii) Raulefs, Dammann, Sand, and Kaiser present an innovative rotated Walsh-Hadamard-based spreading scheme for MCCDMA applications. The rotated spread gain, stemmed from signal-space diversity, increases the system performance by almost 1 dB in a fading environment.

Channel estimation and signal detection

Accurate channel estimation is the guarantee for effective signal detection. On this topic, novel blind channel estimation and multiuser detection approaches are investigated for long-code CDMA and MC-CDMA systems. More specifically, (i) Sirbu and Koivunen address the problem of propagation delay estimation in asynchronous long-code DS-CDMA multiuser systems. By modeling the users' propagation delays in the MIMO channel matrix, delay estimates are obtained as a by-product of the channel estimation. (ii) P. Liu and Xu carry out a joint performance study of channel estimation and multiuser detection for long-code uplink CDMA systems using perturbation theory. Simulation and analytical results show good agreement. (iii) Dang and van der Veen present a joint multiuser source-channel estimation approach for long-code CDMA, which is the combination of the blind (decorrelating) RAKE receiver with an iterative symbol/channel estimation algorithm. The algorithm shows a significant improvement over the decorrelating RAKE receiver and the conventional RAKE receiver. (iv) Gelli, Paura, and Verde propose a novel two-stage blind multiuser detector for quasisynchronous MC-CDMA systems. The receive filter is factored into the production of two parts: $\mathbf{f} = \mathcal{F}\mathbf{u}$, and each part is optimized accordingly. $\mathbf{u}$ is calculated based on the constant modulus criterion, and $\mathcal{F}$ serves as the constraint so that the system will extract the desired user.

System design and signal processing

On this topic, the researchers explore innovative transmitter and receiver design for CDMA systems. (i) Hou, Yi, and Lee propose an intriguing multilevel coding scheme based on LDPC to facilitate multimedia applications in future-generation wireless networks. By offering one low-rate channel and two high-rate channels, the new method allows simultaneous transmission of voice and greater than 1 Mbps high-speed data with minimum error and latency. (ii) Madhukumar, Chin, Liang, and Yang propose a single-carrier cyclic prefix-assisted CDMA system with frequency domain equalization. The proposed system has the advantages of conventional MC-CDMA system, but does not suffer from the high peak-to-average ratio and sensitivity to frequency offset and phase noise. (iii) Vanhaverbeke and Moeneclaey consider to improve the performance of overloaded CDMA systems. The main idea is to introduce time shifts between users so that the overall MUI power is minimized. Simulation results demonstrate the effectiveness of the proposed approach. (iv) Park, Lim, and Gelfand present a performance study showing that with a low-complexity MMSE multiuser detector, superior performance can be obtained through coding across multicodes and time.

We thank all the authors who submitted their articles to the special issue. Special thanks go to all the reviewers for their hard work, on which the quality of the special issue relies. Last but not least, thanks to the Editor-in-Chief and the Editorial Board of EURASIP JWCN for their support and thanks to Hindawi Publishing Corporation for making the publication of this special issue possible.

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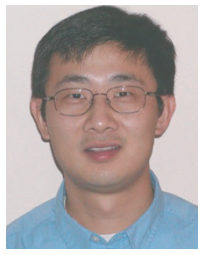

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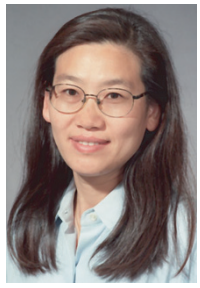

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