

# A Two-hop Proportional Fairness Scheduling Algorithm for Relay Based OFDMA Systems

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**Abstract**—This paper proposes a two-hop proportional fairness scheduling scheme for relay based orthogonal frequency division multiplexing access (OFDMA) systems. The proportional fairness scheduling algorithm is extended to a two-hop scenario to ensure that both direct link users and relay link users are fairly allocated capacity. The fairness allocation problem is considered both in the first time slot between direct link users and relay stations, and the second time slot among relay link

users. Simulation results show that this algorithm achieves an overwhelming performance on the long-term fairness of the user data rate although suffering some throughput loss.

**Keywords**— OFDMA; proportional fairness; relays; scheduling; subchannel allocation

# A New Synchronization Protocol on the Convergence of 3G cellular network and MANET

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**Abstract**—Convergence is the main developing trend of heterogeneous networks in the future. The convergence of 3G cellular network and MANET can provide data communication service with or without an existing infrastructure only with 3G terminals. Synchronization is a critical part for any distributed system. We propose a new synchronization protocol called GTP (GPS-aided Time-syn Protocol) on the convergence of TD-SCDMA cellular network in which air interface standard is proposed by CHINA and MANET. This synchronization protocol aided by GPS is based on SS broadcasting. This protocol solves the synchronization conflict difficulties between TD-SCDMA and MANET. At last we evaluate the performance of the protocol.

**Keywords**—synchronization; 3G; TD-SCDMA; MANET; GPS

# Downlink Performance Evaluation of Centralized and Distributed Antenna Systems in Multicell Multiuser Spatial Multiplexing Environment

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Abstract—In this paper, we compare the downlink performance of multiuser spatial multiplexing of centralized

antenna system (CAS) and distributed antenna system (DAS) in interference-limited cellular scenario. We present the implementation of multiuser spatial multiplexing in a multicell system based on selection diversity. And two user scheduling strategies based on proportional fairness is proposed too. In a typical MIMO configuration (base station with 4 antennas, mobile station with 2 antenna), we achieve the evaluation of spectrum efficiency and user throughput for both CAS and DAS. The results show that compared with CAS with same number of transmit antennas, DAS can support multiuser diversity better and significantly improve the system capacity and cumulate distribution of user throughput.

Keywords: Multiuser, Distributed antenna system, Spatial multiplexing, Proportional fairness

# A Novel Channel Estimation Algrithom in Frequency Domain for FMT Systems

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Abstract—This paper proposes a novel channel estimation for filtered multitone (FMT) systems which is called FPEA. It implements an estimation in frequency domain with pilot sequences in subchannels. The analysis then is given for estimation and anti-frequency-offset performance.

Finally, simulation results of the performance achieved by FPEA are presented and compared with other algorithms.

Keywords-FMT;channel estimation; FPEA

# Performance Analysis in SIR-Based Power Controlled Uplink DS-CDMA Systems using Soft Handover technique with Convolutional Coding Scheme

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Abstract—The coordination of power control and soft handover has a major effect on DS-CDMA systems. In this paper, we investigate the power controlled DS-CDMA reverse-link performance under soft handover with convolutional coding scheme. It is shown that system under soft handover has less sensitivity against incrementing the number of users. The effect of the link balance is evaluated through simulation by considering the reverse-link behavior with power control and soft handover. It observed that the differential loss between two links under soft handover decreases the uplink performance. Finally it is pointed out that by using convolutional error correction coding scheme an additional gain is obtained

Keywords- Direct Sequence Code Division Multiple Access (DSCDMA), convolutional Coding, Power Control, Rake Receiver, Soft Handover (SHO)

# Comparative Study of MMSE-BLE Joint-Detection Based on Block-FFT and Cholesky Factorization for TD-SCDMA

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Abstract—To increase the capacity and performance of TDSCDMA system, the receiver will contain a joint detector. Joint detection is equivalent to solving a least squares problem with a block-Toeplitz system matrix. Therefore, algorithms and implementations must be developed that lower this complexity as far as possible without degrading the performance. In current TD-SCDMA system, MMSE-BLE detectors are the main choice because of its small computational complexity.

Among the various algorithm to solve the MMSE-BLE, Block-FFT and Cholesky Factorization algorithms are widely used in practice. In this paper, we compare the two methods on the basis of simulation performance and computational complexity. The simulations show that Block-Fourier algorithm need low computational amount while yielding a better bit error ratio performance. So we recommend the Block-FFT joint detector as the best choice for TD-SCDMA system.

Keywords—TD-SCDMA; Joint Detection; MMSE BLE

## On Two-Hop MIMO Relay Using Random Beamforming in Cellular System

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Abstract—In this paper, we focus on point-to-multipoint relaying in cellular system. The base station, the mobile users and fixed relay each have multiple antennas. The special case of MIMO fixed relays with random beamforming is investigated. Via path selection, for any mobile user, only a single relay or the home base station is selected for transmission. Since heavy interference may be cancelled in decoding operation, the relays work in decode-and-forward mode. For simplicity, only two-hop communication is considered. Simulation results show the MIMO relay using random beamforming can improve the capacity performance of cellular system.

Keywords: Multiple-input multiple-output (MIMO), relay, capacity, random beamforming

## Analysis of the AMC-ARQ system over MIMO Correlated Fading Channels

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Abstract—In this paper, we focus on investigating the effect that fading correlation has on the

average spectral efficiency (ASE) and outage probability of the cross-layer system, combining of adaptive coding and modulation (AMC) and truncated automatic repeat request (T-ARQ) in the presence of STBC transmit diversity on fading channels. We derive the expressions for the average spectral efficiency and outage probability of this STBC cross-layer scheme over correlated fading channels. Furthermore, we show the numerical simulation results to illustrate that different correlation coefficients induce the different loss of the average spectral efficiency and probability of outage compared with the independent fading.

Keywords—fading correlation; cross-layer system; adaptive coding and modulation; automatic repeat request.

# Power-based Routing for Two-hop OFDMA Cellular Networks with Fixed Relay Stations

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Abstract—This paper addresses aspects of routing strategy of a cellular network enhanced with two-hop fixed relay nodes. The routing strategy for each user is important design parameter because the terminal is energy-limited. To enhance the radio resource utility, a utility maximization framework via pricing is adopted for multi-cell distributed power allocation. Under the optimization physical layer transmission strategy, an efficient power-based routing algorithm is proposed in reverse link which selects the best route in the tradeoff between power consumption and data rate. It is demonstrated through intensive system-level simulation that the performance of our proposed routing algorithm is superior to several known routing algorithms.

Keywords— routing; power allocation; two-hop cellular network; fixed relay; OFDMA

# The research and implementation of 3G terminal authentication service

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**Abstract**—Through analyzing the 3G security services structure, we found that 3GPP did not offer effective authentication services to the terminal client in application domain. On the base of analyzing the Kerberos authentication method and the 3G security mechanism, we first put forward a three-tier security authentication service model for 3G terminal application. The model assembled and encapsulated the 3G security algorithm, and offered a reliable Proactive and convenient authentication services to the 3G terminal application. This research provided strong support with 3G terminal application.

**Keywords**—3G Security algorithms Authentication Security services

# Power Control with Diversity Antenna Arrays in CDMA Wireless Cellular Systems under Multipath Fading

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**Abstract**—In this paper, we present numerical results to show the performance of power control (PC) by using antenna arrays at the base station (BS). We show that the diversity generated by antenna

array, decreases the outage probability, the bit error rate (BER), the fluctuations of the received signal to interference ratio (SIR) over the target SIR, the transmitted power level, and finally increases the speed of convergence of power control algorithms in compared without diversity.

These results also increase the system capacity and the quality of service (QoS).

**Keywords**—Power control, diversity; Code division multiple access (CDMA); capacity; multipath fading.

# Research on Stochastic Comb-pilot Design for NC-OFDM System

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Abstract— NC-OFDM is OFDM-based spectrum pooling technique and also a transmission mode of cognitive radio. The paper models and analyzes NC-OFDM stochastic process, then designs stochastic comb-pilot pattern and analyzes its characteristics in detail. At the end of the paper simulation results prove the feasibilities of the stochastic comb-pilot strategies in NC-OFDM system.

Keywords—NC-OFDM; Stochastic; Comb-pilot

# Differentiated Traffics Network Selection Algorithm for IMT-Advanced System

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Abstract—In face of heterogeneous RATs coexisting in next generation communication system, the network selection is related to Cooperative Radio Resource Management (CRRM) and QoS requirements of traffics and users' preference etc to give the best choice for the users. Based on the proposed MAC layer architecture which set Cooperative RRM manager, in this paper the Differentiated Traffics Relative Band Request (RBR)-based algorithm DTRA is proposed, which is not only a low complexity, centralized network selection scheme aiming to optimally distribute the end users to the networks of the heterogeneous wireless system in the sense of maximizing the global spectrum efficiency, but also considers the priorities of various traffics to decrease the loss rate of real-time traffics.

Keywords—IMT-Advanced; MAC; Cooperative RRM; Network selection; DTRA;

# A Novel Bandwidth Degradation Scheme for Admission Control in IEEE 802.16e

# Networks

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Abstract—IEEE 802.16e networks can be widely applied in broadband wireless access scenarios. Admission control is an essential mechanism in IEEE 802.16e networks to guarantee the QoS of different subscribers. In this paper, we propose a novel bandwidth degradation scheme for the admission control in IEEE 802.16e networks. Simulation results are presented to demonstrate the performance of the proposed scheme in terms of service flow blocking rate and system bandwidth utilization.

## Low Complexity Code-Multiplexed Pilot Aided Adaptive MMSE Equalizer for CDMA Systems

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Abstract—In the high data rate transmission, multiple access interference (MAI) and inter-chip interference (ICI) in the CDMA systems become serious because of the multi-path propagation. A low complexity code-multiplexed pilot aided adaptive MMSE equalizer for CDMA systems is proposed based on the method of steepest decent and Fast Fourier Transform (FFT). Computer simulation has shown that the performance of proposed low complexity adaptive MMSE equalizer approaches the ideal non-adaptive equalizer with the computational complexity reduced considerably. Index Terms—code-multiplexed pilot;

low complexity; adaptive MMSE equalizer; steepest decent method; FFT

## A Simple, Accurate Method for Throughput Analysis of Unslotted CDMA Packet Networks

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Abstract—A theoretical model for describing multiple access interference (MAI) in unslotted CDMA packet networks is presented, and a novel recursive method for throughput analysis of unslotted CDMA packet networks is proposed. Moreover, the impact of spreading gain on throughput performance is discussed. Furthermore, the throughput bounds of unslotted CDMA packet networks are considered by the extension of the proposed method. In comparison with the Markov model of MAI discussed in [7]–[11], the proposed method is more accurate, and more generalized in evaluating the throughput performance of unslotted CDMA packet networks.

# Relaying node selection algorithm based on channel capacity for cooperative system

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Abstract— Cooperative communication is a promising technique that uses many relaying nodes to combat channel fading. To achieve better communication and lower computational cost, some relays in good condition should be selected from all available relays. However, the original algorithm to select

$m'$  relays from  $m$  relays will need to compute  $C(m, m')$  times, which has high complexity. In this paper, two lower complexity relay selection algorithms are proposed based on maximization of channel capacity for two-hop large scale non-regenerative relay system under the constraint of energy consumption. The simulation results show that the proposed two algorithms not only have almost the same channel capacity but have the lower computational complexity to the original algorithm when the selected relay nodes are same. These two algorithms also perform better than the way of random

selection and direct transmission in channel capacity.

Keywords—Cooperative communication;Relay selection;Nonregenerative relay;Channle capacity

## The Performance of Space-Time Spread

# Spectrum

## LS-CDMA System over Fading Channel

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Abstract: Loosely-synchronized code division multiple access (LS-CDMA) system is able to completely eliminate the intersymbol interference and multiple access interference because of the good autocorrelation and crosscorrelation property of LS codes, which results in great enhancement of system performance and potential capacity as compared to ordinary CDMA systems. By combining such LS-CDMA technology with the space-time coding technology, space-time spread spectrum

LS-CDMA system can get more advantages such as spatial diversity when more than one antennas are installed in the system. Both the transmitter scheme and the receiver structure of such space-time spread spectrum LS-CDMA system using multiple transmitting antennas and only one receiving antenna are put forward in this paper. In case of fading channel, it is possible for the system to achieve both temporal diversity and spatial transmit diversity. Some simulation results, as well as a few conclusions are given.

Keywords: LS Code, CDMA, Space-Time Spread Spectrum, Fading Channel

## A Novel Transmission Scheme with Relay Selection and HARQ in Decoded-and-

### Forward Mode of Cooperative Network

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#### ABSTRACT

This paper analyzes the reliability of a two-phase cooperative network. The relays are in decoded-and-forward (DF) mode. Hybrid Automatic Repeated reQuest (HARQ) is employed in the network to exploit time diversity gain by combining multiple transmissions. In the first phase, the transmission is just traditional HARQ scheme. If one of the relays detects

received packets successfully, it forwards regenerated signals in the second phase. When at least two of the relays obtain error-free packets after decoding, two of the relays are

selected to forward regenerated signals in Alamouti scheme. The pairwise error

probability (PEP) performances of the two phases are analyzed, especially that in the second phase. A closed form expression is given by a specific function. The total packet error rate (PER) is given by defining the decoding function D. The simulation results prove the proposed scheme improves system reliability considerably.

# A Novel Cooperative NLOS Error Mitigation Method in Hybrid Cellular Networks

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**Abstract**—A novel mobile location method based on cooperative positioning using time-of-arrival (TOA) measurements to mitigate the impact of non-line-of-sight (NLOS) error in a hybrid cellular network is proposed. Our way to tackle the problem of NLOS error mitigation is divided into two steps: First, a technique is exploited to decide whether there is a NLOS path from the BS to the MS using range measurements sequence; Second, ad-hoc relaying stations (ARSs), which have single-hop line-of-sight (LOS) links with both the base stations (BSs) and the mobile station (MS), are included to establish a new position location scheme if NLOS error is present. Simulation results show that our proposed method can achieve location estimation accuracy enhancement and exhibit significant improvement over the conventional NLOS range reconstruction approach.

**Keywords**—cooperative NLOS error mitigation, hybrid cellular networks, TOA, ARS.

# Delay Performance Analysis on Pure Relay and Cooperative Transmission

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**Abstract**—It has been well known that cooperative transmission provides a new scheme to implement MIMO spatial diversity and multiplexing in wireless networks, thus tradeoff between cooperative

spatial diversity and multiplexing becomes a very important issue. In this paper, we propose to analyze the system delay behavior considering the difference between spatial diversity and multiplexing, in viewpoint of viewpoint of a pure relay system and cooperative transmission system.

Theoretic

analysis and simulation results show that, while a pure relay system tend to have much small processing delay, cooperative transmission systems are capable of deduce system delay to even smaller when the amount of messages exchange over the partner

nodes is reasonable.

Keywords— Relay, Cooperative Transmission, Spatial Diversity, Spatial Multiplexing, Partner Node

# A Cooperative Transmission Strategy using Hierarchical Modulation

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Abstract—In this paper, a novel forward link cooperation scheme using hierarchical modulation is proposed. We define a cooperative unit cell as a unit which includes base-station (BS), fixed relay-station (FRS) and two types of mobile-station (MS) being the relay-assisted mobile-station (RAMS) and the non-relay-assisted mobile-station (NRAMS). We describe how to exploit the hierarchical modulation for the proposed cooperation between BS-FRS-RAMS link and BS-NRAMS link in the unit cell. The proposed scheme yields an improved throughput due to the characteristics of hierarchical modulation such as simultaneous transmission and multi-level protection layer. Simulation results and simple throughput analysis show that the proposed cooperation scheme outperforms the conventional cooperative and non-cooperative communication schemes with respect to the throughput performance.

# Hybrid Positioning Algorithm for Galileo and WCDMA Dual-Mode Receiver

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Abstract—One crucial problem of satellite navigation is the reduced accuracy for location inside buildings and urban canyons. A hybrid positioning algorithm for satellite navigation and cellular radio networks can resolve the problem. This paper studies and compares satellite-based positioning algorithms and hybrid positioning algorithm. Simulation and analysis results show that although hybrid positioning is not as good as double difference in positioning accuracy,

but it does not have to satisfy

the condition that 4 or more than 4 satellites must be in view. At the same time, its positioning error is less than static positioning, especially when few satellites can be observed. Therefore, combining advantages of satellite navigation system and cellular system, we can develop a better receiver which can be used in both urban area and rural area.

Keywords—Galileo satellite navigation; double difference positioning; hybrid positioning algorithm

# Scalable QoS Provisioning and Service Node Selection in Relay Based Cellular Networks

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Abstract— The increasing popularity of wireless communications and the different QoS requirements of new types of service lead to higher demands on cellular mobile networks. With central

control and multi-hop communication, relay based cellular networks are seen as an effective way to meet users' increased bit rate requirements while still retaining the benefits of a cellular structure. However, the more complex architecture and topology make the provision of optimal QoS more challenging. The objective of this paper is to illustrate an effective and efficient approach for scalable QoS provision in relay based cellular networks. Primary concerns are, firstly, the selection of the node

to service the mobile user with QoS that guarantees the time delay requirement for multimedia services and eliminates bottleneck links; and secondly, the choice of the optimal slot allocation scheme that optimizes the radio resource allocation to maximize user satisfaction level and

balance the QoS requirement. The performance evaluations use a Mobile WiMAX network.

Keywords- multi-hop; scalable QoS; OFDMA; Mobile WiMAX; radio resource allocation

# Modelling Cellular/Wireless LAN Integrated Systems with Multi-Rate Traffic Using Queueing Network

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Abstract— In this paper, we model an integrated system of cellular and wireless local area networks (WLANs) with multirate traffic as an open network of Erlang loss systems. A network topology representation of the system is used to facilitate the analysis of handover traffic rates. The performance measures of blocking probabilities and dropping probabilities are calculated using the Erlang fixed-point method. An example scenario is set up and the numerical results show a good agreement with the realistic situation. Keywords-cellular/WLAN integration; multi-Rate traffic; Erlang loss system; queueing network; topology

# Adaptive Cellular Coverage for Radio Resource Management in Mobile Communications

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Abstract— In this article an adaptive radio coverage scheme for increasing capacity in mobile communications is described. The optimization problem of finding optimal coverage for a set of cells is examined and a dedicated algorithm for discovering solutions is described. Method on adjusting radiation patterns of antenna arrays is also given, and the system is called semi-smart antenna, in order to distinguish it from other usage of antenna arrays such as smart antenna. The optimization algorithm developed also allows discovering how differentiated classes o

services can benefit from adaptive coverage and the research is done through WCDMA network simulations. Keywords—Radio Resource Management, Adaptive Coverage System, Mobile Communications, Semi-smart Antenna

# Position aware vertical handoff decision algorithm in heterogeneous wireless networks

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**Abstract**—With the rapidly developed wireless techniques, many wireless networks are deployed with widely varying characteristics. In order to fully utilize the complementary heterogeneous networks, the mobile terminal (MT) may handoff from one network to another by many subjective or objective reasons. The handoff process can be divided by three parts. Firstly, select the best network among different available heterogeneous networks; Secondly, decide which the best objective BS is among some possible homogeneous BSs and when to trigger the handoff; Thirdly, start the signaling interaction to finish this handoff process. In this paper, we analyze the handoff decision part, and present a new position aware vertical handoff decision algorithm (PAHO). By using the precise position, moving velocity and direction information gaining from the Globe Position System (GPS) module of MT, and the beforehand downloaded base station (BS) location and coverage radius information, the MT can decide the best objective BS and the best moment to trigger a vertical handoff. The simulation results demonstrate the excellent performance of PAHO in strict checkout conditions. In addition, this handoff decision algorithm is completely implemented by MT alone, no needing any assistance from BS, and can be adopted by horizontal handoff also. Keywords—heterogeneous networks; mobility management; handoff decision; position aware

## System Performance Evaluation for Advanced Techniques added in cdma2000 1xEV-D0

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Abstract—The system of cdma2000 1x EV-DO is introduced to provide fast and efficient broadband wireless access. Up to now, there are three versions, mentioned as reversion 0, A and B. A great number of techniques, such as hybrid-ARQ, adaptive modulation and coding, as well as multi-user diversity, support the system to have higher spectral efficiency and better performance. In this paper, technical background and some salient features of EV-DO are summarized. In order to evaluate the DO network performance, the system level simulation is considered based on appropriate assumptions and parameters. Four hot advanced techniques, the distributed token bucket rate control mechanism, reverse link interference cancellation, forward link equalizer and multi-carrier, are deployed and judged in the existing EV-DO system. From simulation analysis and discussions, dual receive antennas, equalizer and interference cancellation may improve the average sector throughput in forward and reverse link respectively. Furthermore, multi-carrier technique could obviously enhance the overall system performance. Keywords-cdma2000; 1xEV-DO; system level performance throughput;

## Capacity Analysis and Coverage Comparison for IMT-2000 Systems in Brazilian Cities

Abstract—In this work we aim to present some results to provide useful guidelines for the deployment of IMT-2000 systems like WiMAX and WCDMA, in terms of uplink cell throughput and cell coverage capacities. For this, a simple link level simulations planning tool, based on four established path loss models applicable to three different Brazilian cities were done and the results shown that WiMAX systems, for analyzed frequencies, is more coverage limited, but can support higher capacity than WCDMA, specially for users that are near by the base stations. Keywords-IMT-2000; WiMAX; WCDMA; propagation; capacity.

## A Modified Relay Selection Scheme in Opportunistic Relay Communications

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Abstract—In this paper, we develop a modified relay selection technique in opportunistic relay



communications. In this approaches, we use a threshold level between source and intermediate (M) relay nodes. Then our proposed scheme can decreases the contending relay' s collision probability. We compare the performance depending on different threshold level by using Monte Carlo computer simulation. Through this process, we verify the collision probability performance' s analysis

# Channel-Adapted and Buffer-Aware Packet Scheduling in LTE Wireless Communication System

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Abstract—This paper proposes a channel-adapted and bufferaware scheduling algorithm in LTE wireless communication system. The scheme allocates system resource jointly PHY-MAC layer according to CQI feed back with the uplink, considers UE buffer status to avoid buffer overflow, and guarantees certain fairness among users. Comparing with traditional scheduling algorithms such as RR, PO and PF, the simulation results show that the proposed mechanism can achieve higher system throughput and less packet loss. Keywords—LTE; QoS; CQI; CABA;

# Performance of Multicarrier CDMA with Time-Frequency Spreading in Frequency Impairment Channels

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Abstract— In this paper the effect of carrier frequency offset on the multicarrier direct sequence CDMA system which employs both time and frequency (TF) domain spreading is evaluated and simulated. The MC DS-CDMA system achieves high spectrum efficiency by using time-frequency spreading mechanism. The probability of bit error rate (BER) of TFdomain spread MC DS-CDMA is derived using the standard Gaussian approximation (SGA) in additive white Gaussian noise (AWGN) channel with frequency offset impairments. Numerical evaluation of the analytical expression of BER reveals that a high capacity and BER performance improvement are achieved over the performance

of multicarrier CDMA (MC-CDMA) system which spreads the signal in the frequency domain. Extensive simulations were also performed to illustrate the correctness of the analysis of the TF-domain spread MC DS-CDMA system. Index Terms—Code-division-multiple access (CDMA), carrier frequency offset, frequency-domain spreading, multicarrier modulation, time-domain spreading.

# A Robust Timing Offset Tracking Scheme for SC-FDE System

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Abstract—The SC-FDE(Single Carrier – Frequency Domain Equalizer ) is a field that gathers more and more interest as a modulation scheme for the broadband wireless communications, for simple channel equalization, SC-FDE systems perform equalization in frequency domain instead of time-domain using FFT, IFFT and CP(Cyclic Prefix) like it user for example in OFDM(Orthogonal Frequency Division Multiplexing). In this paper, we propose a new residual timing offset tracking scheme for SC-FDE systems which based on the concept of CP. We analyze the effect of timing offset in a frequency-domain and propose a new method of timing synchronization, Based on the data after decision in SC-FDE receiver, we reconstruct the receive signal. By comparing the received signal and the reconstructed one, a new time offset estimation algorithm is developed. This algorithm has advantages as simple in algorithm, high computation efficiency, high precise in tracking, an requiring no additional pilots. Moreover, we verify the algorithm with a numerical analysis and computer simulation Keywords—SC-FDE;CP;Timing offset tracking.

# Robust Power Control for CDMA Cellular Communication Systems via H<sub>2</sub> Optimal Theory

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Abstract—In this paper, a lead compensator is proposed for compensating round-trip delay of direct-sequence code-division multiple-access (DS-CDMA) cellular mobile radio systems. Furthermore, in addition to the delay compensation, a disturbance rejection filter is designed to minimize the effect of uncertain noise and interference to track a desired signal to interference and noise ratio (SINR). The two-step power control design is achieved by the  $H_2$  optimal approximation theory using the genetic algorithm. To confirm the performance of the proposed method, several simulation results are given in comparison with other methods. Keywords— SINR, Genetic Algorithm (GA),  $H_2$  Theory, Power Control

# A Resource Allocation Strategy using FDMA over Wireless Relay Networks

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# On the WiMAX System Co-existence with WCDMA and cdma2000 1x System

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Abstract—Mobile WiMAX based on IEEE 802.16e standard can realize enhanced network capacity requirements and various services as well as provide more novel experiences for users. Since WiMAX joining in 3G camp as the new member, the coexisting research of WiMAX and other 3G system (WCDMA, cdma2000 1x and TD-SCDMA) deployed in the same service area has gained increasing importance. In this paper, the detailed coexistence issue analysis, including several interference scenarios, network deployment, propagation models and interference models, is described. After some necessary assumption and simulation parameters, system capacity loss due to co-existence of WiMAX and other

3G network on close frequency bands is investigated. The interference cases of BS-to-BS and MS-to-BS with WiMAX deployed respectively with cdma2000 1x and WCDMA in neighbor bands will be discussed and analyzed. At last, some suggestions are to be proposed to better realize the coexisting of WiMAX and other 3G systems. Keywords-co-existence; interference; WiMAX; cdma2000 1x; WCDMA

# Research of Optimal Station Distribution Algorithm in Wireless Navigation System

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Abstract—To find the optimal station distribution algorithm and improve the positioning accuracy of working area, the relationship between the GDOP value and the station distribution on hyperbolic positioning mode and range-range positioning mode was analyzed. Simultaneously, under fixed station distribution, the positioning accuracy distribution on two different positioning modes was calculated and compared. Finally, the better positioning mode and the optimal station distribution is found, the calculation process of optimal station distribution algorithm on electronic map is presented. Keywords-hyperbolic positioning; range-range positioning; station distribution algorithm; GDOP value

# Optimal Timeslot Allocation Algorithm in MF-TDMA

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Abstract— in modern satellite communication systems, because of the high efficiency and flexibility, MF-TDMA has become one of hot issues. The resource-allocation can be described as an optimal location problem in the MF-TDMA channel structure (MTCS). The effective timeslot management is the guarantee of the efficiency of the resource management in MF-TDMA system. This paper discusses the timeslot allocation problem in two aspects. Firstly, we proposed an organizing method of time slots in a timeslot bin-tree. Then, according to the timeslot tree structure, we put forward a Buddy-fit with Recursive Adjustment (BFRA) algorithm to improve the utilization rate of the system. The simulation shows that BFRA algorithm has a good performance in managing

and utilizing timeslot fragments. Keywords: MF-TDMA, timeslot allocation, resource management

# A Low Memory Design for Hybrid-ARQ Systems

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**Abstract**—In this paper, we propose a low memory design for Hybrid-ARQ systems that combines the new transmission with previous transmission either with Chase combining (CC) or code combining (IR: Incremental redundancy). When the current transmission is decoded in error, the channel inputs to be stored for combining with next transmission are quantized with fewer bits by simply dropping the last few least significant bits (LSB) of the quantization results of current channel inputs. In this way, the proposed method can significantly reduce the memory size while keep the performance loss very small. Both the analytical prediction and the simulation results show that the worst case performance loss can be less than 0.25dB if we drop half of the quantization bit-width. **Keywords**— Hybrid-ARQ; quantization; memory

# Power optimization in IDMA with SNR and Differential Evolutions<sub>1</sub>

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**Abstract**—Interleave Division Multiple Access (IDMA) is a multiple access scheme where users are separated by the only means of interleavers. However, IDMA revealed to depend on power optimization because equal power repartition significantly deteriorates the performance when the system is heavy-loaded. Therefore, we propose the application of the genetic annealing Differential Evolution algorithm to SNR evolution for solving this optimum power allocation problem. **Index Terms**—Interleave Division Multiple Access, SNR Evolution, Differential Evolution, Power Optimization

# Modeling and Performance Analysis of

# Two-Hop- Relay Variable-Rate Cellular Systems\*

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**Abstract**—A new architecture of two-hop-relay variable-rate cellular system was introduced, and the analytical model of this system was built. Then based on this model, we get the average downlink throughput and the call blocking probability of the system respectively. Finally, through numerical calculation, we analyze the impact of the various parameters on the performance of the two-hop-relay variable-rate cellular systems. Study results show that the two-hop-relay variable-rate cellular system can obtain more average downlink throughput than traditional cellular system, and reduce the call blocking probability effectively. **Keywords**—two-hop-relay; variable-rate; cellular systems;

# Wireless Queue Scheduling Based on Adaptive Fuzzy Logic

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**Abstract**—In practical wireless system, the system state knowledge is of inaccuracy resulting from the dynamics of system states such as traffic intensity, queue status and channel condition. It is hard to make precise scheduling decision based on these inaccurate information. A wireless queue scheduling scheme based on adaptive fuzzy logic is proposed, which, by using fuzzy inference to alleviate the effect of inaccurate state information, achieves better scheduling performance. Furthermore, a reinforcement learning scheme is adopted to improve the scheduling performance. Better performance in terms of user fairness and system throughput is shown by simulation. **Keywords**— fuzzy logic queue scheduling quality of service (QoS)

# A Novel Relaying Scheme for Improving Capacity of Non-regenerative Coded Cooperation

# System

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Abstract—In the wireless networks, utilization of terminals distributed in space can significantly improve the performance of wireless communication systems. In this paper, we investigate two-hop non-regenerative coded cooperation system and propose a novel design of employing linear dispersion codes (LDC) at the source node and a linear processing matrix at the relays. The relay stations make use of the knowledge of the first hop and second hop channel to assign power among the relay stations adaptively. We deduce and analyze the capacity of the proposed scheme. Numerical results show that the proposed scheme can achieve higher capacity gains over employing LDC on conventional Amplify-and-Forward (AF) system. Keywords- LDC; linear processing matrix; coded cooperation; Capacity

## A NEW GENERATION SATELLITE BROADCASTING SYSTEM IN CHINA

ADVANCED BROADCASTING SYSTEM-SATELLITE

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Abstract—The paper describes a new generation satellite broadcasting system in China named Advanced Broadcasting System-Satellite (ABS-S) that offers system performance and service versatility suitable for future satellite digital broadcasting. The new system utilizes variable rate, constant size single LDPC codes to allow all satellite applications supplied by DVB-S2 system, including: TV and sound broadcasting, interactivity (i.e., Internet access), and professional services, such as TV contribution links and digital satellite news gathering. Meanwhile the new system utilizes fixed frame structure to realize the CCM, VCM and ACM working modes adopted by DVB-S2 system to further simplify the complexity of the implementation. The paper provides a tutorial overview of the ABS-S system, describing its main features and performance. A prototype system has been implemented based on the proposed protocol. Results from both lab tests and field trials demonstrate significant performance advantages of the new design over existing satellite broadcasting system DVB-S and almost the same performance as the second generation satellite broadcasting system DVB-S2. Keywords- Advanced Broadcasting System-Satellite; ABS-S; DVB-S2; low density parity check (LDPC) coding; satellite broadcasting;

# GoS Based Call Admission Control Algorithm for Power Controlled WCDMA Networks

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**Abstract**—The proposed Grade of Service based Call Admission Control (GoS-CAC) algorithm in the next generation mobile communications system operates a threshold comparison, which integrates many factors that affect the decision accuracy of aCAC scheme such as system traffic loads, quality of service (QoS) requirements, channel quality, interference level, system GoS and user handoff, etc. The GoS-CAC algorithm cooperates subtly with a power control and data rate adjustment scheme making able fast, accurate, adaptive threshold, simple and feasible decision-making about incoming calls for next generation mobile communications systems. Simulation results show that the proposed algorithm outperforms SIR based CAC (SIR-CAC) and interference based CAC (I-CAC) schemes about 10%, 50% and above 57% in terms of handoff service blocking probability, system GoS and overall system dropping probability, respectively.

**Keywords**—call admission control; power control; handoff; adaptation; multimedia

I

# Delay Estimation in DS-CDMA Communication Using Conjugate Descent Algorithm

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**Abstract**—In this paper, we propose a method for DS-CDMA delay estimation through the use of the downlink channel character. This method is based on Independent Component Analysis using the conjugate descent algorithm to estimate the multi-path mixture matrix and find the delay information which is embodied by the column vector of the mixture matrix using both the independence of information source and the known spread spectrum code. The simulation results show that it has better estimated effect and enhance the performance of traditional detector comparing with MMSE and Fast-ICA algorithm. **Keywords**: code division multiple access; independent component analysis; delay estimation; conjugate descent algorithm



# Predictive Linear Quadratic Power Control Algorithm in WCDMA Wireless Cellular Networks

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Abstract—Combining the approaches of optimal control theory and linear prediction technique, the user's transmitting powers are minimized and the system capacity is maximized with the quality of services (QoS) being satisfied simultaneously for all mobile terminals. A linear quadratic form of power control problem in wideband code division multiple access (WCDMA) systems is established and the fading channel path-gain is predicted. Simulation results show graphically that the proposed predictive linear quadratic power control (PLQ-PC) algorithm converges faster no less than 7 percents and makes the system support about 1.2 times users compared with those obtained by auto-tuning fuzzy power control (ATF-PC) and signal interference ratio based power control (SIR-PC) algorithms, respectively. Keywords—prediction; linear quadratic; power control; optimal Control

## A Codebook Based Precoding Scheme for 3GPP TDD Systems

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Abstract—In time-division duplex (TDD) system, precoding matrix for downlink transmission can be obtained from estimation of uplink pilots by using reciprocity. However, if the channel is time-varying, the channel difference would cause codeword mismatch between transmitter and receiver, which leads to performance degradation. In this paper, a codebook based precoding scheme is proposed for TDD systems to decrease the probability of codeword mismatch between both sides. Moreover, a linear interpolation method is used to estimate the uplink channel at the receiver, which would reduce the channel difference caused by time delay. Simulations show that the proposed scheme could significantly improve the link performance compared to the existing methods. Keywords—time-division duplex; precoding; codebook; codeword mismatch;

## The Reform Schema of TD-SCDMA

# Standard by CDMA/TDMA

Abstract—The paper proves the unusability of smart antenna (SA) which is defined in the TD-SCDMA standard, and so the TD-SCDMA standard should be improved. A reform schema will be given in this paper, which uses CDMA/TDMA respectively in the uplink/downlink channel. In this schema, the SA can still be used in downlink channel. It will give a new life to TD-SCDMA standard. 8PSK or 16QAM can be used in the downlink channel, which has higher spectrum efficiency. They will transfer the surplus downlink power to the spectrum efficiency. The improved TD-SCDMA standard will meet the needs of the mobile internet. Key words—Smart Antenna, DOA TDMA CDMA

## Dynamic joint code and slot allocation in time division CDMA systems

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Abstract—Dynamic Channel Allocation is an important part of the Radio Resource Management in CDMA/CDD systems. In this paper we propose a new algorithm for code and time-slot allocation method when a new user applies for resources. The new algorithm consists of 2-dimensional searching. A set of candidate slots is first selected from the available slots. Then the spreading code with smallest spreading factor in the candidate slots is selected and assigned to the new user. By the scheme, the algorithm jointly optimizes the allocation of code and time slot. Keywords—Dynamic Channel Allocation; CDMA/TDD; Radio Resource Management)

## An OWL-S Based Adaptive Service Discovery Algorithm for Mobile Users

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Abstract—Nowadays, there are numerous web services with specific capabilities within various

networks, which can be used by mobile users. How to find a suitable service is a challenging task for a discovery. In this paper we propose a matching algorithm measuring the similarity of the request with each of the advertised services based on OWL-S. As a description language of semantic Web services, OWL-S increases flexibility of Web service description, enriches expressiveness and provides a capability-based mechanism of Web service discovery. In order to obtain a precise matching result the user profile is taken into account in the presented algorithm. The proposed technique is applied to a sample test and experimental results are presented demonstrating the effectiveness of the idea. Keywords- OWL-S, matching algorithm, service profile, service Discovery

## A Hybrid Algorithm in IEEE 802.16e Sleep Mode Operation

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Abstract—In IEEE 802.16e system, mobile station (MS) is usually powered by battery. To save the limited power, IEEE 802.16e standard specifies sleep mode operation for power management. There are two significant performance metrics in sleep mode operation, one is energy consumption, the other is waiting delay. Our research is to shorten energy consumption and waiting

delay. In this paper, a hybrid algorithm is proposed to reduce energy consumption and waiting delay. The proposed algorithm decreases the energy consumption and waiting delay efficiently, when data frame from base station (BS) to MS is in low traffic. Keywords-energy consumption; waiting delay; sleep mode; IEEE 802.16e

## A TDD IDMA Downlink With MRC Pre-equalization

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Abstract—It is shown in the paper that by employing a maximum ratio combining (MRC) pre-equalizer, the complexity of the receiver in an Interleave-Division Multiple-Access (IDMA) downlink is reduced, while similar or even slightly better performance is achieved, compared to that using Log Likelihood Ratio Combining (LLRC). Keywords-Pre-equalization; TDD; IDMA ; downlink; MRC; LLRC

# Overview of the Ubiquitous Wireless Mobile Networks and Systems

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**Abstract**—With the developing of wireless technologies and networks, isolated network makes no sense without interconnection with each other in the future. The ubiquitous wireless mobile networks and systems aim to integrate various kinds of wireless heterogeneous networks so as to achieve intercommunication with anyone and/or anything at anytime from anywhere. In this article the primary concept and applications of the ubiquitous wireless mobile networks and systems are comprehensively reviewed. Key basic techniques for the ubiquitous mobile networks developing are discussed. In the end, some promising wireless heterogeneous networks integration in the nearly future are presented. **Index Terms**—ubiquitous mobile networks, heterogeneous integration, comprehensively reviewed, discussed.

## A unified admission control algorithm

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**Abstract**—Call admission control (CAC) plays a significant role in communication networks. In heterogeneous environments, CAC performs different function in different segments along with an end-to-end data path. In this paper, an end-to-end CAC model in transport layer is presented. Further, a unified CAC (U-CAC) algorithm is proposed, which manage different kinds of upstream traffics from different access networks. The algorithm is based both on the traffic class, the access network type and the user requirement and is realized using genetic algorithms (GAs). In addition, priority schemes have been proposed to guarantee QoS for higher class users. For the simulation analysis, we consider two different services and two different access networks. The results reveal that the proposed algorithm provides the optimal threshold values for resource reservation and achieves the reasonable call admitted probabilities. **Keywords**—quality of service(QoS); call admission control(CAC); unified CAC(U-CAC); genetic algorithm; heterogeneous network.

# Game-Theoretic Admission Control in Heterogeneous Wireless Networks

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**Abstract**—In this paper, the call admission control in wireless heterogeneous network is formulated as an extensive game with perfect information, which is solved by backward induction. Simulation results prove that this game-based scheme outperforms opportunistic one in terms of smaller dropping probability of handover connections and blocking probability of new connections in the WLAN area. In addition, the parameters of the system are flexible to adjust the priority of handover connections to new connections to protect existing connections, and achieve a balance between bandwidth utilization and QoS. **Keywords**—heterogeneous wireless network; call admission control; game theory

# A Performance Study of Multi-node System in wireless Network

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performance of cellular dual-hop cooperative communication systems with regenerative relays over flat Rayleigh fading channels. M-ary phase-shift keying (M-PSK) is considered. Two linear diversity reception techniques are adopted in the destination, i.e., maximal-ratio combining (MRC) and selection combining (SC). We first derive the symbol error rate (SER) expression of dual-hop communication with MRC scheme and all relays randomly distributed between the source and the destination. We then derive asymptotic SER expression. With the aid of the asymptotic analysis, asymptotic-optimal power allocation (A-OPA) strategy provides more significant performance improvement compared to equal power allocation (EPA) strategy. Next, we analyze the performance and the asymptotic performance of dual-hop communication with SC scheme. **Keywords**—Cooperative communication, regenerative relays, maximal-ratio combining (MRC), selection combining (SC), symbol error rate (SER).

# On Performance of Combining Methods for Three-Node Cooperative Diversity Wireless Network

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**Abstract**— This paper analysis the performance of the ad-hoc network with a base station, amobile and a third station acting as a relay. Three combining methods for the Amplify-and-Forward (AF) protocol and the Decode-and-Forward (DF) protocol are compared. Simulations indicate that the Amplify-and-Forward (AF) protocol beats the Decode-and-Forward (DF) protocol under all these three combining methods. To combine the incoming signals the channel quality should be estimated as well as possible, more estimation accuracy requires more resource. A very simple combining method can obtain the performance compared with that by optimal combining methods approximately. This indicates the implementation of cooperative diversity in future wireless network. All these three combining methods for both diversity protocols can achieve the maximum diversity order. **Keywords**—cooperative diversity, selecting combining and channels, wireless networks

# Performance Evaluation of Downlink Interference Coordination based on Cooperation between Base Stations

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**Abstract**—Downlink inter-cell interference mitigation problem is studied in this paper from

the perspective of base station cooperation. The concept of cooperative virtual cell is introduced, and two specific virtual cell planning schemes which enable the reuse one frequency planning are proposed. Evaluation results shows that the proposed schemes balance the distribution of spectrum efficiency for different positions in the cell and improvthe performance of the cell-edge users. The min-cooperative scheme also lowers the system outage about 5% compared to the conventional (1, 3, 3) reuse scheme and achieves sector throughput close to the conventional (1, 3, 1) reuse scheme. Keywords-cellular system; reuse one frequency planning; interference coordination; cooperative transmitting

# An Improved Vertical Handoff Decision Algorithm for Heterogeneous Wireless Networks

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Abstract—One of the major design issues in heterogeneous wireless networks is the support of vertical handoff. Vertical handoff occurs when a user with a multi-interface terminal changes association from one type of wireless access technology to another while maintaining an active session. It is believed that vertical handoff decision will be based on multiple criteria. In

this paper, new handoff criteria are introduced along with an improved vertical handoff decision strategy based on fuzzy logic. A performance study using the integration of cellular networks and WLANs as an example shows that our proposed vertical handoff decision algorithm can reduce the handoff call dropping probability as well as unnecessary handoffs in heterogeneous wireless networks. Keywords- Vertical handoff; heterogeneous; fuzzy logic

# Design and Implementation of TD-SCDMA Basestation Using Ring Network on Chip

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{zhanglg, hjg}@xiyou.edu.cn Abstract: This paper presents a case study of the complete baseband part of basestation that is designed and implemented using ring network on chip (ftNoC). By combining general-purpose and application-specific hardware, it is possible to integrate the complete baseband part of TD-SCDMA basestation on a single chip. In ftNoC, links are divided into two groups of ring, one of them used for fault-tolerance. Each group contains a control-ring and a data-ring. Control-ring propagates routing, link error and error control information of all nodes by packet-switching and data-ring propagates data by circuit-switching. Ring network adopts time-division multiplexing (TDM) and priority mechanism to implement space division multiplexing (SDM) of bandwidth and fair routing. Simulation results show the baseband part of TD-SCDMA designed using ftNoC perfectly accords with the requirement of TD-SCDMA at a network clock frequency of 200MHz. And the architecture can efficiently avoid traffic congestion, deadlock and starvation and ensure full use of bandwidth. Keywords: Network on chip, TD-SCDMA, basestation, fault-tolerance, TDM (Time Division Multiplexing), SDM (Space Division Multiplexing)

# New Approach to Closed-Loop Power Control in Cellular CDMA Systems under Multipath Fading

Abstract—This paper proposes a new approach to the closed-loop power control algorithm with decision feedback, called NAPC-DF algorithm. In this algorithm, the step size of the transmitting power by the mobile station (MS) in uplink channel is variable and adjusted by the received command from the base station (BS) and channel conditions. This algorithm is compared with fixed-step, variable step and adaptive step closed-loop power control with decision feedback (FSPC-DF, VSPC-DF and ASPC-DF, respectively). Numerical results indicate that NAPC-DF algorithm, under fading can significantly improve the radio network capacity without any increase in power control signaling. Also the speed of convergence and stability against loop delay can be increased and it decreases the outage probability and bit error rate (BER) of uplink channel in compared with the mentioned references algorithms. Keywords—Power control; capacity; step size; closed-loop; multipath fading; CDMA.

# Site Selection for Wireless Base Station Based on Map Partitioning

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Abstract—The problem to locate wireless base stations relates to how to make the best use of effectiveness, which is very important in the field of wireless communication engineering. This paper refers to the theories of graph partitioning, considering the number of covered vertex, the number of covered ranges and the gradient of density. We present a practical algorithm framework to solve the problem based on map partitioning. When considering the necessary conditions and optional conditions, our algorithm framework adopts the strategy of self adaptive divide and conquers. It works as three steps: divide and conquer map, check restraint conditions, and select locations. We conduct some experiments on Shanghai's traffic map and show the good allocations results for wireless base station in Shanghai city. Keywords—Site Selection, Map Partitioning, Self Adaptive Divide-and-Conquer, Wireless Base Station

# Eigen-beamforming Applied in STBC Multiplexing System

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Abstract—This paper introduces eigen-beamforming technique into the STBC multiplexing scheme. STBC multiplexing scheme integrates orthogonal space time block codes into spatial multilayers such as V-BLAST structure. This hybrid system can balance the spatial multiplexing and diversity gain efficiently. When perfect channel state information (CSI) is available at the transmitter, eigen-beamforming can be employed in STBC multiplexing system for the sake of minimizing error probability or maximizing mutual information. The proposed precoding hybrid scheme provides extra precoding gain comparing with the non-precoded one. Simulation results display that the new precoding STBC multiplexing system can improve the BER performance to some extent especially in lower dimensional modulation. Index Terms—precoding, STBC multiplexing system, eigenbeamforming, water-filling

# NLOS Error Identification and Range Approximation

# Technique in Cellular Networks

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Abstract — A new Non-Line-of-Sight (NLOS) error identification and range approximation algorithm based on apriori knowledge of standard deviation of measurement noise in cellular networks is proposed. First, a NLOS error identification technique is exploited to decide whether there is a NLOS path from the base station (BS) to the mobile station (MS) using a time series of range measurements; Second, a weighted orthogonal polynomial fitting method is used to approximate the true range. Simulation and results show that our proposed algorithm can achieve range approximation enhancement and exhibit significant improvement in intermittent NLOS environment. Keywords—NLOS error identification, range approximation, cellular networks, weighted orthogonal polynomial.

# The Research on Simulation Method of PHS Network Capacity Enlargement

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Abstract—High traffic always leads to descending quality of communication, higher lost call rate and increased complaints with the expansion of regional customer scale. Therefore, it is necessary to improve communication quality by enlarging the capacity of base station with the consideration of utilization efficiency of network resources. The difficulty of decision on PHS network capacity enlargement increases for the stochastic characteristic of traffic. The traffic and the base station capacity in a region are simulated by modeling and simulation experiment in this paper. Considering the economy in network resources, a reasonable enlargement plan is given after the effect comparison of different ones. The conclusion shows that multi-objective optimization plan, which also takes the stochastic characteristic of traffic into account, can be obtained by Monte Carlo simulation in the decision on PHS network capacity enlargement. Keywords —Monte Carlo simulation; simulation; wireless urban telephone; PHS network; base station capacity

# SEP analysis and optimal power allocation of multinode amplify-and-forward cooperation systems

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**Abstract**—In this paper, symbol error probability (SEP) performance analysis and optimal power allocation (OPA) are considered for uncoded multi-node relay network employing amplify-and-forward (AF) cooperation protocol over independent but not identically distributed Rayleigh fading channels. By taking advantage of the approximate probability density function (PDF) and cumulative distribution function (CDF) of the harmonic mean of two independent exponential random variables, we obtain a closed-form SEP formulation for the AF cooperation system with M-PSK and MQAM signals, respectively. Moreover, an approximation is presented which is asymptotically tight at high SNR. Based on the asymptotically tight SEP approximation, an OPA is provided to minimize the SEP under the total power constraints. It turns out that the optimal allocation for AF cooperation system is not dependent on the modulation modes and the direct link between the source and the destination, but it depends only on the links related to the relays.  
**Keywords**— cooperative diversity; amplify-and-forward; symbol error probability; optimal power allocation

# Concurrent Operation of Half- and Full-Duplex Terminals in Future Multi-Hop FDD Based Cellular Networks

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**Abstract**—Future OFDM-based cellular radio networks like IMT-Advanced systems are planned with both frequency division duplex and time division duplex in mind. Each of these duplex schemes

has its benefits and drawbacks dependent on the scenario. In short-range communication and with small radio cells TDD is appropriate. For wide area cells FDD is preferred in general. If combined with multihop, i.e. the use of fixed relays, wide area cells can be built with a reduced number of base stations. Economic rationale also leads to the requirements to produce cheaper terminal equipment. Full duplex FDD terminals can transmit and receive simultaneously, but need high quality, expensive RF duplex-filters, in order to separate uplink and downlink channels. Half-duplex FDD terminals are lower in cost and therefore an interesting solution. This paper shows how halfduplex terminals should be operated to achieve the same performance as full-duplex terminals. The coordination of half- and full-duplex terminal operation by the base station is a challeng. This paper introduces the resource scheduling algorithm located in the MAC layer and discusses implications and performance results especially for multihop cellular networks. Index Terms—Half-duplex, full-duplex, FDD, Relaying, Multihop

# A Novel Power Control Algorithm for CDMA Systems

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Abstract—In this paper, a distributed power control scheme for the third generation wideband CDMA system is presented. In the algorithm, a kind of power update function of exponential type is presented, by adjusting parameter  $k$  in the power update function, the system can satisfy different performance requirement. Simulation results reveal that this algorithm has faster convergence speed and better system stability than the conventional distributed power control algorithm. Keywords- distributed power control, WCDMA.

# A New Method for Signal Path NLOS Effect Mitigating

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Abstract-- In this paper, a three base stations position method based on signal path non-line-of-sight (NLOS) effect mitigating is presented. Under this condition, only two paths of signal transmission are line-of sight propagation and the other is nonlinear- of sight propagation. Because the position equation is nonlinear, the position error is sensitive to the origin of reference coordinate. Therefore, the method of coordinate translation is introduced to mitigate the effect of NLOS error. The simulation result shows that this method is effective in NLOS effect mitigating and it is robust in different error magnitude distribution. Keywords-- TOA, wireless location, NLOS, coordinate translation

# Opportunistic Virtual Antenna Arrays with Optimal

## Relay Mobile Terminals Selection

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Abstract—Most literature about cooperative diversity focus on ad-hoc networks. In this paper, we study cooperative diversity in cellular networks. Our work is based upon virtual antenna arrays (VAA). We show that VAA is superior not only in maximum mutual information but also in outage probability performance. We also propose a distributed method to select multiple relay mobile terminals (MTs) in opportunistic way. Keywords—cooperative diversity; VAA; opportunistic

# A hybrid Receiver combining QR and

# PIC based on MIMO Frequency Channels

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Abstract—This paper extends and modifies MIMO QR algorithm to the frequency selective channel. A combining QR and PIC detection scheme was proposed. The performance of algorithm is evaluated based on computer simulation. Simulation results states that the performance of MIMO detection algorithms in frequency selective channel is better than the performance in narrowband channel, and the scheme has advantage over ZFVBLAST in complexity and signal processing delay. Keywords—MIMO ; space-time coding; frequency channel; interference cancellation ;V-BLAST

# A Differential MIMO-Beamforming Scheme for Transmission over Aeronautical Channels

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Abstract—In this paper beamforming and differential space-time modulation (DSTM) are combined together to construct a robust system for multiple-input multiple-output (MIMO) aeronautical channels. A transmission scheme is developed here that combines digital beamforming (DBF) with differential multi-antenna modulation based on orthogonal space-time block coding (STBC). The minimum variance distortionless response (MVDR) algorithm is modified to make it suitable for multiple transmit antenna system. The simulation results proved that the transmitting scheme is an effective way to solve the problem with performance, complexity, and transmission rate fo

aeronautical communications. Keywords- differential space-time modulation; MVDR; digital beam forming; aeronautical communications

# Efficient Detector for LDPC Coded MIMO System

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**Abstract** — This paper presents a reduced-complexity soft-input soft-output detection scheme for low-density parity-check (LDPC) coded multiple-input multiple-output (MIMO) wireless communication systems employing turbo processing at the receiver. The detection algorithm is decomposed into the preprocessing and tree search stages. In preprocessing stage, we give an unbiased minimum mean-square error (MMSE) filtering algorithm to order and to preprocess the MIMO channel matrix. Then, accumulated metric including a priori information is given. In the tree search stage, we propose a simple modification to TM algorithm by partial length paths augmenting. The proposed detector provides flexible performance-complexity tradeoff. In addition, it is robust to arbitrary MIMO channels. The excellent performance of this detector is demonstrated via simulation results in several MIMO channels. Keywords- complexity reduction; iterative detection; MIMO; LDPC codes; TM algorithm

# Efficient Turbo Equalizer for MIMO Single Carrier Systems

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**Abstract** — This paper proposes an efficient turbo equalization for multiple-input multiple-output (MIMO) single carrier systems with cyclic-prefix (CP). The receiver can effectively conduct inter-symbol interference cancellation (ISIC) and inter-antenna interference cancellation (IAIC) followed by frequency domain equalization (FDE), and the elements of the estimated symbol sequence are demapped onto the bit extrinsic log likelihood ratios (LLRs) using a Gaussian assumption as the inputs of the soft-in soft-out (SISO) decoder. Simulation results show that our proposed equalizer is superior to the traditional, non-iterative ones. Keywords- iterative detection; MIMO; single carrier; turbo Equalization

# Slotted ALOHA with MIMO Spatial Multiplexing

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**Abstract**— Many contention protocols in wireless networks such as carrier sense multiple access with collision avoidance (CSMA/CA) incorporate methods that minimize probability of collision. However there is another possible way that collisions can be avoided, that is by getting some help from physical layer technologies. It has been proved that multiple-input-multiple-output (MIMO) technology with spatial multiplexing (SM) operating in a rich scattering environment can resolve up to  $M$  different data streams where  $M$  is the minimum number of transmitting or receiving antennas. In this paper, we evaluate the performance of slotted ALOHA access protocol employing MIMO with SM. The purpose of this analysis is to gain insight and directions for developing access protocol to fully utilize benefits of MIMO technology from the network point of view. We evaluate an upper bound performance in terms of efficiency (success rate) and corresponding capacity utilisation efficiency, collision rate, and an average number of successful transmissions per slot. We find a substantial gain in efficiency in comparison with the conventional slotted ALOHA. However, we also discover that an additional gain is diminished when more antennas at the receiver are included. Mathematical derivations followed by numerical simulations and discussion are presented. **Keywords**— MIMO; Spatial multiplexing; MAC protocol; slotted ALOHA; contention protocol; efficiency

# On MIMO Channel Shortening For Cyclic-prefixed Systems

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Email: [toufig56@eee.buet.ac.bd](mailto:toufig56@eee.buet.ac.bd) **Abstract**—In this paper, we consider channel shortening for cyclic-prefixed block transmission system over multiple input multiple output (MIMO) channels. A time domain equalizer (TEQ) is necessary at the receiver front end to mitigate inter symbol interference (ISI). Melsa, Younce, and Rohrs proposed the most popular MSSNR channel shortening method for single input single output (SISO) channels based on minimizing the energy of the shortened impulse response (SIR) outside the target window while keeping the energy inside constant. Because of computational simplicity of the MSSNR method, we extended this method directly for MIMO channels unlike other MIMO TEQ design methods which perform shortening in multiple stages. We compared our scheme with other MIMO TEQ design techniques for equalization SNR, energy compaction ratio, signal to interference plus noise ratio and bit rate. The results show significant improvement over some reported



# An Optimum Method of Blind Detection Based on ML Estimate in MIMO Systems

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**Abstract**—This paper provides an advanced method of blind detection based on maximum likelihood estimate, and the scheme can be applied to MIMO systems. Firstly, a model of space-time block code system has been established and also introduces the theory of maximum likelihood estimate. Based on these theories which have been described above, through the way of adjusting steps of iterative algorithm, a balance between reducing bit-error-rate and decreasing the number of iterative cycles can be found. The analysis indicates that this solution is feasibility; furthermore, the simulation results illustrate that, in finite calculation capacity, decreasing the number of iterative steps can increase the concatenation space-time block coding matrices which have positive effect on bit-error-rate reducing. **Keywords**—MIMO; Blind Detection; Space-time Block Coding; Maximum Likelihood Estimate

# Capacity Bounds for Joint Transmit and Receive Antenna Selection Systems with Correlated Fading Channels

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Abstract—In this paper, we investigate the capacity for antenna selection systems in the spatial correlated Rayleigh fading channels. Antenna selection is performed both at the transmitter and receiver, one transmit antenna is selected from  $N$  transmit antennas and  $m$  receive antennas are selected from  $M$  receive antennas. Upper and lower bounds of the capacity are derived. For a special antenna selection system in which one transmit antenna and two receive antennas are selected, the exact forms of the upper bound and lower bound are given. The simulation results show that both upper bound and lower bound are tight with the ergodic capacity and the exact form of the bounds fits the Monte Carlo results exactly. Keywords—Capacity bounds; Antenna selection; correlated fading channels

# Capacity of High-Rank Line-of-Sight MIMO Channels

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Abstract—A method is presented to investigate high-rank line of sight (LOS) multiple input multiple output (MIMO) channels by using matrix perturbation theory in microwave relay system. The upper and lower bounds channel capacity based on space time block codes (STBCs) technique and singular values decomposition (SVD) are also derived. Moreover, the condition number of MIMO channel matrix is studied to deduce a useful constraint for high-rank LOS MIMO channels. Our theoretical analysis channel capacity line up exactly with the simulation results, which are able to give a physical explanation of the high rank LOS channel characteristics. Keywords—MIMO channel, matrix perturbation theory, condition number, space time block codes

## Receive Antenna Selection without CSI for Linear Detection

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Abstract—Multiple-input multiple-output (MIMO) receive antenna selection without channel state information (CSI) for linear detection is proposed in the presence of unknown interferences. This antenna selection technique is implemented based on training sample sequence by minimizing the Least Squares (LS estimation error, which avoids the channel estimation. Since the high complexity of the exhaustive search, a QR decomposition-based fast selection algorithm is presented by using greedy algorithm. Simulations show that the exhaustive selection can retain the diversity benefit of the full complexity system using all the receive antennas and that the fast selection algorithm obtains most of performance of the exhaustive selection system with linear complexity. Keywords—Antenna Selection, Multiple-input Multipleoutput, Least Squares, QR decomposition

# A Practical Adaptive Transmission Scheme for Spatial Multiplexing MIMO Systems

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Abstract—We propose in this paper a practical adaptive modulation and channel encoding scheme for spatial multiplexing multiple-input multiple-output (MIMO) systems. The proposed scheme aims not only to maximize the average spectral efficiency (ASE) for a given bit error rate (BER) constraint but also to lower the computational and hardware complexity. First, an adaptive transmission principle for spatial multiplexing MIMO systems is presented under the assumption that the channel state information (CSI) is available at the receiver; Furthermore, we propose not only an adaptive modulation scheme for different transmit antennas but also an adaptive scheme which combines channel encoding and modulation. Finally we demonstrate from the simulation that the proposed scheme is of practical significance since it provides a well-behaved tradeoff between the ASE and complexity in comparison with the singular value decomposition (SVD) based adaptive transmission scheme with the optimal ASE performance and high computational complexity. Keywords: spatial multiplexing MIMO; adaptive modulation and channel encoding; average spectral efficiency.

# A Novel Transmission Scheme for MIMO Relay

# Channels

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Abstract—A novel transmission scheme that mixes half-duplex decode-and-forward relay transmission (RT) with direct transmission (DT) is proposed for a MIMO relay channel. In this scheme, the source message is divided into two parts: one for DT and the other for RT. Precoding and decoding schemes are to convert the original relay channel into several parallel subchannels so that resource allocation can be easily performed for RT and DT. Simulation results show significant average capacity gain of the proposed scheme over pure DT scheme and pure RT scheme. Keywords—MIMO relay channel; decode-and-forward; resource allocation; capacity.

## Novel Detection Method for Polarization Multiplexing

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[mslim@chonbuk.ac.kr](mailto:mslim@chonbuk.ac.kr) Abstract—A novel detection method was devised using the characteristic of polarization multiplexing system in mobile communication. Using this detection method, the polarization multiplexing system can increase the transmission rate twice while maintaining almost same bit error rate (BER) performance as the normal MIMO system with STBC under some channel condition. Keywords—detection method; MIMO system; polarization multiplexing; Tx diversity

## Performance of Antenna Selection Algorithm Based Cost Function for MIMO System

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Abstract—In this paper, two novel antenna selection algorithms based cost function for multiple-input multiple-output (MIMO) wireless system are introduced, which are named

Increasing selection Based Cost Function (IncBCF) and Decreasing selection Based Cost Function (DecBCF), respectively. The proposed antenna selection algorithms are only considered at the receiver, which aim at maximizing channel capacity. Through the simulation results, it can be seen that the DecBCF algorithm obtains almost the same capacity as the optimal selection algorithm while retaining lower computational complexity. Further more, the results show that the proposed algorithms provide better performance than the existing suboptimal antenna selection algorithms. Keywords—Channel capacity; outage capacity; MIMO system; antenna selection.

# Lower Bound on the Ergodic Capacity of MIMO Relay Channels in Rayleigh Fading case

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Abstract—This paper analyzes the ergodic capacity in Rayleigh fading case and derives the signal-to-noise ratio (SNR) conditions for achieving the lower bound on ergodic capacity when nodes have different number of antennas, especially when the number of source antennas is larger than that of the destination's and the relay transmitter and receiver's. Then we verify it through simulations. Besides, simulation results show that with the increase of the number of the transmitter antennas, the lower bound on ergodic capacity raises linearly. Because the source node and the relay node can function as a “virtual” transmit antenna array when the relay node is located close to the source node. Keywords—signal-to-noise ratio(SNR); ergodic capacity; multiple-input multiple-output(MIMO); relay channel

# Investigation into the Effects of Spatial Correlation on MIMO Channel Estimation and Capacity

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Abstract—This paper reports on investigations into the effects of spatial correlation on channel estimation and capacity of a Multiple Input Multiple Output (MIMO) system. Minimum Mean

Square Error (MMSE) method is applied for channel estimation under a correlated channel scenario. Simulation results for a 4x4 MIMO system with the Jakes model describing a channel between a base station and a mobile station demonstrate a trade-off between the effects of spatial correlation, channel estimation and capacity. For low values of Signal to Noise Ratio (SNR), spatial correlation decreases channel estimation errors and improves capacity. For high values of SNR, spatial correlation has a less pronounced effect on improving channel estimation and thus the MIMO capacity is adversely affected by the decreased channel matrix rank. Keywords—Spatial Correlation ; MIMO; Channel Estimation; Channel Capacity; Trade-off

# Capacity Analysis for Correlated MISO Channels in the presence of Correlated Interference and Noise

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Abstract—Exact and general analysis of the capacity for multiple-input single-output (MISO) correlated Rayleigh fading channels in the presence of both correlated Rayleigh co-channel interference and additive Gaussian noise is not available in the literature, although its counterpart with Gaussian noise alone has been thoroughly investigated. The difficulty arises from the quadratic form of interference term. In this paper, we obtain exact solutions to the ergodic capacity for MISO systems with and without channel state information (CSI) at the transmitter. Numerical results are also presented for illustration. Keywords—Multiple-input single-output; cochannel interference; ergodic capacity; outage probability; noise.

# Particle-Swarm-Optimization-Based Minimum-BER Detection for MIMO Systems with Time-Reversal

# Space-Time Block Codes

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Abstract—The aim of this paper is to present an efficient adaptive minimum bit error rate (MBER) detection approach for multiple-in-multiple-out (MIMO) systems with Time-Reversal space-time block codes (TR-STBC), which have attracted enormous attention in recent years. In general, the popular minimum mean square error (MMSE) receiver can be employed due to its good performance and amenability to adaptive implementation. However, it is not optimal in terms of the bit error rate (BER) performance. In this proposed approach, the main idea is to directly minimize the BER by employing a particle swarm optimization (PSO) algorithm on the estimated BER function in order to adaptively adjust the weights of the MBER detectors. Simulation results demonstrate that this adaptive minimum- BER detection using PSO algorithm (MBER-PSO) can achieve significantly superior performance, which is very close to that of the optimal maximum-likelihood sequence estimation (MLSE) detector.

# A Novel Space-time System Based on Turbo Channel Estimation Method

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Abstract—In order to improve the accuracy of channel estimation in MIMO space-time communication system, a turbo channel estimation which employs MAP iterative algorithm is proposed. The estimator utilizes the soft-decision information at the output of SISO channel decoders to iterative estimate the impulse response of MIMO channels. Since the STBC decoder depends on the output of channel estimator, the proposed method ameliorates the performance of STBC decoder. Simulation results demonstrate the superiority of proposed method at the performance of BER in 3GPP's wireless channels. Keywords- MIMO; Turbo; MAP; channel estimation; softdecision component;

# Cooperative Relaying Transmission in Correlated MIMO Channels

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Abstract—A half-duplex repetition-coded decode-and-forward cooperative relaying scheme is proposed for correlated MIMO channels. In this scheme, two information messages of the source will be transmitted to the destination simultaneously in each transmit block. One is for direct transmission and the other is for relay transmission. Transmit power allocation and linear precoding at the source and the relay are also involved to approach the capacity of the MIMO single-relay channel with system-wide transmit power constraint. Simulation results show that high capacity gain can be achieved by the proposed scheme compared with direct transmission in most cases. Keywords—cooperative relaying; MIMO Channel; precoding; power allocation

## A cross-layer packet scheduling and antenna selection scheme for multi-service MIMO systems

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Abstract—In this paper, we propose a cross-layer packet scheduling scheme for multi-service MIMO system which adopts a unified method to select the set of users to transmit to and the antennas over which users send their packets. Our proposed scheduling scheme makes a difference between RT (Real Time) and non-RT (non-Real Time) services. It defines the utility functions of RT services according to a Modified Delay PF algorithm (MDPF), which could guarantee the QoS of RT services while combining the predominance of PF algorithm. And PF mapping is used for calculate the utility functions of non-RT services considering the tradeoff between throughput and fairness. Through a low-complexity antenna selection algorithm, set of users and antennas are determined at the same time according to the utility functions of every user. Simulation results reveal the proposed scheme provides better QoS guarantee to RT services while not badly deteriorating the throughput of system and fairness among users compared to the conventional PF scheduling. Keywords—MIMO; multi-service; packet scheduling; antenna selection; MDPF

## Multiple Frequency Offsets Pre-correction Based on Enhanced Limited Feedback Precoding



# for Distributed MIMO System

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**Abstract**—In this paper, we consider the problem of multiple frequency offsets pre-correction in distributed multi-input multi-output (MIMO) systems. In practical distributed MIMO system, each pair of transmit and receive antenna has a different frequency offset and the received signal at each receiver is the summation of all the transmitted signals. These multiple frequency offsets make frequency compensation difficult if not impossible. In the paper, taking advantage of equivalent channel matrix with frequency offsets information, an enhanced limited feedback precoding (ELFP) algorithm is proposed to pre-correct the effect of frequency offsets. Simulation results show that the proposed scheme works as well as the system without frequency offsets even if the normalized frequency offsets is as high as 20%. **Keywords**—multiple frequency offset, enhanced limited feedback precoding (ELFP), multi-input multi-output (MIMO).

# A Low Complexity Near Optimal Diversity- Multiplexing Switched MIMO Systems Based on Variable-Rate MQAM

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**Abstract** — A novel diversity-multiplexing decision switched algorithm is proposed for multiple-input multiple-output (MIMO) system based on variable-rate MQAM. The proposed scheme is a closed-loop system, achieves adaptive bit and power allocation according to real-time channel state information (CSI), and the tradeoff between the diversity and multiplexing gains that can simultaneously achieved over a low-rate feedback channel with a little bits. The proposed algorithm takes minimum bit error rate as object, has lower cost can be easily implemented, improves the performance of the receivers, and achieves better bit error rate performance than the traditional suboptimal algorithm. Simulation results demonstrate that the proposed decision algorithm achieves excellent performance. **Keywords**—MIMO system; adaptation; bit error rate (BER);

# Soft-output MMSE MIMO Detector under ML Channel Estimation and Channel Correlation

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**Abstract**—In reality, this is no such thing as perfect channel estimation. But unfortunately, channel estimation errors have never been taken into account by existing soft-output minimum mean square error (MMSE) multiple-input multiple-output (MIMO) detector when calculating the log-likelihood ratio (LLR) for coded bits, i.e., the soft information. As a result, its performance can be substantially degraded. In this paper, we propose a novel soft-output MMSE MIMO detector under maximum likelihood (ML) channel estimation for receiver correlated MIMO wireless communication systems. Based on random vector theorem, this proposed detector takes channel estimation errors and receiver correlation into account when constructing MMSE filter and computing LLR of each coded bit. Furthermore, a simplified version of this proposed detector is provided so that the requirement of the MIMO correlation matrix is dropped. Simulation results show that the proposed novel detector outperforms existing soft-output MMSE MIMO detector with considerable margin, and the simplified version can nearly achieve the same performance as that of the original one. **Keywords**— minimum mean square error (MMSE), multiple-input multiple-output (MIMO), channel estimation, soft-output

# Optimum Detection with Low Complexity for Collaborative Spatial Multiplexing in Uplink Mobile WiMAX Systems

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**Abstract**— In mobile WiMAX systems, uplink collaborative MIMO (Multiple Input Multiple Output) performs spatial multiplexing with two MSs (Mobile Stations), each with one antenna. As two MSs transmit collaboratively on the same subchannel region, the overall uplink capacity will be doubled. To perform this interesting technique with high performance, most system vendors demand the optimal MLD (Maximum-Likelihood Detection) in the base station which has at least two antennas. However, the MLD is difficult to implement due to its explosive computational complexity. In this paper, we propose a novel MIMO decoding scheme which achieves optimal performance with low complexity for collaborative spatial multiplexing in uplink mobile WiMAX systems having an iterative channel decoder using bit log-likelihood ratio information. Simulation results show that the proposed scheme has the same block error rate performance of the MLD with only 28% computational complexity in terms of real multiplication, when both MSs transmit with 16QAM. **Keywords**—component; IEEE 802.16e; mobile WiMAX; uplink; collaborative MIMO; ML; LLR

# A Fast Algorithm for Transmit Antenna Selection in Group Layered Space-Time Architectures

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**Abstract**—Group Layered Space-Time architecture (GLST) which combines space-time block coding and layered space-time processing can achieve a good diversity-multiplexing tradeoff. For GLST, we present an antenna selection (AS) algorithm based on QR decomposition of the equivalent channel matrix. The presented AS algorithm can achieve excellent error rate performance for GLST with the QR decomposition-based successive interference cancellation receiver. Moreover, a fast AS algorithm with only a small loss in performance is considered. **Keywords**— Antenna selection; MIMO systems; space-time block coding; layered space-time

# An MMSE-DBF Interference Suppression Reception Scheme for MIMO-OSTBCs System

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Abstract—In this paper, an interference suppression reception scheme for Multiple Input Multiple Output (MIMO) system using Orthogonal Space-Time Block Codes (OSTBCs) in strong interference scenario is presented. Based on Digital Beam-forming (DBF), the scheme is valid to suppress strong interferences without performing channel estimation. The SER performance of the proposed scheme is close to that of Maximum Likelihood Decoding (MLD) scheme although with a little SER performance loss. But the proposed scheme has much lower complexity. It is more practical in applications. Simulation results are given to verify the interference suppression ability and advantages of the proposed scheme. Keywords— MIMO; OSTBCs; MLD; DBF; MMSE

# Capacity and Power Allocation Scheme for Linear MIMO Beamforming with Imperfect Channel State Information

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Abstract—Perfect channel state information (CSI) is always assumed in work on multiple-input, multiple-output (MIMO) precoding theoretical analyze. In this paper, we investigate the effect of imperfect channel state information on the performance of MIMO broadcast channel (MIMO-BC). We show that even with moderate channel estimation error, the system performance degrade significantly. So, we propose a Frobenius norm based power allocation scheme to guarantee the user's QoS. Simulation results show that this scheme enhances the user's outage performance and reduces the sensitivity to the imperfect CSI. Keywords—Imperfect channel state information; MIMO precoding; user selection

# On the Capacity bounds of Beamforming over MISO Time-Selective Channels with

# Estimation Errors and Feedback Delay

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**Abstract**—We examine the ergodic capacity of beamforming over a multiple-input single-output (MISO) time-selective channel with channel estimation error and delayed limited feedback. At each frame, the receiver obtains the minimum mean squared error estimation of the channel, chooses a transmit beamforming vector, according to the error channel estimation, from a codebook based on random vector quantization design, and feeds back the corresponding index to the transmitter using a finite number of bits. We derive the bounds on the capacity, and show that the tightness of the lower and upper bounds, and the bounds decreasing with the increase of channel estimation error or normalized Doppler spread. **Keywords**—Beamforming; capacity; channel estimation errors; delayed limited feedback; time-selective.

# Novel Power Loading Algorithm for Downlink Multiple Streams MIMO System

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**Abstract**—In downlink multiple streams multiple-input multiple-output (MIMO) system, adaptive modulation and coding (AMC) is used to increase spectrum efficiency (SE) due to selecting the modulation and coding rate scheme (MCS) dynamically. However, there is a gap between UE's signal to interference plus noise ratio (SINR) and that required by the MCS. In this paper, we propose a novel power loading algorithm using the SINR gap. The algorithm converts the SINR gap into the transmit power gap among different streams. Thus BS adjusts transmit power allocation for different streams and selects higher MCS than that without adjusting power. The results demonstrate that this proposed algorithm contributes large gain of SE for single user (SU-) MIMO based on singular value decomposition (SVD) precoding. **Index Terms**—AMC, Downlink multiple streams MIMO system, MC, Power loading, SVD

# Compare Beamforming with Multiplexing for MIMO Relay Network in the Low SNR Regime

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Abstract—Given a multiple-antenna source and a multipleantenna destination, a multiple-antenna relay between the source and the destination is desirable under useful circumstances. In this paper, a spatial multiplexing scheme and a cooperative beamforming scheme have been proposed for a non-regenerative MIMO relay system. In the spatial multiplexing scheme, the MIMO relay channel can be decomposed into several parallel channels each with the source to relay channel gain and the relay to destination channel gain. In the cooperative beamforming scheme, the transmitter uses all of its antennas to transmit one signal instead of multiplexing different signals simultaneously. It can be proved that the capacity of the spatial multiplexing scheme is smaller than that of the cooperative beamforming scheme in the low SNR regime. It is shown that for asymptotically large number of relays, the capacity of the spatial multiplexing scheme is converging to that of the beamforming scheme. Keywords— Multiple-input multiple-output (MIMO); MIMO relay; non-regenerative relay; spatial multiplexing; cooperative beamforming

# A Combined Codebook Constructing Method for Beamforming on Correlated MIMO Channels

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Abstract—A combined codebook constructing method is proposed for beamforming in correlated Multiple-input multiple-output (MIMO) channels, where the codebook is dynamically constructed based on the transmit covariance matrix of the channel. Monte Carlo simulations show performance

close to optimal beamforming. Huffman coding is used to further reduce the feedback rate in correlated MIMO system. Keywords— Beamforming; codebook; Multiple-input multipleoutput (MIMO)

# Optimal Design and Power Allocation for Non- Regenerative MIMO Relay Channels

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Abstract—Relaying techniques can extend the communication range and coverage, and reduce the transmission power required to reach the users far from the base station. These benefits make MIMO relaying techniques a powerful candidate for implementation in the next generation of wireless networks. The conventional non-regenerative approach is the amplify and forward (AF) approach, where the signal received at the relay is simply amplified and retransmitted. In this paper, we have proposed a optimal relaying and power allocation scheme for a non-regenerative MIMO relay system, which maximizes the capacity for non-regenerative cooperative transmission, when the total transmit power for the source and the relay is restricted. We compare the performance so obtained with the performance for the conventional AF approach, the regenerative relaying scheme and a suboptimal relaying scheme. Keywords—Multiple-input multiple-output (MIMO), MI relay, non-regenerative relay, capacity, optimal power allocation

# Reduced Complexity and Performance Comparison of The SISO-MMSE Receivers for MIMO Channels

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Abstract—An a posteriori probability (APP) detector for multiple antenna channels has presented in [1]. It has the high advantage of providing good performance but has an NP complexity. we studied near capacity [2] and near outage performance over multiple antenna channels thanks to optimized bit interleaved coded modulations (BICM) [3] [4]. We will now present a sub-optimal soft-input soft-output (SISO) detector based on the minimum mean square error (MMSE) criterion. Such a SISO-MMSE equalizer has been presented in [5] in the case of single antenna dispersive

channel. We describe the direct application to MIMO channels and present supplementary complexity reductions. Comparison between the shifted list sphere decoder [6] [9] and the list sphere decoder centered on the received point. Performance comparison for equal performance - Performance comparison for equal complexity.

## Capacity Bounds of Dual-Polarization Correlated MIMO System

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Abstract—In this paper, we first derive a lower bound for the capacity of MIMO system employing dual-polarization diversity. An upper bound is also derived in the high SNR regime. In a second part, the tightness and validity of the bounds are analyzed by a definition named pseudo condition number. We conclude that the correlation matrices of antenna array have a great impact on the tightness of bounds. The impact of polarization diversity on the capacity and the robustness of MIMO system are analyzed at last. Index Terms—MIMO, polarization diversity, capacity bound, robustness

## Performance Analysis of Frequency Diversity for Multi-Carrier CDMA System Based on Bridge Function

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Abstract—Based on the characteristics of Bridge function, i.e. zero and nonzero distribution, bridge function's spreading spectrum feature was analyzed and concluded that it is a kind of discrete spreading mode. In specific channel environment, if coherent bandwidth and single sub-carrier bandwidth is known, we can choose the shift parameters for bridge function sequence to get the best frequency diversity. At the same time, the cochannel interference is decreased and the system channel capacity is improved. On the basis of discussing the difference between bridge function's discrete spreading and traditional discrete spreading, the traditional



discrete spreading mode is modified and extended. The new spread spectrum mode will be more flexible and can be adapted to the complex variable channel. And the better frequency diversity can be achieved with various channel environments. The simulation results verified the superiority of bridge function in the MC-CDMA system. Keywords-bridge function; discrete spreading; frequency diversity; multiple access interference

## Fast Antenna Selection for Alamouti Multi-user MIMO Detection

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Abstract—The antenna selection technology is introduced into the existing uplink Alamouti multi-user MIMO detection for a low hardware cost. A selection criterion maximizing the minimum user signal-to-noise-plus-interference-ratio (SINR) is proposed. To avoid the exhaustive search selection, a fast selection algorithm is further proposed that selects an antenna to maximize the minimum user SINR in each stage. Simulations show the exhaustive search selection achieves almost all the diversity benefit of the full complexity system utilizing all receive antennas and the performance of the fast selection is near to the optimal selection. Keywords— Antenna selection, Alamouti, SINR, Fast

## Correlation and Capacity Analysis of MIMO with UCA and Laplacian Angular Distribution

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Abstract Multiple antenna systems are promising architectures for overcoming the

effects of multi-path interference and increasing the spectrum efficiency. Capacity increases promised by MIMO systems mostly depend on the spatial correlation properties of the radio channels. This paper investigates the performance of multiple-input and multiple-output (MIMO) antenna arrays systems including MIMO space-time correlation and antenna array. An analytical formula is derived for the fading correlation function of a uniform circular array (UCA) when the angular energy follows a Laplacian distribution. Computer simulations are carried out to verify the analytical results, such as fading correlation and channel capacity. keywords: MIMO, fading correlation, channel capacity, Laplacian distribution

# Cross Polarization Discrimination of MIMO Antenna Configurations

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**Abstract**—The cross polarization discrimination (XPD) of multiple input multiple output (MIMO) array antenna at a mobile station in indoor propagation environments is studied. The novel closed-form expressions for cross polarization discrimination of angular spread, mean angle of arrival (AOA) and scatterer numbers are presented. It provides a deep understanding of the cross polarization system for different indoor environments and takes into account both azimuth and elevation spectrum. Furthermore, XPD values depend highly on the propagation path between the base station (BS) and mobile station (MS) due to line of sight (LOS) and nonline of sight (NLOS) situation. Finally, we consider antenna inclination at MS, which impact on MIMO array antenna performance because it results in receiving power difference. Keywords—cross polarization discrimination, multiple input multiple output, polarization diversity

# A Genetic Approach for Joint Receive Antenna Selection and Symbol Detection in the

# Multiuser MIMO Systems

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**Abstract**—To meet the rapidly growing demand of quality of service (QoS) while lowering the hardware cost such as the RF chains associated with antennas in the uplink of multiuser multiinput multi-output (MIMO) systems, this paper presents a simple, yet effective scheme for joint receive antenna selection and symbol detection based on the maximum likelihood (ML) criterion. This joint approach, however, is highly nonlinear. Aiming at solving the complex nonlinear optimization with reduced computational overhead, a variant of the conventional genetic algorithm (GA) is employed. Conducted simulations show that the new approach yields superior performance with reduced computational complexity compared with pervious works in various scenarios. **Keywords:** genetic algorithm, antenna selection, heterogeneous crossover, maximum likelihood, multiuser MIMO.

## Application of phased array in MIMO system

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**Abstract**—In this paper, a computer simulation of a MIMO system comprising phased array antennas (PAA) in all receiving branches is presented. In order to examine the system performance under relatively realistic conditions, a ray-tracing simulator was applied to generate a baseband channel impulse response matrix  $H$ . The PAA consists of  $L$  antenna elements where a variable-gained low-noise amplifier and a 360° continuously adjustable phase shifter are inserted in each antenna element and an adder for the array output is connected into the RF front-end of each receive branch. The phase shifters are adaptively controlled to increase the total channel capacity of MIMO systems. **Keywords**— MIMO receiver, phased array antennas

# Model and Simulation of Channel Capacity for MIMO Wireless Navigation System

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Abstract—In order to study the basis of information theory for MIMO wireless navigation system, channel capacity formula of MIMO system which uses multi-sending and multi-receiving antennas was deduced from point of view of information theory. With a circularly symmetric complex Gaussian input signal vector and equally-distributed signal power through all the transmit antennas, a much higher capacity can be obtained compared to the traditional SISO system. Two typical MIMO systems corresponding to all 1's and the unit transmission matrix were modeled completely for their channel capacity, followed by results were also given to testify the MIMO channel capacity. Key words—channel capacity; MIMO; wireless navigation system; space time coding

# Performance Analysis of Adaptive Modulation in MIMO System using Transmit Antenna Selection with Alamouti Scheme

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Abstract—In this paper, we mainly study the performance of adaptive M-QAM in transmit antenna selection (TAS) with the Alamouti scheme. We first derive expressions for the statistics of the receiver SNR in TAS with Alamouti scheme. Then we provide the closed-form expressions for the average spectral efficiency and average BER of TAS with the Alamouti scheme employing adaptive M-QAM. Our analytical results indicate that in the adaptive modulation system, TAS with the Alamouti scheme can obtain higher spectral efficiency compared with OSTBC without antenna selection. Keywords—antenna selection; adaptive modulation; average spectral efficiency; orthogonal space-time block codes.

# Optimum Power Allocation Algorithm for MIMO Relay Channel

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Abstract—In this paper, the capacity of MIMO relay channel with decode and forward (DF) scheme is investigated, where each node within the system is equipped with multiple antennas and located in an environment with distance-dependent path loss. In order to achieve the maximum capacity of the system, the optimal power allocation (OPA) among the nodes and the transmit antennas is analyzed under the assumption that relay node knows all channels instantaneous state information (CSI), and an implement algorithm of the OPA is derived. Numerical results demonstrate that adopting the proposed power allocation algorithm, the capacity of MIMO relay channel with DF relay scheme can be significantly improved. Index Terms—MIMO, relay, power allocation

## A Novel Space-Frequency Receiver for Multirate MIMO MC-CDMA Systems

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Abstract—A unified system model for multirate multiple-input multiple-output (MIMO) multicarrier code division multiple access (MC-CDMA) systems is proposed in this paper. Based on the proposed unified system model, a novel space-frequency minimum mean-squared error based successive interference cancellation receiver (SF-MMSE/SIC) is developed and analyzed. The signal processing of this new detector is jointly carried out in space and frequency domains, so the detector cancels the interference resulted from different sources simultaneously. Simulation results of the proposed detector are provided to demonstrate the good performance of the novel receiver. Our results also show that taking into account the subcarrier interleaving, VSF (variable spreading factor) scheme offers similar performance as that of multicode system. Keywords—MIMO; MC-CDMA; multiuser detection; Receiver

## Trade-off Investigation between

# Diversity and Spatial multiplexing in Practical Systems Using Numerical Results

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**Abstract**—Using multiple antennas in wireless communication systems proposes some degrees of freedom in system design, these degrees of freedom can be applied to improve the system reliability by using Space Time Block Coding (STBC) which provides diversity gain. Degrees of freedom also can be applied to increase the system capacity using Spatial Multiplexing (SM) methods. It is possible to achieve a trade-off between diversity gain and Spatial multiplexing gain. Selecting the method which provides best efficiency for a specific system is an important issue. In this paper we will show which space-time architecture achieves the best efficiency for a specific system in practical cases. This classification depends on the desired data rate, number of transmission antennas, modulation order, SNR regime and channel state. **Keywords**—component; Multiple input-Multiple output systems; Diversity; Spatial multiplexing; Trade off.

## Performance Analysis of Two-Hop Cooperative MIMO transmission with relay Selection in Rayleigh Fading Channel

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Abstract— Wireless Relaying is one of the promising solutions to overcome the channel impairments and provide high data rate coverage that appears for beyond 3G mobile communications. In this paper we present an end to end BER performance analysis of dual hop wireless communication systems equipped with multiple Decode and Forward relays over the Rayleigh fading channel with relay selection. We select the best relay based on end to end channel conditions. We apply source, and also present how the multiple antennas at the source terminal affects the end to end BER performance. This intermediate relay technique will cover long distance where destination is out of reach from source. Keywords—Bit error rate (BER), amplify and forward (AF), multiple input multiple output (MIMO), decode and forward (DF), probability density function (PDF).

# Performance Evaluation of Multi Stage Receivers for Coded Signals in MIMO Channels

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Abstract: In this paper we evaluate the performance of a Multi stage receiver for coded signals (using space time block codes) when MIMO (Multi Input Multi Output) channels are employed. This provides a new paradigm for transmission over Rayleigh fading channels where scattering phenomenon is a major obstruction. At the transmitter side data encoded using a space - time block code, and the encoded data is split into  $n$  streams which are simultaneously transmitted using  $n$  transmit antennas. The received signal at each receive antenna is a linear superposition of the  $n$  transmitted signals perturbed by noise. At the receiver side we employ different equalization and detection techniques to obtain optimum BER. The detection algorithms that we have tried out are Zero-Forcing, MMSE, Maximum a Posteriori, Maximum Likelihood, Nulling and Cancellation using QR factorization and iterative MMSE. We review the encoding and decoding algorithms for various codes and provide simulation results demonstrating their performance. It is shown that using multiple transmit antennas and space - time block coding provides remarkable performance at the expense of almost no extra processing. It is also seen different detecting algorithms are optimized for different fading environments. Keywords- Space-time block codes, MIMO channels, ZF, MMSE, MAP, ML, Nulling and Cancellation.

## Effect of Channel Estimation Error on the Mutual

# Information of MIMO Fading Channels

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Abstract—In this paper, we study the effect of channel estimation error at the receiver on the mutual information of a multiple-input - multiple-output (MIMO) channel obeying correlated Rayleigh fading. The system model is constructed based on the channel estimation error at the receiver side. And using the properties of Wishart distribution, the lower bound on the channel capacity is derived when the MIMO channel is full rank. The simulation results show that the channel capacity of MIMO system is sensitive to the channel estimation error. The channel capacity is maximized when the signal-to-noise increases to a certain point. Keywords—MIMO; channel capacity; fading correlation; channel Estimation

## Joint Sphere Detector and User Scheduling in Multiuser MIMO Uplink System

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Abstract: In this paper, we proposed a joint design scheme between sphere decoding and user scheduling for multiuser MIMO uplink system. This is a cross layer design scheme which adopt the channel quality information based on user scheduling to reduced the search radius of sphere detector, it leads the better bit error ratio performance and low complexity than conventional sphere detection with fixed search radius. Keywords: sphere detector, multiuser MIMO, uplink, scheduling, cross layer

## Joint Sphere Detector and User Scheduling in Multiuser MIMO Uplink System

Haitao Li  
College of Electronic Information and Control Engineering  
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Abstract: In this paper, we proposed a joint design scheme between sphere decoding and user scheduling for multiuse MIMO uplink system. This is a cross layer design scheme which adopt the channel quality information based on user scheduling to reduced the search radius of sphere detector, it leads the better bit error ratio performance and low complexity than conventional sphere detection with fixed search radius. Keywords: sphere detector, multiuser MIMO, uplink,



scheduling, cross layer

# A Novel PMI Feedback Method for EUTRA TDD Systems

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**Abstract**—This paper proposes a novel method to feedback PMI (precoding matrix index) in EUTRA TDD (Time Division Duplex) systems. The proposed method groups the precoding matrices which have opposite phase rotations into one precoding matrix group and feedback the PGI (precoding group index) to the transmitter. The transmitter will utilize the reciprocal channel state information to recover the selected precoding matrix from the received PGI. Numerical results show that even under very unideal channel reciprocity assumptions, the proposed scheme can save feedback bits without performance loss.

**Keywords**—component; precoding; MIMO; TDD; EUTRA

## An improved codebook design for precoding in MIMO system

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Abstract— on the analysis of precoding principle in MIMO-OFDM system, an improved codebook design method is presented in this paper. Combing direct quantization method and Householder matrix, the proposed schemes has a better tradeoff performance than traditional quantization method. Simulation result s also shows a better performance than traditional method especially in 3 and 4 transmit antennas. Keywords—MIMO; precoding;codebook; quantization

# Exact and Approximation Expressions to the SER of Space-Time Block Codes in Correlated MIMO

## Nakagami Fading Channels

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Abstract—We present the exact closed-form expressions to the symbol error rate (SER) of coherent M-ary phase-shift keying (MPSK) and M-ary quadrature amplitude modulation (MQAM), when these modulations schemes are used along with space-time block codes in spatially correlated MIMO Nakagami fading channels with arbitrary fading parameters. Using the well-known moment generating function-based analysis pproach, we express the average SERs in terms of Lauricella's multivariate hypergeometric functions. Using exponential bounds for the Gaussian Q-function and for MPSK error probability over additive Gaussian noise channels, we also present new bounds and simple approximate solutions for the exact closedform expressions to the SERs of MPSK and MQAM, respectively. The new bounds and approximate solutions can be used to compute the average SER of MPSK and MQAM. Numerical results are presented to verify the accuracy of the solutions. Keywords—Orthogonal space-time block coding (STBC); correlated fading; multiple-input multiple-utput (MIMO) systems; symbol error rate.

# Outage Performance of User Cooperation with Multiple Receive Antennas at Destination under Nakagami Fading

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Abstract — We investigate the outage performance in the Nakagami fading for the decode-and-forward relaying with multiple receive antennas at the destination. A close-form expression for the outage probability is derived. Simulation results demonstrate our theoretical solution. Keywords— Outage Probability, cooperative relaying, Nakagami fading.



# Joint Relay Selection and ARQ in Cooperative Diversity Wireless Networks

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Abstract—The concept of cooperative diversity promises to offer the benefits of spatial diversity gains to handheld wireless devices with single antennas. So far the research has focused on special modulation or space-time coding in order to allow the cooperating terminals transmit simultaneously during the relay phase. In this paper, we proposed a joint relay selection and ARQ scheme in the cooperative diversity wireless networks. The simulation comparison of the direct transmission scheme, decodeand- forward scheme (DF) and joint relay selection and ARQ scheme showed that the proposed scheme can always achieve the highest throughput. Keywords- cooperative diversity, relay selection, ARQ, wireless sensors networks

# PIC Receiver for MIMO MC-CDMA systems Based on LCRLSCMA

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Abstract—Parallel interference canceller (PIC) is a powerful algorithm to combat multi-user interference (MUI). In this paper, a PIC receiver for space-time block codemultiple input multiple output multi-carrier code division multiple access (STBC MIMO MC-CDMA) based on linearly constraint recursive least squares constant modulus algorithm (LCRLSCMA) is studied. Simulations indicate that the proposed algorithm has better BER performance than the traditional algorithms among different environments.

Keywords- Space-time block coded multiple input multiple output multi-carrier cod division multiple access; linearly constraint recursive least squares constant modulus algorithm; Parallel interference canceller; multi-user detection.

I. I

# A New Coded Cooperation Algorithm

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**Abstract**—User cooperation provides transmit diversity even when mobile users cannot possess multiple antennas due to size constraints. Recently, a kind of user cooperation scheme called coded cooperation was proposed, in which standard channel coding methods were used to implement cooperation. This scheme achieves remarkable gains compared to non-cooperative system and other cooperation diversity scheme (such as amplify-and-forward and decode-and-forward) while maintaining the same information rate and transmit power. In this paper, we propose a new coded cooperation Algorithm. We compare the performance of our scheme with coded cooperation proposed by Hunter under a variety of conditions in slow fading, and a significant improvement is achieved.  
**Keywords**—user cooperation; coded cooperation; convolutional coding; wireless communication

# Antenna Selection for MIMO Systems in Correlated Channels with diversity technique

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**Abstract**—In recent years, due to the increasing demand of the data transmission rate, a lot of research based on Multiple-Input Multiple-Output (MIMO) system is established. MIMO systems can increase the system capacity and improve transmission reliability. However, the multiple RF chains associate with multiple antennas are costly in terms of size, power and hardware. Antenna selection techniques have been applied in MIMO system design to reduce the system complexity and cost. In this paper, we consider two schemes of antenna selection in correlated Rayleigh channels i. e. the maximal ratio transmission and Orthogonal Space-Time Block Code technique. The simulation results illustrate that; the new antenna selection scheme can obtain performance close to the optimum selection with low computational complexity. **Index Terms**—Antenna selection, receiver diversity, transmit diversity, multiple-input multiple-output (MIMO) systems, multiple-antenna communications, Correlated channels, spacetime coding, wireless communications.

# Power Allocation for the Uplink of Multi-User MIMO-OFDMA Systems

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Abstract — In this paper, power allocation scheme for clusters by mobile station (MS) is investigated in the uplink of a multi-user multiple-input multiple-output (MU-MIMO) and orthogonal frequency division multiplexing access (OFDMA) cellular system. In system level simulation works, without the knowledge of how many clusters will be assigned to a MS, it is a puzzle to decide how much transmission power should be used to calculate the signal to noise ratio (SNR) value before scheduled by the scheduler in base station (BS). Four feasible schemes are proposed for this problem. System level simulation results show that one of these schemes can improve system throughput while keeping the inter-cell interference at a moderate level.

Keywords—power allocation; scheduling; Multi-User MIMO; OFDMA; uplink system

## A Non-Cyclic Prefixed MIMO-OFDM System Based on a Recursive Algorithm of Joint Channel Estimation and Data Detection

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Abstract—We propose in this paper a non-cyclic prefixed multiple-input multiple-output orthogonal frequency division multiplexing (non-cp MIMO-OFDM) system based on a recursive algorithm of joint channel estimation and data detection. Unlike in the traditional cyclic prefixed MIMO-OFDM system, the transmitted sequence of the proposed system is given in the way that block-type pilot sequences and OFDM symbols before each OFDM symbol. Moreover, a recursive algorithm of joint channel estimation and data detection (recursive-JCEDD) based on interference cancellation is proposed for the corresponding receivers. Simulation results show that the proposed system based on the recursive-JCEDD algorithm achieves lower bit error rate (BER) and higher information data rate than the traditional cyclic prefixed MIMO-OFDM system with least square (LS) or iterative LS channel estimation

algorithm. Keywords: cyclic prefix (CP); non-cyclic prefixed multiple-input multiple-output orthogonal frequency division multiplexing (non-cp MIMO-OFDM); a recursive algorithm of joint channel estimation and data detection (recursive-JCEDD); interference cancellation.

# Evaluation of the Channel State Information Effect to MIMO-OFDM System Performance

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Abstract— researches about conditions of the resource allocation algorithm in wireless communication have been done a lot recently. An evaluation model for the adaptive algorithm of MIMO-OFDM system is built in this paper. After formulating system efficiency under static and adaptive conditions, the effect of imperfect Channel State Information (CSI) to MIMO-OFDM system is analyzed. Analytical and numerical results show effect to the frequency efficiency when the CSI is imperfect, and simulations show that MIMO-OFDM can resist the channel delay. At last we propose the compensatory policy for channel delay and channel estimation error. Keywords- adaptive; frequency efficiency; channel state information; multiple input multiple output

# A Novel Coarse Time Synchronization Algorithm for MIMO-OFDM Systems

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Abstract—This paper proposes a coarse time synchronization method which reduces the influence



of the inter symbol interference (ISI) for MIMO-OFDM systems. The proposed method extracts the timing which is not disturbed by delay spread within the guard interval (GI) by utilizing the cyclic prefix (CP). Thus, the proposed method is effective in reducing the influence of the ISI. Simulation results demonstrate that the proposed coarse time synchronization algorithm has a satisfactory performance even at a low SNR in rich multipath environment. And the synchronization performances in MIMO channel are super to those in SISO channel for its larger diversity gain. Keywords- ; coarse time synchronization; multipath

# A Cross-layer Design Based on Precoding and Partial Feedback for Multiuser MIMO-OFDM Systems

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**Abstract**—A cross-layer design based on precoding and partial feedback for multiuser MIMO-OFDM systems is presented in this paper. First, we design precoder vectors with partial feedback in order to convert the MIMO channels into equivalent single-input single-output (SISO) channels. Then we can divide the radio resource into many space-time-frequency (STF) three dimension resource units. Then we present a novel cross-layer design that combines packet scheduling and resource allocation. The two parts function tightly together make use of the feedback channel state information (CSI) and packets characteristic such as packet arrival, delay constraint, packet size and users' contentment and so on. Simulation results show that our scheme can satisfy most users' QoS requirements and have very good performance in packet drop rate, packet delay and syst throughput while reduces feedback greatly. Keywords- cross-layer; precode; partial feedback; multiuser MIMO-OFDM; scheduling

# Multi-user MIMO-OFDM with Adaptive Resource Allocation over Frequency Selective Fading Channel

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**Abstract**—In this paper, a practical and efficient adaptive subcarrier, power and bit allocation algorithm for multi-user MIMO-OFDM systems is described. Assuming perfect knowledge of the channel state information (CSI) on the transmitter, we explore the problem of minimizing the total transmit power with constant overall bit rate requirement. The scheme proposed here attempts to make the MIMO-OFDM systems more flexible and robust to channel variations. To minimize the total transmit power, we assign each OFDM subcarrier according to the square of the maximum eigenvalue of the channel frequency response matrix. We also provide a low complexity algorithm based on the greedy algorithm for the adaptive bit and power allocation over the frequency selective fading channel. Computer simulations are conducted to demonstrate the performance of the proposed scheme comparing with some other adaptive schemes in the terms of bit error rate (BER). **Keywords**— MIMO; OFDM Adaptive resource allocation; multi-user; eigenvalue INT

# A Cross-layer Design Based on Precoding and Partial Feedback for Multiuser MIMO-OFDM Systems

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# Multi-user MIMO-OFDM with Adaptive Resource Allocation over Frequency Selective Fading Channel

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**Abstract**—In this paper, a practical and efficient adaptive subcarrier, power and bit allocation algorithm for multi-user MIMO-OFDM systems is described. Assuming perfect knowledge of the channel state information (CSI) on the transmitter, we explore the problem of minimizing the total transmit power with constant overall bit rate requirement. The scheme proposed here attempts to make the MIMO-OFDM systems more flexible and robust to channel variations. To minimize the total transmit power, we assign each OFDM subcarrier according to the square of the maximum eigenvalue of the channel frequency response matrix. We also provide a low complexity algorithm based on the greedy algorithm for the adaptive bit and power allocation over the frequency selective fading channel. Computer simulations are conducted to demonstrate the performance of the proposed scheme comparing with some other adaptive schemes in the terms of bit error rate (BER). **Keywords**— MIMO; OFDM; Adaptive resource allocation; multi-user; eigenvalue I. INTRODUCTION

# Frequency Synchronization for MIMO OFDM-based High Throughput Wireless LAN Systems

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**Abstract**—This paper proposes a post-FFT frequency synchronization algorithm for IEEE 802.11n based MIMO OFDM (multiple-input multiple-output orthogonal frequency division multiplexing) wireless LAN systems. The proposed synchronization algorithm uses preamble for rapid

synchronization, and is thus suitable for burst mode transmission. The proposed method exploits receive diversity, which significantly improves the accuracy of the frequency offset estimation. Simulation results show that the proposed algorithm operates close to Cramér-Rao lower bound at high SNR, and is robust against multipath fading channels. Keywords-cyclic shift; MIMO systems; OFDM; synchronization; wireless LAN

# The Spatial Diversity Algorithm of Sampling Clock Synchronization in MIMO-OFDM Systems

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Abstract- Sampling offset estimation and sampling clock recovery are crucial in MIMO-OFDM systems. In this paper, a novel spatial diversity algorithm of sampling offset estimation in MIMO-OFDM systems is proposed. In addition, a lower complexity sampling clock recovery design is presented. The simulation results show that the proposed algorithm is accurate and robust against fast time-varying frequencyselective fading channel. Keywords- MIMO-OFDM; sampling offset; sampling clock recovery; synchronization; diversity

# Adaptation Combined Spatial Multiplexing and Diversity Techniques for Adaptive MIMO-OFDM System

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Abstract — An adaptive modulation and coding(AMC) and adaptive antenna grouping(AAG)

architecture for multi-input multi-output orthogonal frequency-division multiplexed (MIMO-OFDM) system was proposed to effectively eliminate or resist various fading in wireless channels and to offer best tradeoff between transmission reliability and capacity. This combining scheme is not only adaptively to modulate to transmit more information over subcarriers but also adaptively to find the optimal STC/SM grouping scheme according to the estimated SNR. The simulation shows that the BER and throughput performance of the AMC and AAG MIMO-OFDM system outperform the conventional MIMO-OFDM and the AMC MIMO-OFDM system. Keywords— ; adaptive; Spatial Multiplexing; Diversity

# Cross Layer Dynamic Resource Management with Guaranteed QoS in MIMO OFDM Systems

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Abstract—In this paper, we have formulated the problem of cross layer throughput-maximized dynamic resource management with guaranteed QoS in MIMO OFDM beamforming systems. In order to reduce of the amount of feedback information and computation complexity, OFDM subcarriers are grouped into subchannels based on the fact that adjacent subcarriers experience the same fading. According to characteristics of various traffics in actual networks, four types of traffics are classified. Different class has different QoS requirements and one connection only belongs to one class. Considering MAC QoS requirements, PHY channel side information (CSI) and connection fairness, the scheduling priority factor (SPF) is defined for each connection. Based on the scheduling priority factor, the suboptimal solutions for the formulated problem are obtained. Packets from different connections are queued at the base station. Scheduling and subchannel allocation are operated at jointly. Then, power allocation and bit loading is made for each packet. The performance of our proposed algorithm is also studied by simulation. Keywords—MIMO-OFDM beamforming Systems, Cross-Layer Guaranteed QoS throughput\_maximized, scheduling priority factor.

# Sampling Frequency Offset Estimation for MIMO OFDM Systems

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Abstract—This paper proposes a pilot-assisted sampling frequency offset (SFO) estimation

algorithm for MIMO OFDM (multiple-input multiple-output orthogonal frequency division multiplexing) systems. The sampling frequency offset is estimated from phase errors in the received pilot subcarrier symbols between two transmitted OFDM blocks. The optimal weight for each SFO estimate is derived. The proposed weighted method is remarkably superior to the unweighted method, and the receive diversity exploited by the proposed method can significantly reduce the MSE (mean square error) of the SFO estimator. Simulation results show that the proposed algorithm can accurately estimate the SFO in both AWGN channels and multipath fading channels.

Keywords—estimation; MIMO systems; OFDM; sampling frequency offset

# Adaptive MIMO switching for Mobile WiMAX OFDMA Systems: Performance Trade off

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**Abstract:** The future mobile communication system will be distinguished by high integration of services, flexibility and higher throughput. Thus, the rapid growth in traffic volume and increase in new services has begun to change the configuration and structure of wireless networks. In the recent past, WiMAX has gained lot of interest for providing broadband communication. The present demand in the field of wireless communication is not only to provide data communication when the user is mobile, but also to provide high data rate by consuming less bandwidth. To meet these requirements, WiMAX provides specification for FEC (Forward Error Correction), and optional schemes like Advanced Antenna Systems (AAS), Space Time Code (STC) and Multiple Input Multiple Output (MIMO) systems. Also it includes two MIMO profiles, which can be used for different purposes including diversity, spatial multiplexing and interference reduction. MIMO in conjunction with OFDMA promises to provide massive amelioration in system throughput. The objective of the paper is to propound a unified guideline for choosing optimal schemes for different scenario in WiMAX OFDMA systems. In this paper, a simple technique to switch between diversity and multiplexing has been proposed. It is discerned through simulations that the proposed scheme achieves significant performance improvement than that can be obtained with either multiplexing or diversity lone. Keywords— WiMAX, Space-time code (STC), MIMO channels, ML, ZF, OFDMA.

# Distributed Multibase Collaborative Transmission for MIMO OFDM with Zero Forcing Beamforming

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Abstract: This paper addresses the problem cooperative downlink transmission in multicell multiantenna cellular networks. We have presented scheme for base station coordination and cooperation in MIMO with zero forcing beamformig system. Firstly, a projected channel matrices is given and it make the beams steer into the preferred user direction. Secondly, partial collaboration transmission and distributed scheduling method have been proposed. These approaches can reduce the complexity of user selection and achieve reasonable performance. Keywords: muticell, multiuser MIMO, zero forcing beamformig, scheduling, base station collaboration

# ICI Compensation in MISO-OFDM System Affected by Frequency Offset and Phase Noise

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Abstract—In this paper, to compensate frequency offset and phase noise influence, several ICI self-cancellation methods are proposed, CPE, ICI and CIR are derived in MISO OFDM system. As results, by choosing several ICI self-cancellation methods appropriately, considerable performance improvement can be achieved in the MISO OFDM system which affected by

frequency offset and phase noise. Key words: MISO-OFDM, Frequency offset, Phase noise, ICI, CIR, ICI self-cancellation, Orthogonal transmission of SFBC Technique

# ICI Compensation in MISO-OFDM System Affected by Frequency Offset and Phase Noise

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Abstract—In this paper, to compensate frequency offset and phase noise influence, several ICI self-cancellation methods are proposed, CPE, ICI and CIR are derived in MISO OFDM system. As results, by choosing several ICI self-cancellation methods appropriately, considerable performance improvement can be achieved in the MISO OFDM system which affected by frequency offset and phase noise. Key words: MISO-OFDM, Frequency offset, Phase noise, ICI, CIR, ICI self-cancellation, Orthogonal transmission of SFBC Technique

# Pilot Aided Channel Estimation of MIMO OFDM Systems

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Abstract—Multiple transmit-and-receive antennas can be used in orthogonal frequency division multiplexing (OFDM) systems to improve communication quality and capacity. In this paper, an improved channel estimation for MIMO-OFDM system is proposed by exploiting a new method of pilot insert by which pilots are inserted into different carriers at different time. The method can estimate the CSI of all frequencies, so it will enhance the ability to resist frequency selective fading. Then it regards the results of interpolation as pre-estimation and takes different Averaged Channel Estimation in the Time-domain (ACE-T) on different channel conditions to get final channel estimation. The effectiveness of the new technique is demonstrated through the simulation of an OFDM system with two-transmit and two-receive antennas. Keywords—OFDM; MIMO; Channel Estimation; Training Sequence; Pilot Symbol

# MIMO-OFDM PAPR Reduction by Space-Frequency Permutation and Inversion

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Abstract—Multiple-input multiple-output (MIMO) orthogonal frequency division multiplexing (OFDM) has attracted much attention as a solution of high-quality service for next generation wireless communications. However, like OFDM, one of main problems of MIMO-OFDM is the high peak-to-average power ratio (PAPR). In this paper, a novel method to reduce the MIMO-OFDM PAPR is proposed. This method applies space and frequency two-dimensional subblock permutation and inversion to the multiple antenna OFDM signals based on STBC. Two suboptimal schemes, termed successive suboptimal SFPI (SS-SFPI) and random suboptimal SFPI (RS-SFPI) are presented to reduce the complexity of the proposed scheme. Simulation results show that SFPI improves PAPR reduction performance compared with existing PAPR scheme, and the suboptimal schemes can significantly reduce PAPR on all transmit branches at the same time with low complexity. Keywords—multiple-input multiple-output (MIMO); orthogonal frequency division multiplexing (OFDM); peak-to-average power ratio (PAPR)

# Carrier Frequency Offset Estimation in MIMO OFDM Systems

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Abstract – The combination of Multi-Input Multi-Output (MIMO) with Orthogonal Frequency Division Multiplexing (OFDM) is regarded as a promising technique for the future wireless communications. However, the performance of MIMO OFDM systems is very sensitive to carrier frequency offset (CFO) which introduces inter-carrier-interference (ICI). Consequently, CFO estimation plays a key role in MIMO OFDM systems. In this paper, a novel scheme for CFO estimation is proposed, which is based on training sequences composed of repeated pseudo-noise (PN) sequences. In the proposed scheme, single-g estimators are adopted for CFO acquisition to get large estimation range. And, multiple-g estimators are used for CFO tracking to improve estimation accuracy. Simulation results demonstrate that all the estimators in our scheme have superior performance, and are more robust and accurate than Schenk' s scheme [10] [11] both in the AWGN channel and in the multipath channel. Keywords—Multi-Input Multi-Output (MIMO), Orthogonal Frequency Division Multiplexing (OFDM), carrier frequency offset (CFO)

## A STBC and V-BLAST Combining MIMO System

# Applies in Ad Hoc Networks

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Abstract—This paper presents a MIMO system scheme which is combined with STBC and V-BLAST. It can balance spatial multiplexing gain and diversity gain. Then, according to theory, a result is provided by a simple simulation analyze. In addition, for the application to Ad Hoc networks, a CSMA/TDCA protocol, which avoids the collision through a mode of time slot assignment without effecting data transmission, is offered. Finally, a virtual central base station theory, which provides convincing support for applying this combining system to Ad Hoc networks in the abstract, is proposed. Keywords—MIMO, Ad Hoc, CSMA/TDCA, virtual central base Station

# Balanced Power Control in Uplink MIMO-OFDM System

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Abstract—This paper presents a balanced power control scheme for the uplink of cellular MIMO system. The problem of coordinating power consumption reduce with raise in capacity simultaneously is formulated and an efficient algorithm with good performance is derived. Convex optimization method is used to solve the question. In this paper, an adaptive power allocation scheme is proposed by using interior-point method. Simulation results show that the proposed approach, compared to the optimal water-filling algorithm, actually achieves significantly lower total power consumption with similar performance in throughput.

# Optimal Time-Domain Training Pattern for ML Channel Estimation in MIMO OFDM

# System

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Abstract — High peak-to-average power ratio (PAPR) is a disadvantage of comb-type frequency-domain training pattern (FDTP) in MIMO OFDM system. To deal with such problem, an excellent orthogonal time-domain training pattern (TDTP), based on circularly shifting Chu sequence and satisfying that optimal condition derived by us, is proposed for maximum likelihood (ML) channel estimation. From theory analysis and simulation, we find: 1) This TDTP achieves the same optimal mean square error (MSE) performance as comb-type FDTP; 2) For bit error ratio (BER), it performs as well as comb-type FDTP for low and medium signal-to-noise ratios (SNRs) whereas it behaves slightly better than comb-type FDTP for high SNR. Thus, this pattern may be used as an alternative solution for ML channel estimation in MIMO OFDM system. Keywords- TDTP; FDTP; PAPR; Chu sequence.

# Time-varying Channel Estimation for MIMO/OFDM Systems Using Superimposed Training

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Abstract — This paper deals with the problem of time-varying (TV) channel estimation for multiple-input multiple-output/orthogonal frequency-division multiplexing (MIMO/OFDM) systems based on superimposed training (ST). The time-varying coefficients of the TV channel are firstly modeled by truncated discrete Fourier bases, and then optimally estimated both in one OFDM symbols and over multiple OFDM symbols by judiciously designing the superimposed pilots. In addition, an iterative symbol detection based channel estimation scheme with analytical performance analysis, is provided to mitigate the interference due to the unknown information sequences (thus to further improve channel estimation performance as well as SER levels). Simulations confirm that the proposed estimator achieves a considerable gain in estimating TV channels, and exhibits a nearly indistinguishable symbol error rate performance from the OFDM systems of frequency-division multiplexed trainings.<sup>1</sup> Keywords-channel estimation, MIMO/OFDM, superimposed training

# Adaptive Bit Power Allocation

# Algorithm for Multiuser MIMO-OFDM Systems

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Abstract—In this paper, an improvement of the RA (Rate Adaptive) algorithm with alterable allocation step is proposed. Considering of the requirement on system bit error rate and the restriction on allocated bits in each channel, we compare the performance between the improved algorithm and the Traditional RA algorithm. Simulation results show that the computational complexity of the proposed RA algorithm decreases a lot than the traditional algorithm while the capability of system is increased. So the proposed improved RA algorithm is a promising optimal method for implementation. Keywords— MIMO, OFDM, bit power allocation, RA, Adaptive

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Abstract—MIMO linear precoding can transform relative MIMO channels into  $N_s$  independent virtual channels by precoding process in the transmitter and receiver, and is an effective MIMO multiplex mode to improve throughput. In this contribution the principle and system structure of MIMO linear precoding based on CDD is introduced. With the CDD based precoding, we can select the best precoding for the data channel not only based on the sum capacity metric but also based on the feedback reliability. By choosing a proper cyclic delay between a small delay (e.g.

$2\tau$ ) and a large delay (e.g.,  $\tau$ )

), we can efficiently adapt to the proper MIMO mode with a single unified precoding structure.

Key words: MIMO; Precoding; CDD; delay

# Methods for Obtaining CIR Based on IFFT in MIMO-OFDMA Mobile Communication Systems

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**Abstract**—This paper mainly focus on methods for obtaining the CIR by performing the IFFT of CFR, which are heuristic or direct to improve channel estimation and tracking in MIMO-OFDMA systems. When FUSC mode is used, pilot signal are uniformly inserted into the carrier sets during preamble and the FFT size over pilots spacing is an integer in mobile WiMAX. Therefore, it is possible to obtain CIR based on IFFT of CFR. In this paper, we propose two methods involved in IFFT to get CIR, and the size of FFT used by method-1 is smaller than that done by method-2 however, method-1 has to consider the problem about the offset of pilot carriers. **Keywords**—MIMO-OFDMA; FUSC; CIR; CFR

# The Study of Multi-user Diversity technology over the MIMO-OFDM System

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Abstract—Recently, Orthogonal frequency division multiplexing (OFDM) has become a popular technique for transmission of signals over wireless channels. Also, Multiple-Input Multiple-Output (MIMO) is one of the most promising technologies for assisting fading and improving link reliability without sacrificing bandwidth efficiency. The combination of OFDM and MIMO seems to be the key technology in next generation high-rate wireless mobile systems. First, this paper introduces the MIMO technology, point out that the combination of OFDM and MIMO seems to be very promising when aiming at the design of very high-rate wireless mobile systems. Secondly, describes the application of OFDM and outlines the block diagrams of an OFDM modulator and demodulator and MIMO-OFDM system. Then, study several methods for combining the different diversity at the receiver, analyze the performances of diversity in OFDM-MIMO system with simulation results. Finally, achieves the conclusions. Keywords: MIMO OFDM, IEEE802.11n, Maximum Ratio Combine MRC Diversity INTRODU

# Combining Eigen-Beamforming and Differential Space-Time Modulation for Ricean Fading Channels

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Abstract—In this paper eigen-beamforming and differential space-time modulation (DSTM) are combined together to construct a robust and relatively simple system for multipleinput multiple-output (MIMO) Ricean fading channels. A transmission scheme with feedback link is developed here that combines beamforming with differential multi-antenna modulation based on orthogonal space-time block coding. The power loading algorithm of the eigen-beamformer is derived based on the principle of minimizing error probability bound. The optimality leads to better performance than traditional STBC transmission scheme. The simulation results proved that the combination of the eigen-beamforming and DSTM is an effective way to solve the problem with performance, complexity, and transmission rate for wireless communications.

Keywords—differential space-time modulation;mean feedback; Ricean Fading;transmit diversity

# Performance Analysis of V-BLAST system with Two Transmit Antennas in the Presence of Channel Estimation Error

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Abstract—The detection of V-BLAST system always requires a optimal ordering procedure, and also it requires knowledge of the channel state information (CSI) while in practice accurate CSI may not be available. In this paper, we investigate the system with two transmit antennas to evaluate its performance, considering both the effects of channel estimation error and optimal ordering procedure. Based on the modified postprocessing SNR, we derive the closed-form analytical BER expressions for MPSK and MQAM modulation at each processing stage. Monte Carlo simulations validate the analytical results and conclusions. Keywords—V-BLAST; successive interference cancellation; optimal ordering; channel estimation error; bit error rate (BER).

## The Hardware Design and Implementation of Space Time System

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Abstract—In this paper, we propose a simple hardware implementation scheme of the D-STBC system. According to the theory of D-STBC, the specific implementation scheme of encoding and decoding

come up. In the design, one differential encoding table is set up to replace the complex computation of the encoder; two decoding tables are set up to replace the complex computation of the decoder. Meanwhile likelihood decision replaces the maximum likelihood decoding decision. The hardware simulation results prove that the design scheme is correct. Furthermore, a software wireless communication flat is discussed, which adopts EPF10K30EFC256-1X and TMS320VC5509 as the digital baseband disposal part. Keywords-STBC;likelihood; implementation

# A Novel Cross-layer Resource Allocation Algorithm for Heterogeneous Services in OFDMA Systems

Yuan Feng, Hui Tian, Haibo Xu, Youjun Gao

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Wireless Technology Innovation Institute, Beijing University of Posts &  
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Beijing, China

Abstract— A new cross-layer urgent bit first (CLUBF) scheduling mechanism is proposed and analyzed in the paper. The proposed algorithm focuses on cross-layer resource allocation scheme for heterogeneous services in Orthogonal Frequency Division Multiplexing Access (OFDMA) downlink systems. And the CLUBF scheduling mechanism is operated over four steps: (1) traffic mapping: dividing traffic into UB (urgent bit) part, which represents the quality of service (QoS) and has service differentiation, and non-UB part, which means that no QoS is required and doesn't have service differentiation. (2) Resource allocation procedures for traffics' UB part and non-UB part, which aims to satisfy traffic QoS, maximize the system throughput and keep fairness among users. (3) Power and bit adjustment jointly to improve further performance. Besides, as fully indicated by simulation results, the proposed algorithm can improve system throughput and can reduce the compute complexity, which means that the proposed algorithm is a better choice for downlink scheduling. Keywords- OFDMA; CLUBF; cross-layer; QoS; heterogeneous services;

I

# FFT Based Superimposed Pilot Aided Carrier Frequency Offset Estimation in OFDM Systems

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Abstract—In this paper, a novel superimposed pilot based carrier frequency offset (CFO) estimator for Orthogonal frequency division multiplexing (OFDM) systems over frequency selective fading channel is proposed. Through utilizing the properly designed superimposed pilots, the CFO estimation can be resolved by implementing the fast Fourier transform (FFT) operation on the average values of the received signals on all subcarriers within several consecutive OFDM blocks. Compared with the existing superimposed training aided algorithm, the proposed scheme can obtain more accurate CFO estimation without increasing computation complexity. The simulation results verify the robustness and effectiveness of the proposed estimator. Keywords—carrier frequency offset; superimposed pilots; OFDM

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Keywords-carrier frequency offset; superimposed pilots;OFDM

# Reducing the Peak to Average Power Ratio of OFDM System using Particle Swarm Optimization

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Abstract—A new phasing scheme to achieve the lowest peak-to-average power ratio (PAPR) of OFDM system is presented in this paper, which is based on a global optimization combination of the initial phases using particle swarm optimization (PSO). The particle swarm optimization is applied to search the optimal combination of phase factors, which can achieve the OFDM signals with low PAPR and reduce the computational complexity significantly. To validate the analytical results, some simulations have been conducted, showing that the proposed schemes can achieve the lowest PAPR with low computational complexity. Keywords—OFDM; PAPR; PTS; PSO

# On Performance of Space-Time Eigenbeam Coding

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Abstract—For downlink transmission channels in which fading is correlated at the transmitter but independent at the receiver, array and diversity gains can be attained simultaneously by use of Space-Time Eigenbeam Coding (STEBC) which combines eigenbeamforming and Space-Time Coding.

STBEC can greatly reduce the complexity of the system and improve the performance as well. This paper is devoted to the evaluation of the performance of STBEC theoretically. The upper-bound of the average Pair Error Probability is utilized to measure the performance of STBEC. It shows that STBEC can achieve the maximum diversity gain and is especially suitable for the wireless environments with many paths around the transmitter which concentrate in several directions. Keywords—Space-Time Coding; Eigenbeamforming; Pair Error Probability

# The Study of Multi-user Diversity technology over the MIMO-OFDM System

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Abstract—Recently, Orthogonal frequency division multiplexing (OFDM) has become a popular technique for transmission of signals over wireless channels. Also, Multiple-Input Multiple-Output (MIMO) is one of the most promising technologies for assisting fading and improving link reliability without sacrificing bandwidth efficiency. The combination of OFDM and MIMO seems to be the key technology in next generation high-rate wireless mobile systems. First, this paper introduces the MIMO technology, point out that the combination of OFDM and MIMO seems to be very promising when aiming at the design of very high-rate wireless mobile systems. Secondly, describes the application of OFDM and outlines the block diagrams of an OFDM modulator and demodulator and a MIMO-OFDM system. Then, study several methods for combining the different diversity at the receiver, analyze the performances of diversity in OFDM-MIMO system with simulation results. Finally, achieves the conclusions. Keywords: MIMO OFDM, IEEE802.11n, Maximum Ratio Combine MRC Diversity INTRO

# Combining Eigen-Beamforming and Differential Space-Time Modulation for Ricean Fading Channels

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# The Hardware Design and Implementation of Space Time System

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# A Novel Cross-layer Resource Allocation Algorithm for Heterogeneous Services in OFDMA Systems

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# FFT Based Superimposed Pilot Aided Carrier Frequency Offset Estimation in OFDM Systems

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Abstract—In this paper, a novel superimposed pilot based carrier frequency offset (CFO) estimator for Orthogonal frequency division multiplexing (OFDM) systems over frequency selective fading channel is proposed. Through utilizing the properly designed superimposed pilots, the CFO estimation can be resolved by implementing the fast Fourier transform (FFT) operation on the average values of the received signals on all subcarriers within several consecutive OFDM blocks. Compared with the existing superimposed training aided algorithm, the proposed scheme can obtain more accurate CFO estimation without increasing computation complexity. The simulation results verify the robustness and effectiveness of the proposed estimator. Keywords-carrier frequency offset; superimposed pilots; OFDM

# Reducing the Peak to Average Power Ratio of

# OFDM System using Particle Swarm Optimization

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# On Performance of Space-Time Eigenbeam Coding

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**Abstract**—For downlink transmission channels in which fading is correlated at the transmitter but independent at the receiver, array and diversity gains can be attained simultaneously by use of Space-Time Eigenbeam Coding (STEBC) which combines eigenbeamforming and Space-Time Coding. STEBC can greatly reduce the complexity of the system and improve the performance as well. This paper is devoted to the evaluation of the performance of STEBC theoretically. The upper-bound of the average Pair Error Probability is utilized to measure the performance of STEBC. It shows that STEBC can achieve the maximum diversity gain and is especially suitable for the wireless environments with many paths around the transmitter which concentrate in several directions. **Keywords**—Space-Time Coding; Eigenbeamforming; Pair Error Probability

# Optimal Fractional Frequency Reuse in OFDMA based Wireless Networks

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Abstract—Fractional Frequency Reuse (FFR) is often used in interference-limited systems to improve coverage in cellular networks. Its cost is reducing the amount of available resources. In this paper, we intend to propose the FFR scheme by introducing the concept of normalized Spectral Efficiency (nSE). With the optimal Frequency Reuse Factor (FRF), the FFR scheme can maximize the system SE with throughput improvement of celledge users. To solve the optimal problem, we divide it into two sub-problems. However, this scheme is asymptotically optimal with the assumption of the uniform distributions of signal and interference in sectors. The simulation results demonstrate the gain of the system SE is about 3% by our FFR scheme.

# Local Linear Regression based Channel Estimation for OFDM systems

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Abstract— A local linear regression (LLR) based least-Square (LS) channel estimation technique for mobile Orthogonal Frequency Division Multiplexing (OFDM) communication systems over the doubly selective fading channel is proposed in this paper. In our proposed method, the doubly selective fading channel is firstly estimated via pilots arranged in block-type, comb-type or distributed pilot scheme, piece-wise linear interpolated and at last smoothed by local linear regression. The last smoothing procedure greatly decrease the estimation error introduced by channel noise and interpolation error so achieved better mean square error (MSE) performance and symbol error rate (SER) performance than the conventional interpolation method such as linear interpolation and DFT based interpolation, and the error floor is greatly decreased compared to DFT based interpolation scheme. The computational complexity increased by the smoothing procedure is only linearly proportional to the effective subcarrier-number. Simulations show the performance improvements offered by our approach to the existing ones. Keywords—Local linear regression (LLR); Least Square; DFT; Channel Estimation



# A Low-Complexity Frequency Offset Correction Scheme for Synchronization in OFDM Systems

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**Abstract**—A new carrier frequency offset estimation scheme in the orthogonal frequency division multiplexing (OFDM) system is proposed. In non-data-aided synchronization systems, maximum likelihood estimation (MLE) is often used for carrier frequency offset acquisition but it could not correct the accumulated residue frequency offset caused by sampling clock offset and other factors. After simple comparisons at frequency domain, the proposed scheme takes correction to OFDM symbols and makes compensation for MLE algorithm. By sharing the same phase calculation block with the acquisition step, it keeps very low computational cost and reduces the implementation complexity. The system performance was investigated in additive white Gaussian noise channel.

**Keywords**—Orthogonal frequency division multiplexing (OFDM); frequency offset; synchronizatio; maximum likelihood estimation (MLE)

## A Novel PAR Reduction Scheme based on ieee802.16a System

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**Abstract:** OFDM (Orthogonal frequency-division multiplexing) is one of the key techniques of the next generation high rate communications system. One of the major drawbacks in OFDM systems is high PAR (peak-to-average power ratio) of the transmitted signal. This paper presents a novel PAR reduction method, called IPR (Interleaving and Phase Rotation), which achieves significant PAR reduction. And also this method is studied based on ieee802.16a system. Simulation results show that the novel method achieves better CCDF (Complementary Cumulative Distribution Function) performance than the others for comparison. **Keywords:** PAR, OFDM, IPR, SPI, CCDF, SLM, Interleaving

# A robust power amplifier predistorter constructed using memory polynomials

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**Abstract**—A robust memory polynomial predistorter for power amplifier nonlinear compensation in OFDM system is proposed in this paper. The memory polynomial for the predistorter design is equivalent simplification of volterra series. This paper gives the indirect learning architecture and generalised normalized gradient descent (GNGD) algorithm for polynomial coefficient estimation. Computer simulations show that the proposed predistorter is very robust. It can overcome the initial parameter sensitive problem that exists in the predistorter using normalized least mean square (NLMS) algorithm. The proposed predistorter also gets a better linearization performance than the predistorter using NLMS algorithm. The predistorter is still easy to be implemented with a relatively higher computational complexity. **Keywords**— orthogonal frequency division multiplexing (OFDM); power amplifier (PA); predistortion; memory polynomial

# Sparse Multi-path Channel Estimation for OFDM Systems

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**Abstract**—Sparse multi-path is encountered in OFDM and Ultra-wideBand (UWB) communications. Conventional channel estimation methods ignore the prior knowledge of the sparseness, and estimates have higher MSE. We introduced two approaches: Lp norm constraint method and LASSO method which are related to Bayesian model. The two approaches exploit the sparse a priori and obtain better performance. **Keywords**—Sparse multi-path channel, OFDM systems, Lp norm, LASSO.

# NOFDM System Based on Circular Conjugate Symmetry Properties of DFT

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**Abstract**—Based on circular conjugate symmetry properties (CCSP) of discrete Fourier transform (DFT), a novel approach to nonorthogonal frequency division multiplexing (NOFDM) is presented. Different from other NOFDM systems, a simple estimation algorithm is exploited in the receiver instead of maximum likelihood sequence detection (MLSD) while the bit error rate (BER) of the proposed system is similar to those of other NOFDM systems in terms of the same bandwidth efficiency. We describe the proposed system model and derive the estimation algorithm. Simulation results show that the presented NOFDM system has both higher bandwidth efficiency and better BER performance than standard orthogonal frequency division multiplexing (OFDM) when the derived estimation algorithm is adopted. **Keywords**—nonorthogonal frequency division multiplexing; discrete Fourier transform; circular conjugate symmetry properties

# Second Order Polynomial Receiver Window for Narrowband Interference Suppression in IEEE802.11a System

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Abstract—Orthogonal frequency division multiplexing (OFDM) has been adopted as the physical layer transmission technology in IEEE802.11a standard, where the Fourier transform is used in demodulation. Because of the effect of spectral leakage in discrete Fourier transform, narrowband interference is spreaded in spectrum domain to impact adjacent subcarriers. Receiver window function was previously proposed to suppress narrowband interference in OFDM systems. In this paper, we propose a novel Nyquist window for OFDM receiver and we also choose several other Nyquist windows for analysis and simulation in IEEE802.11a system based on the indoor wireless environment. The results of analysis and simulation show the receiver window can suppress NBI and reduce the BER, especially in the case of the novel Nyquist window adopted. Keywords—OFDM; receiver window; narrowband interference; IEEE802.11a

# PAPR Reduction Of FrFT-Based MB-OFDM Ultra Wide Band Signals

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xie\_dandan@126.com, iesyyang@zzu.edu.cn Abstract—Multi-band orthogonal frequency division multiplexing (MB-OFDM) is being considered as a promising candidate for UWB systems due to its higher spectral efficiencies and better system performance. The classical Fourier transform scheme may fail when the channel is doubly selective. Chirp-like basis (fractional Fourier transform based) can be used instead of exponential functions to combat this problem. However just like in the Fourier transform based MB-OFDM, fractional Fourier transform based MB-OFDM (FrFT based MB-OFDM) UWB also suffers from the high Peak to Average Power Ratio (PAPR) problem. In this paper, we have analyzed the MB-OFDM UWB signals in the fractional domain, and evaluated the effect of the well-known OFDM PAPR reduction methods such as selected mapping (SLM) and partial transmit sequences (PTS) to FrFT based MB-OFDM UWB through computer simulations. Keywords— MB-OFDM UWB; FrFT; PAPR; SLM; PTS

# A Grouping method of Bit Loading for Real-time OFDM-based Wireless Networks

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Abstract—A Grouping method of bit and power allocation in orthogonal frequency division multiplex (OFDM) system is presented in this paper. The complexity of BABGS algorithm, as bit allocation based on grouping subcarriers (BABGS), is lower than suboptimal algorithms. This algorithm aims to minimize the total transmitted power under the constraint of bit error rate (BER) and total bit rate, so it is based on margin adaptive (MA) principle. The structure of the proposed algorithm includes two stages. In the first stage, the subcarriers are divided into several groups according to the channel characteristics and the initial bits are assigned to per subcarrier in each group at the same time. The second stage is to adjust bits of each subcarrier in order to minimize the total transmission power. Compared with the Nader algorithms, this algorithm is reduced computing complexity by 20% and suitable to be utilized in deep fading frequency selected channel of the real-time systems. And its performance is still close to suboptimal algorithms. Keywords— bit loading; deep fading channel; Grouping method; OFDM

## Tracking Effective Length of Channel Impulse Response for

### ML Estimator in OFDM Systems

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Abstract—This paper deals with the estimation of the channel impulse response (CIR) in orthogonal frequency division multiplexing (OFDM) systems. In particular, we focus on the maximum likelihood estimator (MLE). The MLE is simpler to implement as it needs no information on the channel statistics, but the channel estimation performance depends on the assumed effective length of channel impulse response (ELCIR) we propose a novel ML channel estimator which combine the ML estimation with a strategy of linear search. The proposed method introduces a few complexities, but, compared with the existing ML channel estimators, it is highly robust to variation of ELCIR. Its performance has been proved using theoretical analysis and simulations. Keywords—OFDM; channel estimation; maximum likelihood; effective length of channel impulse response.

## Study on Turbo Code for Multicarrier

# Underwater Acoustic Communication

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Abstract—Turbo code is proposed for underwater acoustic communication (UWA) based on orthogonal frequency division multiplexing (OFDM). In this paper, performance of turbo code under different modulations are studied and simulated. Simulation results proof that turbo code has a better performances than other method which not use channel code or use convolutional code in higher signal-to-noise (SNR), when using different modulation but has the same frequency bandwidth efficiency. Keywords—Orthogonal frequency division multiplexing (OFDM); underwater acoustic communication; turbo code; Monte- Carlo simulation

# Distributed Linear Dispersion Space-Time Code

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Abstract—In this paper, a new distributed space-time code incorporating linear dispersion propriety used in cooperative diversity system is introduced. After a CRC detection, each cooperative node applies distinctive transmit method according to its CRC result. Based on PEP upper bound analysis, we deduce optimal power allocation for this system. Besides, theory analysis demonstrates that our proposed Distributed Space-Time code can almost achieve full diversity. Simulations further verify our theory deduction and demonstrate an obvious improvement over some other Distributed Space-Time code under the same circumstance. Keywords—component; space-time coding; linear dispersion; cooperative diversity; power allocation; selection relaying;

# A Modified Power Control Scheme in OFDMA Uplink

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**Abstract**—In OFDMA cellular system, the inter-cell interference is the dominating interference of the system, which greatly degrades the system performance, especially for the user at cell edge. The power control in uplink is an effective method to control the inter-cell interference. In this paper, we propose a modified uplink power control scheme utilizing the path loss difference between the serving cell and strongest neighbor cell without any additional signaling. The proposed power control scheme can provide a better tradeoff between average throughput and the cell edge throughput. Besides, it can make IoT more steady compared to the conventional fractional power control scheme. Simulation results show that the proposed power control scheme has 10% gain at a specific IoT operating point. **Keywords**—inter-cell interference; open loop; power control;

# A Modified Power Control Scheme in OFDMA Uplink

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Jingzhou, Hubei, P. R. China **Abstract**—In OFDMA cellular system, the inter-cell interference is the dominating interference of the system, which greatly degrades the system performance especially for the user at cell edge. The power control in uplink is an effective method to control the inter-cell interference. In this paper, we propose a modified uplink power control scheme utilizing the path loss difference between the serving cell and strongest neighbor cell without any additional signaling. The proposed power control scheme can provide a better tradeoff between average throughput and the cell edge throughput. Besides, it can make IoT more steady compared to the conventional fractional power control scheme. Simulation results show that the proposed power control scheme has 10% gain at a specific IoT operating point. **Keywords**—inter-cell interference; open loop; power control;

# Analysis of Frequency Hopping Patterns for

# EUTRA Uplink

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**Abstract**—This paper describes the exploration of Frequency Hopping for the E-UTRA Uplink. The Frequency Hopping technique based on orthogonal hopping patterns can improve communication performance in a cellular system since it could make intra-cell interference be zero due to the orthogonality between sub-carriers in the same cell and average inter-cell interference. In this paper, a RB (Resource Block) adaptive hopping method based on predefined pattern of intra/inter-TTI frequency hopping is proposed for E-UTRA uplink, and both the Latin Square and the Welch-Costas array are derived for the method. Simulation results show that the proposed hopping mode is effective. We also simulate and analyze the impacts of the channel environment and parameters, the hopping pattern and frequency diversity on the performance of the DFT-SOFDM system. **Index Terms**—E-UTRA, DFT-S OFDM, frequency hopping, frequency diversity

# An Improved Algorithm for PAPR Reduction in OFDM System

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**Abstract**—As a popular technology for providing high-datarate, efficient, and reliable wireless transaction. Orthogonal Frequency Division Multiplexing (OFDM) has been adopted in several wireless standards. However, due to the high peak-to-average power ratio (PAPR), OFDM transmitters require very linear output amplifiers with wide dynamic range. In this paper, some important approaches focusing on PAPR reduction are discussed and an improved and effective method using coding in SLM algorithm is proposed. And simulation results show that our algorithm can gain better PAPR performance with lower complexity. **Index Terms**—OFDM, PAPR, CCDF, SLM, PTS

# Doppler Frequency Offset Compensation Using Aid Information for Improving Performance in Aviation Mobile Broadband



# Communication

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Abstract—Because the high DFO (Doppler Frequency Offset) of aviation channel causes much ICI (Inter-Channel Interference) among subcarriers of AMBC (Aviation Mobile Broadband Communication) based on OFDM technology, which degrades the performance badly, a new method, ANTI-D (ANTI-Doppler by information aid), aiming at eliminating ICI and improving the performance, is presented with a view to the characteristics of the aircraft as a platform of AMBC. For there are many kinds of equipments, such as navigation equipments and surveillance equipments on an aircraft, the information of position and the vector of velocity of the aircrafts or ground stations around, called aid information, can be get in real time or near real time, to compute the DFO, according to which the compensation can be done. The simulation results show that ANTI-D based on aid information, resolves the ICI caused by DFO effectively, and makes AMBC get better performance in En\_route phase as well

as in Arrival phase.

Key word—Aviation Mobile Communication; Doppler Effect;

Information Aid; OFDM

## I. IN Performance Analysis of Different Pilot-symbol Patterns in Underwater Acoustic OFDM System

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Abstract—the underwater acoustic channel is very complex where Doppler frequency offsets, narrow bandwidth, serious multi-path time delay interference and frequency selective deep fading obstruct the development of high speed and fidelity underwater data transmissions. Orthogonal Frequency Division Multiplexing (OFDM) is a kind of novel paralleling transmission technology. In this paper, we mainly discuss three different pilot structures in channel estimation in OFD

underwater acoustic communication system and analyze the performance of channel estimation based on different pilot structure by simulation. Keywords—OFDM; Channel Estimation; Pilot patterns

# An Intercarrier Interference Cancellation Technique with SSC and ASIZ in OFDM Systems

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**Abstract**—For intercarrier interference (ICI) due to frequency offsets, an ICI cancellation scheme is proposed for combating the impact of ICI on OFDM systems in this paper. A received symbol shift cancellation (SSC) algorithm and an adjacent subchannel inserting zero (ASIZ) algorithm are designed for the ICI cancellation scheme, respectively. At the transmitter, original data symbols are mapped into one special symbol block by using ASIZ, and then it is transmitted as a regular OFDM system. At the receiver, Received signals are demodulated to obtain the data symbols as a regular OFDM system, and then these symbols are processed by using SSC. By doing so, the estimation of original data symbols is obtained, and meanwhile ICI is mitigated, finally. Simulation results show that the ICI contained in the received signals can be effectively reduced by using the ASIZ scheme, and the Signal-to-Interference power Ratio (SIR) of the scheme is obviously much better than that of a regular scheme. Similarly, Bit Error Rate (BER) performance of the scheme is much better than that of others. Keywords: OFDM; CIR; ICI; BER; ASIZ; SSC

# A QRD-based Chase Decoding Algorithm for Quasi- Orthogonal Space-Time Block Code Systems

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**Abstract**—In the paper, we proposed a Chase decoding algorithm(Chase-QRD-SIC) based on QR decomposition. The analysis and

simulation show that the fewer number of transmit antennas, the closer performance of the proposed algorithm is to maximumlikelihood (ML) algorithm. Its performance is virtually identical to ML decoding for 2x2 V-BLAST systems. At the same time, the 4x4 QOSTBC systems can be decompose into two independent 2x2 QR-decomposition sub-systems according to the Equivalent Virtual Channel

Matrix (EVCM) model. The proposed algorithm is applied to each of the sub-systems. The simulation shows that the new decoding scheme is able to achieve ML performance for 4x4 QOSTBC systems, and the complexity of the new scheme is lower than that of the conventional ML decoding due to the reduced number of paths used for calculating ML metrics. Keywords—MIMO; QOSTBC; QR decomposition Chase decoding; Equivalent Virtual Channel Matrix; Detection

## Multiple Frequency Offset Estimation and Mitigation for Cooperative OFDM System

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Abstract: In this paper, we propose a multiple CFOs(Carrier Frequency Offset) estimation and mitigation algorithm for the destination node in a cooperative OFDM(Orthogonal Frequency Division Multiplex) system. In a cooperative OFDM system, every relay node has a separate local oscillator, so that each relay-to-destination link has individual CFO parameter, so that the traditional estimation and mitigation algorithms are no longer applicable. In the proposed algorithm, based on the specially designed training sequences, the destination node can decouple the signal from different relay nodes by correlation and simplify the MD(Multi-Dimensional) nonlinear problem to an linear problem. Then, an mitigation matrix can be constructed, and the ICI(Inter-Carrier-Interference) caused by multiple CFOs can be perfectly compensated based on the over sampled OFDM symbol vectors. Theoretical analysis and simulation results prove that the proposed algorithm is effective in estimating the multiple CFOs and mitigating the performance degradation. Keywords: multiple CFOs(Carrier Frequency Offset), cooperative OFDM system, training sequence, over sample

## A Novel PAPR Reduction Method in OFDM Systems by Using CAZAC Matrix Transform

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Abstract—One of the major disadvantage of OFDM is the high peak-to-average power ratio (PAPR) of the transmitted OFDM signal. This paper proofed the autocorrelation properties of CAZAC Sequence, and then proposed a new method to reduce the PAPR in OFDM systems based on CAZAC sequence by taking advantage of the low autocorrelation characteristics of CAZAC sequence .This scheme expands the conventional OFDM signal constellation points, an decreases relevance between the frequency symbols in order to reduces the PAPR of the OFDM system. Simulations results show that

CAZAC transform can significantly reduce the PAPR of the transmitted signal and without loss of BER performance along with low-complexity and easy implementation. Keywords- OFDM; CAZAC Sequence; PAPR

# Low Pilot Ratio Channel Estimation for OFDM Systems

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Abstract—Doubly-selective channel estimator for orthogonal frequency division multiplexing (OFDM) systems is proposed in this paper. Based on the generalized complex exponential basis expansion model (GCE-BEM), we describe the time-variant channel with time-invariant coefficient over multiple OFDM blocks. The time variation of channel destroys the orthogonality between subcarriers. The resulting channel matrix in the frequency domain is no longer diagonal, but the main interference comes from the near subcarriers. Based on this, we propose a least-square (LS) channel estimator with low pilot ratio. The proposed estimator is with the advantages of low pilotratio and robustness against inter-carrier interference. Keywors- channel estimation; OFDM; doubly-selective channel; GCE-BEM

# Cubic Metric and PAPR of OFDM – CPM Signal

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Abstract—OFDM/CPM is now a recognized alternative to conventional OFDM for the transmission of signals over nonlinear channel. This paper presents a characterization of nonlinear distortion effects in orthogonal frequency-division multiplexing/continuous phase modulation (OFDM/CPM) transmission systems. In a second step, a comparison with simulation results is carried out to show that CM is more suitable to show characterization of nonlinear distortion than PAPR .

Keywords- nonlinearities, OFDM-CPM, Cubic Metric, PAPR

# A Novel Low-Complexity MAP SISO Detector for

# Iterative Detection in Precoded OFDM Systems

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**Abstract**—In this paper, we propose a novel low-complexity MAP soft-in-soft-out (SISO) detector used for iterative detection in precoded OFDM systems. First, we decompose the precoder into serially concatenated sub-precoders separated by interleavers. Based on this decomposed precoder, our proposed low-complexity MAP SISO detector is accomplished by concatenated SISO sub-detectors separated by deinterleavers or interleavers. Three evaluating algorithms of SISO sub-detectors are developed. The first one does not use approximation. The other two use Max-Log and Gaussian approximation. Based on the Gaussian approximation algorithm, complexity of the proposed MAP SISO detector with a precoder of size  $N \times N$  can be as low as  $O(2N \cdot \log N)$ , much lower than that for conventional SISO detectors. Simulation results show that the performance of iterative detection using the proposed MAP SISO detector is almost near the optimal performance for both uncoded and coded systems. EXIT analysis is also presented to predict the

BER performance of the iterative detection using our proposed low complexity MAP SISO detector.

**key words** : precoded OFDM, iterative detection, MAP based

SISO detector, concatenated sub-precoders, concatenated SISO

sub-detectors

# Frequency synchronization algorithm based on PN sequence

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Abstract—In this paper, we propose a new frequency synchronization algorithm for orthogonal frequency division multiplexing(OFDM) system by combining PN sequences with cyclic prefix. It is the improvement of Tufvesson' s algorithm. In the new algorithm, the frequency offset is estimation with two steps. First a small step (span of the correlation) is used to estimate frequency offset which will result in a larger estimation range but less precise. After the frequency offset has been compensated, the second estimation using cyclic prefix is conducted which is a large step. The new algorithm has large estimation range and the estimation is more precise. Performance of the new estimator improved than that of the old one in AWGN channel and multipath fading channel. Keywords-orthogonal frequency division multiplexing; frequency offset estimation; two steps; PN sequence; cyclic prefix

## A Beam-forming Detector For Variable-Rate Group Space-Time Coded Systems

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Abstract—A novel beam-forming detector for group space-time coded systems is proposed in this paper, which utilizes unitary preprocessing in the transmitter to simplify the decoding complexity in the receiver. Eigen-mode selection is introduced to achieve more system diversity gain. Furthermore, a simple example for variable-rate group space-time coded systems is presented. Simulation results show that the proposed detecting algorithm has better BER performance with lower decoding complexity. Keywords- beam-forming; group space-time code; eigen-mode selection; diversity gain

## Improved Subspace-Based (Semi-) Blind Channel Estimation for Block Space-Time OFDM

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**Abstract**—Multiantenna wireless systems have been well studied in achieving high data rates. In this paper, we improve a subspace-based blind channel estimation technique for multiinput multi-output (MIMO) orthogonal frequency-division multiplexing (OFDM) approach based on tracking the subspace recursively. The recursive subspace algorithm has a computational complexity of  $O(J^2)$ , where the  $J$  is the input vector dimension. The simulation results show that the improved estimator's capability is similar to the source approach, but deeply decrease the computational complexity.  
**key words:** Blind channel estimation, multiple-input multiple output (MIMO), orthogonal frequency-division multiplexing (OFDM) subspace recursive algorithm, wireless communication

# Genetic Algorithm for Designing Polyphase Orthogonal Code

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**Abstract** – Successful design of orthogonal polyphase code sets is one of crucial for implementing Multiple Input Multiple Output (MIMO) radar and orthogonal Netted radar systems (ONRS). A genetic algorithm (GA) is presented to numerically optimize orthogonal code sets design. The simulation results show that the proposed algorithm are feasible and effective for the design of polyphase code sets used in MIMO radar and ONRS radar. Computational results are compared with Simulated Annealing (SA). In some cases, GA outperforms SA. **Index Terms** – MIMO radar, ONRS radar, polyphase orthogonal code, Genetic Algorithm.

# A Modified Soft-decision Algorithm of V-BALST Architecture

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Abstract—A method based on modified Sphere-decoding to compute the soft-information for the V-BLAST architecture is deduced in this paper. The system Bit Error Ratio (BER) and computation complexity are simulated and compared with the classical methods. Simulation indicates that the new methods can reduce the decoding complexity with negligible performance degradation. Keywords—V-BLAST; MIMO; Sphere-decoding

# Channel Impulse Response Order Adjustment for OFDM in SFN

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Abstract—In orthogonal frequency division multiplexing (OFDM) systems, channel power delay profile can be acquired by an IFFT of pilot-aided channel estimate which is used for fine timing. However, an ambiguous channel impulse response (CIR) estimate is induced by coarse timing errors. In this paper, a simple CIR adjustment algorithm is proposed to correct the CIR order which can hold with large coarse timing errors and high delay spread environment, and a modified coarse symbol timing algorithm is adopted to ensure its performance. Simulations show the timing synchronization performance is excellent even in the high delay spread environment. Keywords—OFDM; timing synchronization; channel impulse response; SFN

# Cross-layer Design Combining Adaptive Modulation and Coding with ARQ on Frequency Domain Subcarrier of OFDM

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Abstract—The system model and the algorithm for a cross-layer design combining the adaptive



modulation and coding with ARQ based on frequency domain subcarrier of OFDM is developed at first. And then the effect of high speed move to the performance of that is analyzed. In order to compensate the degraded performance of wireless link due to high-speed move, a novel Finite-State Markov channel model is formed to represent the frequency domain subcarrier of OFDM modeled as random process with Nakagami-m fading distribution. A correction of the threshold of modulation and coding scheme and the channel quality information as well as the method for link prediction in Chase combining is investigated. On this foundation, an improved cross-layer design combining of adaptive modulation and coding with H-ARQ is proposed. The computer simulation results reveal that the improved design and modified algorithm has higher average throughput and lower FER than the original one when the terminal moves in high speed. Keywords-cross-layer combining AMC with H-ARQ; improvement of cross-layer design; FSMM; threshold of MCS; CQI and Chase combining; throughput; FER

# Noise Reduction with Sub-Channel Sorting for OFDM-CDM

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Abstract— In this paper, we consider an Orthogonal Frequency Division Multiplexing-Code Division Multiplexing (OFDM-CDM) system. The noise reduction method based on Least Squares (LS) is introduced into the OFDM-CDM receiver to improve the signal-to-noise ratio (SNR), while the system does not work under full load. In this paper, Walsh code is considered to be used in CDM module. The relationship between the spreading codes and the variance of the noise after noise reduction is investigated. Based on this relationship, a simple noise reduction after channel frequency response (CFR) sorting is proposed to improve the Bit Error Rate (BER) performance of the system further. Simulation results suggest that good performance can be achieved with proposed scheme. Keywords- OFDM-CDM; Noise Reduction; LS; CFR Sorting

# A Unitary Space-Time Cooperative Diversity Based on Detect and Forward method

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Abstract—A unitary space-time cooperative diversity algorithm based on detect and forward method is proposed in this paper. It can be well-tailored for flat-fading channels where neither the transmitter nor the receiver knows the fading coefficients. We can know that the bit error rate (BER) is dependent on the characteristics of the user's individual channel and the inter-user channel between them from the computer simulation. Keywords—cooperative diversity; unitary space-time code; unitary space-time cooperative diversity

# An Improved Algorithm to Reduce PAPR Based Clipping-and-Filtering

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Abstract—One of the main disadvantages of Orthogonal Frequency Division Multiplexing (OFDM) is its high peak-to-average power ratio (PAPR). As the simplest approach to reducing the PAPR, clipping exhibits good practicability, and the repeated clipping-and-filtering (RCF) algorithm proposed by Jean Armstrong provides a good performance in PAPR reduction and out-of-band power's filtering. However, its way of filtering in frequency-domain requires RCF operations to control the peak regrowth, which degrades the bit error rate (BER) performance and greatly increases the computational complexity. Therefore, this paper put forward a new method of utilizing Hanning window to filter the out-of-band noise in the frequencydomain. The simulation results show that, this method can still limit the out-of-band power to meet the requirement of transmit spectrum mask specified in the IEEE802.11a standard. Moreover, it dramatically reduces the PAPR as well as provides lower BER and computational complexity. Keywords—OFDM; PAPR; RCF; Hanning window I. INTRODUCTION As a promising technique, OFDM has been widely used in many new and emerging broadband communication systems, such as digital audio broadcasting (DAB

# Closed-form SINR distributions for OFDMA

# Cellular System using Fixed Relays

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Abstract—In this paper, we derived closed-form expressions for the SINR distributions in OFDMA cellular system using fixed relays. First of all, the intercell interference at the BS and the RS are characterized and it is found that the intercell interference power is successfully modeled as the average of it. From the interference power modeling, the pdfs of SINRs for the four uplink cases are analyzed. The analytical results are verified from computer simulations. The analytical results can be applied to evaluate various aspect of OFDMA cellular systems using fixed relays such as the average system capacity, the average system capacity for a specific region, the outage probability for a given

QoS and so on.

# Fast Resource Allocation for OFDMA Downlink Utilizing An Efficient Bit Loading

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Email: {liu, mathar, reyer}@ti.rwth-aachen.de Abstract—In this paper, bit loading for orthogonal frequency division multiplexing (OFDM) is studied first. The continuous water-filling is modified to take the maximal rate constraint on each subcarrier into account. Its continuous outputs are optimally quantized by a non-iterative algorithm. By iteratively utilizing bit loading for OFDM, a class of resource allocation methods with low complexity for orthogonal frequency division multiple access (OFDMA) downlink is proposed. Subcarrier assignments for users are initialized independently, which may cause conflicts on arbitrary subcarriers. We suggest a method for conflict cancellation, which may be improved by using appropriate sorting criteria. The proposed method is compared to a newly suggested reference method by simulation. Within the simulation the performance loss is limited by about 5% whereas the complexity reduction is up to 95%.

# Utilizing scale down and restoration to reduce PAPR in OFDM system

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Abstract—The high peak OFDM signal out of the linear region of the power amplifier is compressed with fixed scale down ratio instead of clipping. The compressed signal is transmitted using the additional subcarrier and can be restored if the tone detector at the receiver indicates the presence of additional subcarrier. This method shows the better BER performance than the normal clipping method. And also the comparison in the view of throughput efficiency shows that the proposed method is better than SLM. Keywords— OFDM; PAPR; restoration; scaling

# Power Allocation for Decode-and-Forward Relay System Employing Space-Time Codes Based on Genetic Algorithm

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Abstract—Cooperative relay transmission is an effective way to combat multi-path fading. With proper coding scheme, the diversity and coding gains can be obtained. two-hop decodeand- forward relay protocol using Distributed Linear Dispersion Code (LDC) is introduced and analyzed in terms

of capacity gains over the system with the traditional uniform power allocation. To optimize the capacity of the system subjected to total transmit power constraint, an optimal power allocation scheme based on Genetic Algorithm is explored, which distributes resource appropriately to each hop according to the channel state information (CSI) and some characteristics of Distributed LDC. Theoretical analysis and numerical results indicate that with optimal power allocation, the proposed coded cooperative system will outperform the one with traditional uniform power allocation. Keywords—decode-and-forward; linear dispersion code; power allocation; genetic algorithm

# An efficient rate one STBC scheme with 3 transmit antennas

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Abstract—In this paper, we propose an efficient rate one quasiorthogonal space-time block code for three antenna system. In order to compensate the performance degradation due to quasiorthogonal scheme, in this proposed scheme, we incorporate a selective receiver for decoding. The receiver divides the received signals into two groups, and two receiving antennas alternatively operate to receive the divided signals. By this way, we can eliminate the interference from the neighboring signals in the same symbol almost by half. The simulation results demonstrate that the proposed scheme can provide improved performance. Keywords: quasi-orthogonal space-time block codes, multiple antennas, selective receiver

# Pilot-Assisted Time-Varying Channel Estimation for OFDM Systems with Phase Noise

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Harbin, P. R. China Abstract—In this paper, a novel channel estimation technique is presented

to fight against the impairment caused by the rapidly time-varying channel and random phase noise which is very common in the wireless orthogonal frequency division multiplexing (OFDM) systems.

By utilizing optimal comb pilots and a linear minimum mean square error (LMMSE) estimator, the algorithm proposed can jointly perform the channel and phase noise estimation using a modified basis expansion model (BEM). Theoretical analysis and simulation results indicate that this scheme can estimate the channel information accurately, and then improve the performance of equalization for reducing ICI. Keywords-OFDM; channel estimation; phase noise; BEM

# Adaptive Sub-carrier and Bit Allocation Algorithms for Multi-user OFDM Wireless Systems

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Abstract — Multi-user orthogonal frequency division multiplexing (OFDM) with adaptive sub-carrier and bit allocation are considered in this paper. Assuming having the knowledge of the instantaneous users' channel gains, three typical dynamic sub-carrier and bit allocation algorithms are analyzed and compared. All the algorithms' goal are to minimize the total transmit power with the user data rate constraint. Here, an improvement method is proposed for Zhang algorithm. Finally, performance comparisons between adaptive schemes and static ones are given. The results prove that adaptive algorithms' performances are greatly better than that of the traditional fixed sub-carrier allocation method. Keywords-OFDM; OFDM; bit loadin; sub-carrier allocation; multi-user

# Performance Analysis of TCM Coded OFDM System in Underwater Acoustic Channel

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Abstract—the main characteristics of underwater acoustic (UWA) channel are Narrow bandwidth, strong interference caused by multi-path and severe noise. At the same time, these disadvantages

have been always obstructed the development of high speed and fidelity underwater data transmission. This paper discusses the performance of integration of Trellis-coded modulation (TCM) and OFDM; furthermore, this transmission mode can solve the problems of the bandwidth efficiency and reliability effectively in UWA communication. The theoretical analysis and application of TCM based on OFDM in UWA system are introduced in detail. Simulation results are given in the end. It is proved that this method has a further 3dB coding gain over the non-coded QPSK, so the performance of UWA communication has been improved significantly. Keywords-Trellis Coded Modulation (TCM); underwater

# PAPR Analysis in OFDM Signals Based on Power Variance

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Abstract— The relationship among the peak-to-average power ratio (PAPR), aperiodic autocorrelation co-efficient and power variance (PV) is discussed. We show that low values of PV do not always correspond to low values of PAPR as has been mentioned in literature. Hence PV cannot be used as a basis for comparison and measure of PAPR for OFDM signals. Further through simulations we assert that PV can be a good criterion for high values for PAPR, while for the moderate ones it might fail. Finally, we show that PV based comparison in SLM and PTS techniques gives degraded PAPR performance compared to the actual PAPR based comparison. Keywords- Aperiodic autocorrelation co-efficient; OFDM; PAPR; Power variance; SLM

# Pilot Embedded Training for Doubly Selective Channel Estimation in OFDM Systems

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Abstract—Channel estimation and data detection are investigated for OFDM systems over time- and

frequency-selective (doubly selective) channels. Relying on the complex exponential basis expansion channel model, a pilot embedded channel estimation scheme with low computational complexity and high data rate efficiency is proposed. An iterative edition exploiting recovered data to enhance the performance is also presented. Simulations show that the proposed method is suitable for doubly selective channel estimation in orthogonal frequency division multiplexing (OFDM) systems and the performance can be better than that of Wiener filter method under some conditions. Keywords- channel estimation; doubly selective; iterative; pilot Embedded

# Analysis of Two-step Frequency Offset Estimators for OFDM

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**Abstract**—The conventional two-step carrier frequency offset (CFO) estimator using  $L$  identical parts is analyzed. It turns out that the conventional two-step CFO estimator is not optimal in terms of MSE. A novel two-step CFO estimator is proposed in this paper. In first step, a fine estimate is obtained based on the principle of minimum variance. The fine estimation has ambiguity since its estimate range is limited. In second step, a coarse estimation is obtained which results in a larger estimate range but less precision. Using the coarse estimation, the ambiguity of fine estimation is resolved. Finally, the fine estimation resolved the ambiguity and the coarse estimation are optimally combined to improve the estimate performance. Analysis and simulation results demonstrate that the novel twostep estimator outperforms the conventional two-step estimator in terms of estimate performance and computational complexity. **Keywords**— frequency offset estimation; OFDM; training symbol; two-step

# Performance Comparison of Different Space-Time Block Codes Using A Single Receiver

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**Abstract**— Recently there has been increasing interest in providing high quality and efficient broadband services over wireless and mobile links. Space-time codes (STC) are designed to exploit Multi-input and Multi-output (MIMO) antenna systems and by doing so, an enormous increase in the capacity of wireless systems can be achieved. STC can be viewed as combined coding and modulation scheme for multi-input and multi-output (MIMO) channels. Using an efficient way to allocate different symbols to different antennas, while adding coding redundancy, the code can achieve full antenna diversity and good coding gain. The paper presents performance comparisons of different space-time codes using a single receiver. Space-time codes employ redundancy to minimize the effects of fading, noise and interference. Although, the Alamouti code does not perform as well as the same space-time trellis code, it is most preferred choice due to its computational simplicity and satisfactory performance. The computer simulation results are included.

**.Keywords**— MIMO channels; Space-time codes; fading; multipath;

# Channel-Tolerant OFDM System for an Underwater Acoustic Channel

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**Abstract**—As is well known, the robust and reliable acoustic communication in adverse littoral water is a very challenging task. Orthogonal frequency division multiplexing (OFDM) is a promising technique for achieving high speed rate and combating multi-path fading in underwater acoustic communication. In this paper, the basic principle of OFDM system is firstly introduced.

Then a channel estimation method based on Pilot Symbol Assisted Modulation (PSAM) is studied. Finally, the experiment results are presented to compare the channel estimation performance of three pilot patterns. It is concluded that the comb pilot pattern is not suitable for complex underwater acoustic channel. **Keywords**—OFDM; PSAM; Channel Estimation; Underwater Acoustic Communication

## A MINIMUM MEAN SQUARE ERROR ESTIMATOR for 3GPP' s SPATIAL

## CHANNEL MODEL based on OFDM SYSTEM

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**Abstract**—This paper deals with the minimum mean square error estimation (MMSEE) of spatial channel model (SCM) in the Third Generation Partnership Project (3GPP) based on orthogonal frequency division multiplexing (OFDM) system. In particular, we focus on MMSEE on the basis of maximum likelihood estimation (MLE). Since statistical information is the critical element of MMSEE, we derive the generation of coefficients of autocorrelation in SCM with different data rates. Utilizing Monte Carlo method, the prior channel information is gotten. Simulation results validate the accuracy of MMSEE over MLE in terms of mean square error, and better BER performance in three typical wireless environment of SCM. **Keywords**—minimum mean square error estimation, maximum likelihood estimation, spatial channel model, autocorrelation,

OFDM.

# An Efficient Joint Sub-Carrier , Bit, and Power Allocation of OFDM System in Fading Channels

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**Abstract**—In this paper, we proposed an efficient joint subcarrier, bit and power allocation algorithm which tries to minimize the total transmit power for OFDM system, while maintaining the BER constraint and the rate requirement of each user. Some existing allocation algorithms allocate resources based on the “best channel gain” rule, which made some resources assigned to the users which are in deep fading. In this paper, we swap the sub-carriers between users to minimize the transmit power after the sub-carrier allocation is decided. Simulation results show that the performance of the proposed algorithm is much better than that of the other algorithms.

**Keywords**—OFDM; Sub-Carrier Allocation; Power Allocation; Fading Channels

# A Study of Channel Estimation in OFDM System Based on a Single Vector Sensor for Underwater Acoustic Communications

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Abstract—Channel estimation is an important procedure of coherent demodulation of OFDM system for underwater acoustic communications, by which the system performance is largely restricted. In this paper, the performance of three pilot patterns and their own application conditions are analyzed and compared. According to the simulation and experiment results, it is concluded that scatter pilot pattern is very suitable for OFDM system for underwater acoustic communications

In addition, vector hydrophone is also can be used to improve communication performance via joint processing of pressure and particle velocity.

Keywords—OFDM; Underwater Acoustic Communication; Channel Estimation; Vector sensor

# Carrier Frequency Synchronization joint Channel Estimation for OFDM Using Block-Type Pilot

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Abstract—In this paper, we proposed a carrier frequency synchronization algorithm joint channel estimation for OFDM using block-type pilot. Each pilot symbol was composed of repeated short PN-sequences. By using this kind of pilot, the estimation of the carrier frequency

offset (CFO) was performed into two steps, an acquisition step and a tracking step. During the acquisition step, the estimation range and precision can be adjusted. Once the parameters are properly designed, the CFO efficiently estimated was large by coarse estimation and accurate by fine estimation. Making full use of the relation between the CFO and the channel coefficient, the CFO tracking is realized based on the decision feedback algorithm. Simulation results show that this algorithm has satisfactory performance. Increasing the quantity of the pilot symbols can improve the ability of the CFO and the channel tracking but decrease the spectrum efficiency. Thereby quantity of the pilot symbols should be trade-off. Keywords-OFDM; synchronization; acquisition; tracking; channel estimation

# Modeling Admission Control in OFDMA System Using Petri Nets

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Abstract—Admission control plays an important role in OFDMA system. However, admission control becomes rather complex along with the increase of users' demand and the diversification of service types, so building an appropriate stochastic model is especially significant. The Petri net can distinctly describe the stochastic process. In this paper we build and analyze the Petri net model of admission control in OFDMA system. The simulation results demonstrate our theoretica analysis and indicate that the PN model is effectively to analyze the process of admission in OFDMA system. Keywords-OFDMA; admission control; Petri net; blocking Probability

## A Novel Method Based DCT to Reduce PAPR of OFDM Systems

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Abstract—orthogonal frequency division multiplexing (OFDM) systems based on discrete cosine transform (DCT) is proposed for the first time in this paper in order to solve the distortion due to great Peak-to-Average Power Ratio (PAPR) of OFDM systems signals. The character of the DCT energy focused is made use of in the frequency domain, and it helps to reduce the PAPR engendered by IFFT at the transmitter statistically, avoiding the nonlinear distortion in OFDM systems due to great change of PAPR. In this paper, the characters of DCT algorithm are analyzed first, and then the algorithm is applied to signal processing in OFDM systems. It is mathematically verified that this method is potent to reduce the PAPR. Lastly, the simulation results show that the proposed scheme in reducing the threshold of PAPR statistically is feasible. Index Terms—Discrete Cosine

Transform (DCT), Orthogonal Frequency Division Multiplexing (OFDM), Peak-to-Average Power Ratio (PAPR)

# On Timing and Frequency Offset Estimation for OFDM Systems

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**Abstract**—A new training symbol weighted by the PN sequence was designed and an efficient timing and frequency offset estimation scheme for orthogonal frequency division multiplexing systems was proposed. The timing synchronization is accomplished by using the piecewise symmetric conjugate of the primitive training symbol and the good autocorrelation of the PN weighted factor. After the time synchronization is finished, the PN weighted factor is removed and the renewed training symbol is used to estimate the frequency offset. Compared with conventional schemes, the proposed scheme can achieve a significantly smaller mean square error and provide a wider frequency acquisition range. **Keywords**— Orthogonal frequency division multiplexing technique; Time synchronization; Frequency synchronization; Training symbol

# Channel Estimation for Amplify and Forward Relay in OFDM System

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**Abstract**—this paper provides three channel estimations including LS (least square) estimation, LMMSE (linear minimum meansquare error) estimation and Lr-MMSE (low rank minimum meansquare error) estimation utilized to the relay channel to approximate the optimal solution in OFDM system. The simulation results show that LMMSE estimation outperforms the other two estimations, but it is too complicated. The performance of LrMMSE estimation approaches that of the LMMSE estimation, but LrMMSE lessens the number of the multiplications. We also present the approximate average symbol error (ASER) of variable gain relay for the 16QAM modulation and give the tight bounds and the simpler form without integral expression is proposed to simplify the bound expression. **Keywords**— relay channel; LrMMSE; channel estimation

# S-PTS for PAPR Reduction in OFDM Systems

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**Abstract**—Partial transmit sequences (PTS) is a class of distortless PAPR reduction techniques for OFDM systems. However, the high complexity of PTS remains a problem. In [5] the authors show that the PAPR reduction performance of PTS is not as good as that of another distortless technique—selected mapping (SLM) with the same computational complexity. To alleviate this problem, a novel selected PTS (S-PTS) method with low complexity is proposed. The main idea is based on selecting part of the candidate signals from the overall signals, so as to make a better tradeoff between PAPR reduction and computational complexity. Simulation results demonstrate that the PAPR reduction performance of S-PTS is better than that in SLM when their overall computational complexities are identical. **Keywords**—Orthogonal frequency division multiplexing (OFDM); partial transmit sequence (PTS); selected mapping (SLM); peak-to-average power ratio (PAPR)

# Clipping Noise Mitigation for OFDM System with Large Clipping Ratio

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**Abstract**—In this paper, a novel clipping noise mitigation algorithm for OFDM system with large clipping ratio is proposed. We notice that the situation that there is only one sample above the clipping level appears with a large probability and the clipping noise on each subcarrier can be estimated in this case. Simulation result shows that the proposed algorithm can mitigate the clipping noise effectively. **Keywords**—OFDM; PAPR clipping noise mitigation

# Performance of DTC-OFDM of the LMS Channel in Ka Band

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Abstract— Differential Turbo coded OFDM(DTC-OFDM) scheme was presented, together with a differential soft-detection method for Ka-band satellite communications. DTC-OFDM combines Turbo codes, orthogonal frequency division multiplexing (OFDM) modulation and differential detection, which has the advantages of high spectrum efficiency and suppression of multipath fading, Jamming and noise. The DTC-OFDM system model and Ka-band satellite communication system simulation model have been found, then we also analyzed the Bit error rate (BER) performance of OFDM with N-QAM modulation technique. The results show that DTC-OFDM system gives the best performance compared to convolutional coded (CC) and trellis coded OFDM systems. In the case of 256-QAM, DTCOFDM system can provide 1dB coding gain at a BER of  $10^{-4}$  compared with TCM-OFDM system and 4dB compared with CC-OFDM system. Keywords- OFDM; Satellite communication; Ka Band; LMS Channel

# An OFDM system Optimization for Satellite Communication in Ka Band

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Abstract—An OFDM system optimization for satellite communication in Ka Band is estimated in terms of the Shannon theory. The analysis covers a novel closed-form expression for the optimal subcarriers, with respect to the maximization of the achieved spectral efficiency, expressed in terms of the theoretically Shannon channel capacity available to each system' s user. Keywords- OFDM; Satellite communication; Ka Band

# Capon Beamforming-based method in IR-UWB imaging System

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Abstract—Recently, many studies have been focused on impulse radio UWB (IR-UWB) imaging system as the advantages of IR-UWB, such as penetrating ability and high resolution. However, it is difficult to reconstruct the information of target by antenna array in IR-UWB imaging system. Several imaging schemes, such as Capon beamforming-based method have been applied in ultra sound imaging. In this paper, the Capon beamforming-based method is proposed to apply to the IR-UWB imaging system to reconstruct a point target in free space. A circular antenna array was used for signal transceiving. According to the results, the Capon beamforming-based method is feasible for IR-UWB imaging system. The performance of the Capon beamforming-based method is better than the traditional DAS method. Keywords—UWB; impulse radio; imaging; Capon beamforming

# Application of IFFT Based on CORDIC Algorithms in OFDM-UWB System

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**Abstract**—The key technology in Multi-band Orthogonal Frequency Division Multiplexing Ultra Wide Band (MB-OFDMUWB) system is Inverse Fast Fourier Transforms (IFFT) which is used to implement OFDM modulation. However, the realization of multiplier with Field Programmable Gate Array (FPGA) in IFFT needs a large number of resources. This paper describes the implementations of IFFT based on COordinate Rotation DIgital Computer (CORDIC) algorithm. The whole structure of IFFT using CORDIC algorithm is shown in the form of double-rams architecture which is implemented based on FPGA with the software tools of ISE Foundation and Modelsim. The simulation results show that it's convenient to realize IFFT with a high speed of more than 270 MHz with fewer resources than by using multipliers of FPGA chip directly and that the implementated IFFT module can produce an output of right data within an acceptable error range. **Keywords**—IFFT;CORDIC;OFDM;FPGA

# Synchronization Algorithm Based on Pseudo Random Time-Hopping Codes for UWB Systems

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**Abstract**— In this paper, we propose a new blind synchronization algorithm for Ultra-wideband (UWB) systems based on pseudo random Time-Hopping (TH) codes. The synchronization parameter is acquired by using integrate-and-dump (I&D) among several segments (these segments are chosen according to a user-specific TH codes) of the observation waveform and peak-picking the outputs of the I&D device. Due to the pseudo random property of the TH codes, the maximum significantly differs from other values, thus the proposed algorithm has high immunity to noise. Owing to the

periodicity of the TH codes, one symbol-long observation interval is enough to achieve synchronization, which speeds up the overall synchronization process. Simulations and comparisons confirm that our algorithm outperforms existing similar one in terms of normalized mean square error (NMSE) and bit error rate (BER). Keywords- Ultra-wideband (UWB); synchronization; Time-hopping

(TH) code

# Performance Studies of a MB-OFDM UWB Systems

Using Reduced-complexity Algorithm for LDPC Decoder

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Abstract—In this paper, we study a MB-OFDM UWB system using reduced complexity decoding algorithm for LDPC codes. Focusing on the system simulation and performance analysis, we design a high rate MB-OFDM UWB system and run a complete simulation for such system over the additive white Gaussian noise (AWGN) channel and IEEE UWB channel. Simulation results show that the bit error rate (BER) performance of such UWB system is better, and illustrate that the use of reduced complexity decoding algorithm for LDPC codes in MB-OFDM UWB system is quite feasible. Keywords-UWB; OFDM; LDPC

# New Hybrid Multiuser Receiver for DS-UWB Systems

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Abstract—With the development and prosperity of ultra wideband (UWB) technologies, the multiple access UWB system has been a hot research topic. Multiuser detection technique has the potential to enlarge the system capacity in multiple access UWB communication environments. In this paper, a new hybrid multiuser receiver is proposed for DS-UWB system. To implement the hybrid receiver, an improved genetic algorithm (GA) proposed by the author is incorporated with the parallel interference cancellation (PIC) detector to further eliminate the multiuser interference, and provide better detection performance.

The improved GA has faster convergence performance, and it adopts a simple but effective population initialization method based on the concept of Hamming sphere solution space, which can make full use of the information delivered by the input chromosome. Simulation results show the proposed new hybrid multiuser receiver possesses better detection performance and near-far resistant ability.

Keywords— multiuser detection; UWB; PIC;GA

# Bandwidth Efficiency Analysis of UNB Modulation Schemes

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Abstract—although UNB is scorned by the advanced in the art, a new view of understanding it is presented through power spectra and bandwidth analysis. Bandwidths of UNB modulation schemes such as VMSK are analyzed by deducing their power spectrum analytical forms. Both mathematical analysis and simulation results show that UNB modulation schemes cannot attain high bandwidth efficiency. A conclusion is reached that VMSK etc. are not “Ultra Narrow Spectrum” Modulation, but a kind of “Wideband” modulation with carrier. Or, UNB is to mean that frequency band occupied by the carrier is “Ultra Narrow”, but signal bandwidth including modulation information is “Wideband”. ZGD filters are analyzed. And it is

proposed that CSVMSK modulation can achieve a high bandwidth and power efficiency using bps/Hz/W as measurement unit, power spectrum of which, without discrete line spectrum components, can be lower than -60dB only if proper modulation parameter N is selected, thus, its spectrum can underlay to the licensed spectra and share them. So, UNB can be understood from the view of spectrum sharing and Cognitive Radio. The theoretical bit error rates (BER) of VMSK, BPSK and CSVMSK are presented and simulation results verify the theoretical values: BPSK and CSVMSK have the same BERs, which are better than VMSK, but CSVMSK has a better bandwidth and power efficiency than BPSK. Besides, CSVMSK has the performance like xMax technology.

Keywords- Ultra Narrow Band (UNB); Very Minimum Shifting Keying (VMSK); Bandwidth Efficiency; Zero Group Delay Filter (ZGD Filter); Continues Spectrum VMSK (CSVMSK)

# An Analysis of Signal Propagation in UWB Transceiver System with Frequency Offset Correction

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Abstract—This paper analyzes mathematically the crucial points of signal processing in a Multi-Band (MB) Orthogonal Frequency Division Multiplexing (OFDM) based system considering realistic Ultra-Wideband (UWB) channel environment. In the process of analysis, it emphasizes the significant aspects of UWB receiver design in comparison with a narrow-band system design. This is extended further with a frequency offset error and its correction. Performance of a MB-OFDM system with frequency offset correction via computer simulation is provided in order to support the mathematical analysis.

Keywords—MB-OFDM; Signal propagation; Transceiver; UWB

# A UWB Pulse Shapes Modulation Scheme Based on Modified Hermite Polynomials

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Abstract—Considering Ultra wide band (UWB) system which transmits data information using ultra-short pulses, a pulse shape modulation UWB system based on orthogonal UWB pulse is proposed, which is on the basis of the orthogonality and nondirect component of modified Hermite polynomial function. The simulation result shows that the method can not only improve the performance, but also decrease the bit error rate.

Keywords—UWB, orthogona, Hermite polynomials, PSM

# Enhanced Exact Modeling of Multiple Access Interference for TH-PPM UWB System

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Abstract—The time-hopping pulse position modulation (THPPM) is one of the most popular approaches for IR-UWB multiuser systems, and a lot of research efforts have been devoted on its performance analysis. In several latest literatures, a method of MAI modeling, as well as the numerical computation of the MAI characteristic function, had been carried out to derive precision analytical bit error performance, which, however, still drops inconvenient limitation on UWB system configuration. To overcome this shortage, an enhancement on the above mentioned

MAI model has been proposed in this paper. Based on this modified model, the multi-access BER performance expression for the coherent receiver of the TH-PPM UWB system has also been derived. Finally, Monte-Carlo simulations have been carried out to verify the analytical results.

Index Terms—UWB, TH-PPM, MAI, BER

## UWB Signal Detection Based on Wavelet Packet Decomposition

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Abstract—Impulse radio ultra-wideband signal is difficult to detect due to its low power spectral density. Moreover, its extreme wide band makes it hard to digitalize. In this paper, a channelized blind detection based on wavelet packet decomposition is proposed and its detection performance is investigated. Based on the analysis of the detection performance, we develop a new detection threshold. Simulation results show that the detection performance based on wavelet packet decomposition maintains a good performance while it is easy to be implemented. Furthermore, within a fixed alarm probability, the new threshold obtains solid performance improvement.

Keywords— Impulse Radio Ultra-Wideband, Wavelet Packet  
Decomposition, Channelized Processing

## Rapid and Low-Complexity Synchronization for IR-UWB Receiver

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Abstract—Practical and low complexity implementation of receivers is of vital importance for the successful penetration of the ultra-wideband (UWB) technology. The role of a synchronization technique is essentially to determine the relative delay of the

received signal with respect to a template signal in the receiver, and it is difficult to implement due to the ultra-fine timeresolvability of the UWB signal. In this paper, a new method for synchronization based on sliding correlation theory and energy detection is proposed, which can reduce the average acquisition time considerably. The algorithm is shown to have enhanced efficiency compared to the conventional serial search algorithm and the degradation in performance is limited. For binary PPM modulation, the key design parameter selections that minimize the BER are derived and analyzed. Simulations corroborate our results.

Index Terms—time hopping pulse position modulation ultra wideband (TH-PPM-UWB); sliding correlation; energy detection; coarse acquisition; fine acquisition; optimal integration length

## Adaptive Pre-Interpolation Multiuser Detector for Impulse Radio Systems

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Abstract—In multiuser impulse radio systems, the conventional detection methods always suffer from high complexity and poor robustness caused by dense multipath and long maximum excess delay of the nonline-of-sight (NLOS) channel. To detect the direct spread (DS) impulse signal, an adaptive pre-interpolation filter algorithm is introduced. By analysis and simulation, this adaptive interpolator applied before the decorrelator is proved to have a good steady-state performance of the adaptation.

## Study on the Emission Limits of UWB Based on the Entire Physical Layer Model Method

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Abstract—Aiming at the effect of ultra wideband (UWB) system for the potential victim systems on UWB operating frequency band, using the entire physical layer model method, this paper studies the interference of direct-sequence ultra wideband (DS-UWB) and multi-band ultra wideband (MB-UWB) on these victim systems. Depended on the physical characteristics of UWB and these victim systems, the entire physical layer models are set up. Based on the requirement of bit error rate (BER) and sensitivity of receiver of these victim systems, the emission limits of UWB are obtained on the operating frequency band of these victim systems, The conclusion not only can provide the reference to constitute the frequency spectrum strategy of UWB, but also can offer a solution to the coexistence between UWB and these victim systems.

# Time Frequency Representations for Classification of Landmine Using UWB Impulse GPR

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Abstract—In this paper, Time Frequency Representations (TFRs) for classification of landmine using Ultra Wideband (UWB) impulse Ground Penetrating Radar (GPR) is presented. GPR signal is composed of three parts: ground bounce, clutter and target echo signal, the target signal is seriously deteriorated by ground bounce and clutter. To extract intricate structures of target signal, wavelet packet transforms (WPT)-based algorithm is used to ground bounce removal and clutter reduction. Then the Fisher Discriminant Ratio (FDR) for feature subset selection method is used to select the suboptimal feature subset of target signal, thereby a Learning Vector Quantization (LVQ) classifier is designed. Experimental results based on GPR measured data



are presented, showing that the feasibility and advantage of the presented algorithm.

# A New Multi-Access scheme for PCTH UWB System

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**Abstract**—Pseudo Chaotic Time Hopping (PCTH) is a recently proposed modulation scheme for UWB impulse radio. Unlike a typical TH-UWB, the PCTH-UWB system exploits concepts from symbolic dynamics to generate aperiodic sequences which modulate the position of pulses. The use of aperiodic TH sequence can enhance the spread-spectrum characteristics of UWB system by removing the spectral feature of the transmitted signal. In this paper, in order to improve the performance of conventional MA-PCTH-UWB system, we propose a new scheme for the multi-access communication of PCTH UWB system by transmitting specific training sequences which initialize the conditions of the shift registers for each user in each  $s$   $N$  frames.

The performance of BER of this system is analyzed.

**Keywords**—UWB; Self-Encoded; MA; TMA-PCTH

# A TOA Estimation based on Adaptive Noise Cancellation For UWB Sensor Networks

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**Abstract**—This paper discussion the designing of UWB (ultra wideband) wireless sensor network (WSN) location measure,

traditional GPS position estimation is not suitable due to cost, so a improved TOA (time of arrival) estimation which based on Adaptive Noise Cancellation method is proposed in order to design a low-calculation and high precision estimation algorithm. Adaptive Noise Cancellation (ANC) system was used to counteract input noise and Maximum Energy Selection estimate the maximum energy block. The simulation results show that the proposed method reached higher precision than traditional energy detection based non-coherent method, while largely decreases the computational complexity compared to the match-filtering based coherent method.

Keywords- WSN; location estimation; non-coherent algorithms; ANC system

# A Novel Quasi-4PPM Modulation for UWB Systems with Corresponding Synchronization Scheme

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Abstract—In this paper, a novel quasi-4PPM modulation is presented firstly for UWB systems, and then the corresponding synchronization and demodulation schemes are proposed. Due to the nature of the unique signal structure, the information bits are transmitted and demodulated by twos, which doubles the transmission efficiency compared with conventional existing methods under the same condition. Besides, the blind synchronization and noncoherent demodulation have dispensed with the training sequence and local template, which ensures the high throughput and the low complexity. Simulations are performed to demonstrate the promising performance of the presented algorithms.

Keywords—Ultra-wideband; modulation; synchronization;

## UWB SATCOM Towards Cognitive Radio

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Abstract—Multiband ultra wide band(UWB) schemes are proposed in IEEE 802.15 TG3a and terrestrial short-range highspeed

UWB communications have been mature. In this paper, the possibility of UWB SATCOM systems using cognitive radio(CR) is considered. CR is an emerging approach for a more flexible usage of the precious radio spectrum resources. UWB technology as one of the transmission techniques suitable for implementing a

Cognitive Radio system is discussed. A SATCOM downlink employing the multiband UWB signal transmission is considered. The total bandwidth is assumed to be 500 MHz in the allocation of the satellite downlink and it is divided into multiple subbands.

The link budget calculation and the estimation of the signal transmission speed are reported assuming multiband UWB signal transmission from a GSO satellite to the earth's surface.

The initial results show that the UWB SATCOM towards CR has broad application prospect.

Keywords—UWB; CR; SATCOM; link; interference

# A Bit Allocation Algorithm for MB-OFDM UWB with Spectral Mask Constraint

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Abstract—As a competitive solution to the short-range high data-rate communication, Multi-Band Orthogonal Frequency Division Multiplexing (MB-OFDM) Ultra-wideband (UWB) technique can obtain further performance improvement with the use of adaptive resource allocation schemes. In this paper, an incremental bit allocation algorithm is proposed for MB-OFDM UWB system, which aims at minimum bit error rate (BER) under constant rate constraint while complying with the spectral mask limit. The BER performance improvement and transmission distance extension due to this algorithm is evaluated by employing a simulation model based on MB-OFDM proposal.

Keywords—bit-loading; spectral mask constraint; MB-OFDM

# A New Private Multi-Channel UWB MAC Protocol Design for Distributed Network

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Abstract—Channel logical partitioning can better avoid the conflict and improve the agreement's efficiency. It has proved that double-channel access agreement efficient than the single-channel one by theory and simulation's test. And it will solve the exposed terminal problem. Proposed a design for new private multi-channel UWB MAC protocol applied distributed network in the background of UWB applied in wireless local network in this paper. This protocol not only solve the hidden terminal and exposed terminal, but also distribute channels effectively and improve network performance. Key words—UWB; MAC; multi-channel; PHY;

# Application of Equivalent Circuit Method in Designing the Vivaldi UWB Antenna

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Abstract—Directed at eliminating the repeated experiment as required by the conventional method, this paper starts with the design of the Vivaldi UWB antenna of microstrip feed structure. The paper goes to introduce the design of the parts of feed structure by equivalent circuit method, the optimization of the antenna structure by the computer-aided design and the test of prototype of the antenna. This paper ends with an analysis of effect of processing technique on the design parameter. The antenna has a working band of 3.1~10.6GHz. In this wide band, the antenna gives gain of above 8.5dB, a width of 3dB beam efficiency up to 80%, all of which meet FCC-specified

UWB antenna indexes. Keywords- Vivaldi UWB Antenna; feeding structure; equivalent circuit method; simulation; measurement

# Simplified Maximum Likelihood Channel Estimation Algorithm for Impulse Radio UWB

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Abstract—The maximum likelihood (ML) approach is a classical approach to the channel estimation problem. However, without reducing the number of parameters, the complexity is prohibitive.

This paper proposes a (data-aided) DA simplified ML channel estimation algorithm based on unstructured channel model and time-hopping binary phase shift keying (TH-BPSK) modulation for impulse radio (IR) UWB systems. This approach need not estimate the multipath propagation delays and its complexity is reduced evidently. The computer simulations have been run to verify this approach proposed in this paper. Keywords—maximum likelihood (ML);

## Analysis on performance improvement in multiuser UWB system under imperfect power

# control

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Abstract—Power control techniques are adopted in narrow-band systems to overcome near-far effects by varying transmitted power levels so that all signals are received with equal power level. However, since the transmission data rate is too high in Ultra-Wideband (UWB) in which multimedia communication is desired to realize, it is impossible to accomplish perfect power control with current technologies and hardware, and therefore performance of UWB systems will be reduced. A model of UWB system under imperfect power control is proposed, and system performance with this model is analyzed. Since system performances are different by utilizing different waveforms, to improve the performance, an optimal waveform is adopted in UWB system, and the improvement of system performance is shown by comparing to the performance using Gaussian waveform. Keywords— Ultra-wideband(UWB); multiuser interference; imperfect power control; optimal waveform

## A Modified Transmitted Reference UWB Receiver

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Abstract—A Modified Transmitted Reference (MTR) systems is proposed for Ultra Wideband (UWB) communications in a single user multipath environment. The performance of this receiver and the basic Transmitted Reference (TR) receiver are analyzed and compared both in the theory and simulation. The results turn out that MTR can improve both the performance and data speed. This paper also considers the influence of multipath, Inter/intra Symbol Interference (ISI) with Time-Reversal (TiR) technology. Keywords: Transmitted Reference, Modified Transmitted Reference, Time-Reversal

## Time-Hopping Spread-Spectrum based on Balance Gold Sequences in Ultra-Wide Band Communications

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Abstract--- To solve the problem which the spectrum spread rate is held in the clock period and the sequence length of address code lies on the quotient of clock rate with information rate. A method which is based on the Balance Gold Sequences (BGS) is presented in Ultra-Wide Band communications. After presenting a mathematical model for the system, the theoretical bit error rate (BER) performance is presented. Through computer simulation, it shows that the Balance Gold Sequences obtained higher system capacity and superior performance over the Traditional Pseudorandom Code (TPNC) Time-Hopping systems in additive noise and multi-user environments. Finally, the simulation results show that the high system capacity can be achieved in different multi-user interference (MUI). Keywords-component: Balance Gold Sequences; Ultra-wide Band; Time-Hopping; Impulse Radio;

# Designing Optimal UWB Pulse Waveform Directly by FIR Filter

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Abstract—In this paper, we address the optimal mask-constraint UWB pulse waveform design problem. We let the basic pulse waveform to be synthesized by FIR filter. But unlike the optimization of the mask utilization efficiency by way of autocorrelation of filter coefficients in [1][2], we do it directly with respect to the filter coefficients, and get performance improvement, such as larger mask utilization ratio and shorter filter length requirement. We also analyze the influence of the basis pulse's parameters on the synthesized pulse. Keywords- FIR filter; Ultra-wideband (UWB); waveform design.

# Printed-Circuit Elliptical Dipole Antenna for 3.1–10.6 GHz UWB Application

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Abstract—Printed-circuit board (PCB) antenna with useful bandwidth covering from 3.1 GHz to 10.6 GHz is suitable for wireless ultra wideband (UWB) application. Firstly, we present a low profile, elliptical antenna etched on PCB with dielectric constant 4.2 achieving the above specific bandwidth. Next, to reduce the size of the product, an elliptical dipole antenna with PCB dielectric constant 10.2 has been fabricated. Swept frequency return loss, impedance and radiation patterns of these antennas have been measured. Design criteria for this elliptical dipole antenna is also investigated. Keywords—Elliptical dipole antenna, printed-circuit antenna, printed circuit board (PCB), ultra wideband (UWB).

# Design of an Ultra-wideband Pulse Generator Based on Avalanche Transistor

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Abstract—Based on the avalanche effect of avalanche transistor, a kind of ultra-wideband nanosecond pulse circuit has been designed, whose frequency, pulse width and amplitude are tunable. In this paper, the principle, structure and selection of components' parameters in the circuit are analyzed in detail. The circuit generates periodic negative pulse, whose pulse full width is 890ps and pulse amplitude is -11.2V in simulation mode. By setting up circuit for experiment and changing parameters properly, a kind of ultra-wideband pulse with pulse width of 2.131ns and pulse amplitude of -9.23V is achieved. With the features such as simple structure, stable and reliable performance and low cost, this pulse generator is applicable to ultra-wideband wireless communication system. Keyword: ultra-wideband; pulse generator; avalanche effect; Nanosecond

# Chirp Frequency-Translated



# Reference Ultra- Wideband (UWB) Wireless Communication System

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**Abstract**—A Chirp Frequency-Translated Reference Ultra- Wideband system is proposed based on the time-domain and code-domain transmitted-reference impulse radio UWB systems. Mathematic derivation and simulation results show that while this system has similar performance to pulse-based UWB system without losing the merits, it has the advantages of Chirp communication system as well. Meanwhile, this system not only offers a solution of simple structure and low-power consumption for low rate and short distance wireless data transmission and location, but performs well in medium and long distance wireless data transmission and location. **Keywords**—wireless communication; Ultra-Wideband (UWB); transmitted reference; Chirp

# Reflection Characteristics Analysis of IR-UWB Signal

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**Abstract**—As one of the most important propagation mechanisms in Ultra-wideband (UWB) indoor environmen, reflection has its own characteristics due to the huge bandwidth of the UWB pulse. The inherent material dispersions represent the changes of permittivity and conductivity, etc. with frequency, which will cause UWB pulse undergoes waveform distortion in propagation, and furthermore affects the channel modeling and the receiver structure. In this paper, the reflection waveforms of an IR-UWB signal are calculated in two ways: Time-Domain (TD) and Frequency-Domain (FD). In TD method we deduce the time domain reflection coefficient from the frequency Fresnel reflection coefficient through some analytical approximations, then convolute

with the transmitted pulse to obtain the reflection waveform. In FD method, the frequency dispersion of material is taken into account by uniformly divided the frequency band (2– 11GHz) into several subbands. Each subband is simulated separately and then combined in the whole bandwidth. Then the final waveform is got by using the Inverse Discrete Fourier Transform (IDFT). Two typical indoor materials: wooden door and block are used in the analysis. The results show that the two methods curves agree well, and the reflection waveform of an UWB pulse doesn't distort apparently. The numerical data also imply that the simple time domain reflection coefficient can be also used to model an UWB pulse's reflection in the analytical channel modeling. Keywords—UWB; reflection; frequency dispersion

# Small Printed UWB Antenna with Annular Structure

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**Abstract**—a small printed antenna is presented for ultrawideband (UWB) applications. The configurations are etched onto a piece of printed circuit board (FR4) with a very compact size of  $27\text{mm} \times 20\text{mm} \times 1.6\text{mm}$ . The performances and characteristics of the antenna are investigated numerically. The effect of the notch at the ground plane is investigated. Parametric studies have also been carried out for the antenna. The results demonstrate that this miniaturized antenna is suitable for UWB applications. Keywords—ultra-wideband (UWB), printed antenna, small antenna, miniaturized antenna.

# Pulse Design Methods for UWB Vehicular Radar

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E-mail xiabin@sdut.edu.cn, [xienan@sdut.edu.cn](mailto:xienan@sdut.edu.cn) **Abstract**—A UWB vehicular radar has been studied and developed to achieve a safe driving and to promote business in an

intelligent transport system. In the paper, pulse design methods for Ultra-wideband (UWB) vehicular radar are presented. One method is based on prolate spheroidal wave function; the other

is the modified method which can obtain the pulse by adjusting the parameters ,

$H(f)$  . Simulation results show that both the two methods can generate pulse shapes which comply

with FCC regulation. Meanwhile by selecting appropriate ,  $L(f)$  , the latter

method has higher spectral utilization ratio than the former. Keywords-UWB; vehicular radar; pulse shape

## Performance Analysis of a Hybrid DS/TH UWB Wireless System

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**Abstract:** In this paper, a hybrid direct sequence (DS) multi-band ultra-wideband (UWB) system compared with a hybrid direct sequence time hopping (DS/TH) impulse radio (IR) analysis facilitates to obtain simple-to-evaluate and accurate error probabilities based on Holtzman' Simplified improved Gaussian approximation (SIGA). System performance is also presented for various duty-cycles of the signals considering equal and unequal powers of the users and the validity of standard Gaussian approximation(SGA) is examined. The theoretical results are validated by Monte Carlo simulation. Keywords: UWB, error analysis, multiple access system

## An Optimal High-Order-Phase Chirp for DS-UWB Ranging

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**Abstract** The UWB (Ultra-wideband) communication system occupies very large bandwidth of 7.5 GHz. This enables highprecision ranging that provides correct position information. In this paper, we analyzed each of high-order-phase chirps from 2<sup>nd</sup>-order to 4<sup>th</sup>-order for DS (Direct-Sequence)-UWB ranging and investigated to find out the optimal phase based on the mainlobe-1<sup>st</sup>sidelobe ratio which determines the ranging accuracy. Simulation results confirmed

# A Study of Cooperative Diversity Scheme in Ultra-Wideband System

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**Abstract**—A novel system based on cooperative distributed spacetime block code (DSTBC) and multi-band Orthogonal frequency division multiple (MB-OFDM) is proposed which works well on multiple single-antenna users wireless networks in Ultra-Wideband System. In this system, using MB-OFDM technology modulate data to subcarriers, can resist the influence of frequency selective fading channel effectively. Over cooperative diversity scheme based on DSTBC-MB-OFDM, a theoretical bit error rate (BER) performance expression of the system has been derived. Also its closed-form expression is derived by means of the moment generating function (MGF). Monte Carlo simulation results are given to demonstrate the BER performance of DSTBC-MB-OFDM outperforms non-cooperative MB-OFDM with distinctive gains. **Keywords**— cooperative diversity; UWB, DSTBC; MB-OFDM

## Ultra-Wideband MB-OFDM Channel Estimation with Pilots

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Abstract—Multi-Band Orthogonal Frequency Division Multiplexing (MB-OFDM) is a suitable solution to implementation of high speed data transmission in ultra wideband (UWB) spectrum by dividing the spectrum available into multiple bands. MB-OFDM system structure and transmitted signal is introduced in this paper. Channel models are fundamental to the study and design of communication systems. A survey on indoor wireless channels for UWB radio is given and the IEEE 802.15.3a model for UWB channel models is introduced in detail in this paper. The least square (LS) channel estimation based on comb type pilot and linearity insertion are described and some simulation results are given in this paper. The simulation results have shown that this method has good performance, can meet the demand of MB-OFDM system with high estimation precision, strong resistance to ICI and easy realization. Keywords: UWB; MB-OFDM; Channel Model; Channel estimation; Pilot

# A Shape Reconstruction Method Using IR-UWB By Illuminating The Target From Multiple Aspects

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Abstract—The impulse radio ultra wide band (IR-UWB) signal has been applied to many imaging systems such as throughwall- imaging, ground penetrating radar etc., due to the ultra wide frequency band and the simplicity of IR-UWB. Several imaging schemes, such as Delay-and - sum (DAS), Cap beamforming-based method etc., were proposed in the previous literatures. But there is few method whose aims wer to reconstruct the shape of the target. In this paper, a shape reconstruction method employing IR-UWB signal was proposed. The proposed method is based on the DAS imaging algorithm. Multiple aspects of the target were illuminated in the proposed method to obtain more information about the target than what can be obtained through only one aspect in the traditional imaging systems. The finite-difference timedomain (FDTD) method was employed to simulate the received data for the 2-D imaging using the proposed method. From the image results, the shape of target can be recognized. The capability of the proposed shape reconstruction method is verified, and it can be concluded that the more aspects were illuminated, the more precise shape of the target can be obtained using the proposed shape reconstruction method. Keywords- IR-UWB; shape reconstruction; multiple aspects

## Error and Outage Performance of STBC MB-OFDM UWB

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Abstract—Bit error performance is investigated in this paper for orthogonal space-time block coded (STBC) multiband orthogonal frequency division multiplexing (MB-OFDM) ultra-wideband (UWB) systems. As the channel model considers the log-normal fading, the resultant signal to noise ratio (SNR) follows a chisquared log-normal distribution. Based on this, the bit error probability and the outage probability are derived. Simulations demonstrate the theoretical solutions. Keywords-BER; Outage Probability; STBC; MB-OFDM UWB

## Research On Ultra-wideband Antenna

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Abstract—This paper introduces the character and requirement of UWB antenna based on microstrip quasi-horn, horn, abnormality monopole, microstrip meandered-loop and biconcave omni-directional antenna. Several types of antenna for UWB are reviewed. These antennas are simulated and compared. These improvements are provided. Keywords—UWB; antenna; VSWR

# Performance Analysis of Time-Hopping Pulse Width Modulation for Ultra-Wideband Impulse Radio

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Abstract—The Ultra Wide-Band (UWB) technology is going to become one of main technologies in short-range highrate wireless communications due to its unique characteristics. This paper presents a new modulation scheme—pulse width modulation (PWM) for UW communication systems and describes the signal model modulated by this modulation scheme based on the timehopping (TH) multiple access mode. Its bit error rate (BER) performance is analyzed in presence of multipath channel and a comparison is made between TH-PWM a time-hopping pulse position (TH-PPM) systems. BER performances for these two systems are simulated respectively in the four typical dense multipath channel CM1-CM4 recommended by IEEE 802.15.3a. The theoretical and simulation results prove that PWM is a viable modulation scheme with better BER performance for UWB communication systems. Despite the theoretical analysis and simulation are based on the time-hopping multiple access, PWM modulation scheme can also be applied to other multiple access methods of UWB communication system. Keywords—Ultra-wideband (UWB)

## The analysis of WiMAX and UWB interference issues and solution for the future

# advancements

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Abstract— The recent history of Ultra Wide Band (UWB) communications technology has seen great debate over whether UWB causes unacceptable interference to existing users of the same and nearby bands. The ongoing debate is not over whether or not UWB can cause interference with other incumbent signals in the same band, but the effectiveness of techniques used to protect the victim service. WiMAX is the future of communications but it has got some inherent problems that must be overcome for its efficient use and implementation. In this paper we shall analyze the UWB and WiMAX interference and try to find out a suitable solution for it. Keywords: WiMax interference, future of WiMax, UWB interference, wireless communication, smart antenna.

## Two-step Imaging Method and Resolution Analysis for UWB Through Wall Imaging

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Abstract—Through wall imaging (TWI) is one of the applications of ultra wideband (UWB) that attracts recent interests for its capability to penetrate the common wall materials. However, in the multi targets imaging scenario, false imaging is a crucial problem leading to the failure of imaging and generating the false target. This paper proposes a two-step imaging method for UWB TWI and analyzes the imaging resolution. The proposed imaging method theoretically solves the problem during the imaging processing. Based on the proposed method, imaging resolution for TWI is analyzed and derived. The results show that the imaging resolution is directly decided by the imaging system time resolution and the imaging method. So it is concluded that the imaging signal with good time resolution, such as UWB short pulse, will result in a good imaging resolution. Keywords—UWB; through wall; imaging resolution; false target

## Joint Channel and Timing Estimation for Chirp UWB

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Abstract—Synchronization and channel estimation are two of the most critical issues in ultra-wideband (UWB) communication systems. Conventional transmitted-reference (TR) UWB avoids the stringent synchronization and channel estimation requirements. In this work, we utilize transmitted reference technology to add reference pulses between data pulses in Chirp UWB transmitter. And in Chirp UWB receiver, a synchronization scheme based on interference mitigation mechanism to recover symbol timing is developed. Moreover the proposed algorithm performs joint timing and channel estimation through storing and averaging reference pulses. The principles of the proposed algorithm are presented and the system performance of a synchronized receiver is investigated by computer simulations. Our researches show that the proposed scheme can offer good system performance at the cost of low complexity. Keywords—Chirp UWB; transmitted-reference; synchronization; channel estimation

# A Study on Performance of an IR-UWB Receiver Based on Energy Detection

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Abstract—An energy detection-based impulse radio ultrawideband (IR-UWB) system is proposed in this study. The related synchronization process is investigated on the pulse and frame level respectively. According to the system structure, an optimal transmission mode is described in a typical indoor environment, which could take the balance in the system reliability and effectivity. Meanwhile, the referenced frame structure and transmission rate under certain environments are given in this optimal mode. System performance is tested by practical experiments, and the results show the usefulness of the optimal mode to the UWB system design.

# A Synchronization Scheme Based on Entire Time Hopping Code in

## Multiuser TH-UWB System

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**Abstract** A synchronization scheme based on entire time hopping (TH) codes in multiuser TH-UWB system is proposed in this paper. A novel timing with dirty template (TDT) coarse synchronization scheme is presented, which is based on the synchronizing of the entire time hopping pulses on the premise that the users' TH codes are orthogonal each other. And all the possible synchronzationreferential positions can be found for multiuser after only one single search. Then the coarsesynchronization positions are used as the starting points to acquire fine synchronization sequences). The analysis of the performance and the simulation results show that the scheme is feasible. And it provides a new method for the synchronization of the impulse UWB system. Key words UWB, Synchronization, TH (Time Hopping), Multiuser

# Performance of Overlapped and Orthogonal TH-BPPM UWB Systems

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**Abstract**—This paper describes a modulation scheme for THUWB systems using pulse position modulated (PPM). For this scheme, a set of overlapped and orthogonal signals are transmitted simultaneously in the same time slot resulting in a composite pulse. And the signals have been discussed analytically for AWGN and multi-path channels. The proposed scheme can achieve an excellent BER performance by using one signaling over another.

# Lunar Rover Positioning based on Time of Arrival

## Measurements of UWB Signals

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Abstract—The application of ultra-wideband (UWB) to lunar rover positioning and navigation shows great foreground for many characteristics of UWB, such as broad transmission wideband, high transmission rate, low power consumption, exceptional multi-path immunity and high localization precision. In the paper, a lunar rover positioning method based on UWB is proposed using exact time-of-arrival (TOA) measurements on the lunar surface. There are two steps in lunar rover localization: the first is to estimate the propagation delays of UWB signals that are sent from a lunar rover. A MUSIC timing estimator is used to estimate the direct-path delay in a DS-UWB system. The second step is a lunar rover positioning algorithm based on obtaining TDOA, AOA and then computing the position. The simulation illustrates that the proposed methods are effective in the lunar rover positioning and navigation. Keywords—Lunar rover; Ultra wideband; Wireless localization; Time-of-arrival (TOA); Timing estimator

# A Differential Evolutionary Based Algorithm for Multiuser OFDMA System Adaptive Resource Allocation

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Abstract— In this paper, the problems of radio resource allocation for Orthogonal Frequency Division Multiple Access (OFDMA) systems are addressed. The main goal of this paper is to present and analyze base station allocation of subcarriers and adaptive modulation. We impose a set of proportional fairness constraints to assure that each user can achieve a required data rate. Since the optimal solution to the fairness problem is extremely computationally complex to obtain, we propose an adaptive radio resource allocation method based on differential evolutionary algorithm for multiuser OFDMA system. The performance of the described schemes is further evaluated in numerical experiments. We improve the convergence of the differential evolutionary algorithm through the method of elitist selection and adding some individuals with ‘good’ genes to the initial population. Simulation results show that our proposed algorithm better than static subcarrier allocation schemes TDMA in multiuser OFDMA system. Keywords: OFDMA, Multiuser, Subcarrier, Proportional Fairness, Differential Evolutionary

# A Pulse Coupled Neural Network Based Approach for Frequency Assignment Problem in non-Homogeneous Cellular Radio Networks

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Abstract—Frequency Assignment Problem is a NP problem. Separation of frequencies assigned to cells needs to avoid causing interference and fit minimum span constraints, because the cost of unnecessary assigned frequencies will be high. The aim of our work is to find optimal solution in frequency assignment with minimum cost function and number of channels in nonhomogeneous cellular networks. Compared with the work presented in the literature, this paper presents a novel algorithm based on pulse-coupled neural network (PCNN) model to solve the Frequency Assignment Problem in non-homogeneous cellular radio networks, by highlighting the frequency causing interference to fit the interference and minimum span constraints. Keywords- adjacent channel interference; co-channel interference; minimum span; PCNN

# Anti-intermittence source routing protocol in distributed cognitive radio network

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Abstract—In this paper, based on distributed Cognitive Radio Networks, we have investigated the problem of intermittent connectivity in routing for either per link propagation time guarantee or global spectrum utilization, after efficiently analyzing broadcast TV system channel-usage model, we develop a novel collaborative strategy for spectrum and route selection. The main protocol mechanisms include routing discover, routing maintenance, and re-routing etc, which

takes into account the opportunistic spectrum, the link disruption probabilities as well as the link propagation time between nodes. Simulation results show that, comparing to other typical approaches, our protocol provides better routing lifetime to the dynamic spectrum. Keywords—Cognitive Radio, Intermittence, Routing, Spectrum

## A Microeconomics based Radio Resource Allocation Scheme for B3G Heterogeneous Networks

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Beijing University of Posts and Telecommunications, Beijing 100876, ChinaAbstract— This paper brings forward a microeconomics based radio resource allocation (MBRRA) scheme to solve the joint radio resource management (JRRM) problem in the Beyond 3G (B3G) heterogeneous wireless networks. The MBRRA mechanism is formulated based on game theory. Through the resource allocation game played by different operators, the radio resource is utilized effectively. Simulation results show that the proposed scheme effectively improves the operators' profit and the radio resource utilization efficiency. Besides, the game converges quickly to the Nash equilibrium, and achieves a well balance of high degree of efficiency and fairness at the equilibrium. Index Terms—microeconomics; game theory; B3G; JRRM

## Cross Layer Opportunistic Scheduling for Multiclass Users in Cognitive Radio Networks

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Abstract—In this paper, we propose a novel cross layer opportunistic scheduling strategy with interference control for multiple cognitive users working at the same area with a primary user. The proposed scheduler incorporates multidimensional factors into the scheduling rule, and attempts to satisfy multiple QoS requirements and achieve fairness among multiclass cognitive users, while at the same time using the bandwidth efficiently and decreasing the average interference to the primary user. Simulation results show that our scheme can decrease the interferences to a primary user without significantly dropping the QoS.

Keywords— CRN; cross-layer; opportunistic scheduling; QoS;

fairness; interference.

# Agilize Spectrum Sensing for Cognitive Radios

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Abstract—In cognitive radio (CR) networks, cognitive users need to continuously monitor spectrum to detect the presence of primary users, yet attain a reasonable throughput. In this paper, we exploit a scheme to detect the primary transmitting signal as quickly as possible using energy detection, besides a necessary transmission rate of CR networks is sustained. Also the relationship between time and frequency sensitivity in spectrum detection is given, whose product is a function of effective receive signal to noise ratio (SNR) of CR user.

Keywords—cognitive radio; spectrum sensing; average detection time; time sensitivity; frequency sensitivity

# Spectrum Sensing Based on Goertzel Algorithm

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Abstract—The spectrum scarcity, which is a serious problem in wireless communication, shows the extreme importance of spectrum sensing technologies. For the traditional spectrum sensing algorithms, they are very difficult to have a good tradeoff between accuracy and simplicity. This paper is based on the application of Goertzel algorithm to the cyclostationary feature detector, which makes fast-searching and precise-searching of spectrum come true. The result of simulation indicates that it is

feasible to get nearly zero Percentage Missed Detect (PMD) when the Signal to Noise Ratio (SNR) is 3. The Goertzel algorithm is capable of computing the spectrum of some appointed frequency, while the Fourier Transform is only allowed to get the spectrum of the whole frequency band. So while detecting whether there exist a primary user in several frequencies rather than the whole band, the proposed algorithm is superior in simplicity of calculation.

Keywords—Spectrum sensing; Goertzel; Spectral Correlation Function(SCF); Fast-searching; Percentage Missed Detect (PMD)

# A Proposed Propagation-based Methodology with which to address the Hidden Node Problem and Security/Reliability Issues in Cognitive Radio

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Abstract—A highly accurate, fast and robust Integral Equationbased propagation method is presented here. It is explained how this method, in conjunction with a Radio Environment Mapping server can be used to address the ‘Hidden Node Problem’ and salient security/reliability issues in Cognitive Radio (CR) by accurately quantifying the effects of CR transmissions in realtime thus allaying the legitimate concerns of Primary Users regarding the deployment of CR technology. A roadmap for the development of the propagation method is given such that sufficient accuracy and execution times can be achieved.

Keywords—Cognitive Radio, Propagation, Security.

# Investigation of Mutual Interference Channel with

# Relay in Cognitive Transmission

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Abstract—The current regulation of static spectrum distribution is a key factor that results in underutilization of fruitful wireless spectrum. Cognitive transmission must be predetermined to resolve the problems in the future network. In this paper, two kinds of cognitive channel, which are mutual interference cognitive channel with and without cognitive relay, will be modeled and analyzed. In mutual interference channel, the secondary system attempts to transmit its own data without degradation of primary system's performances. In cognitive relay channel, a relay is induced to improve throughput of the secondary system. Simulation results are presented to compare performance of both schemes.

# A Slot-Based MAC Protocol in Cognitive Radio Wireless Networks

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Abstract—In this paper, a slot-based MAC protocol is proposed for cognitive radio wireless networks. This protocol makes cognitive users sense licensed channels periodically, and each period consists of a fixed number of slots. When cognitive users identify un-used licensed channels, they use IEEE 802.11 distribution coordination function (DCF) to contend the spare channels. According to 802.11 DCF, all other cognitive users freeze their backoff counters when a cognitive user transmits data. So the decrement of backoff counter, which equals to the decrement of the number of slots in one period, depends on the traffic of cognitive users. When the slots of one period decrease to zero, this period ends. So the duration of each period may be variable with different busy conditions of cognitive users. We use the Markov chain model to estimate the saturation throughput of



our proposed MAC protocol.

Keywords—cognitive radio; slot; markov chain; saturation

Throughput

# Temporal Design Tradeoffs in the Sensing of Cognitive Radio System

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Abstract—Cognitive radio (CR) is proposed as an approach to solve the conflict between the spectrum congestion and under-utilization. The practicality of CR system is promised by the avoidance of the interference to the primary systems. The performance of CR system includes the interference to the primary system and the utilization efficiency of the spectrum. In this paper, we define two indices to measure the two aspects of the performance of CR system. The situation of CR system working in both non-cooperative form and cooperative form are studied. Temporal tradeoffs should be made in the sensing of CR system. To determine the sensing time and the sensing frequency of CR system, the detection performance of the detectors applied in the system should be taken into consideration. Based on the two indices, we propose a design principle to make these tradeoffs.

Index Terms—cognitive radio, primary signal detection, cooperative sensing, temporal design tradeoffs

# Study on Power Allocation of Cognitive OFDM Systems

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Abstract—Cognitive radio is an emerging technique to improve the spectrum utilization in future

wireless communication systems. In this paper, we study the power allocation strategy of cognitive orthogonal frequency division multiplexing (OFDM) system, where both primary user and cognitive user have multiple channels to transmit. The mathematical optimization problem is first formulated, based on the interference temperature model. The object of problem is to maximize the capacity of cognitive user under the constraint of interference temperature at the primary receiver and peak power constraint at the cognitive transmitter. An optimal solution based on Lagrange multiplier is proposed to solve the optimization problem. Three suboptimal solutions, which require less channel side information, are also presented for the purpose of comparison. Numerical simulation results of different algorithms are provided.

# Cooperative Spectrum Sensing under Noise Uncertainty in Cognitive Radio

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**Abstract**—Spectrum sensing is the key technology in Cognitive Radio (CR) for primary user detection. Noise uncertainty in spectrum sensing will make the detector unreliable due to "SNR walls". In this paper, cooperative spectrum sensing with adaptive thresholds is proposed to improve the detection performance under noise uncertainty. In this algorithm, each secondary user will use a two-thresholds detector for local detection. The thresholds are chosen according to the noise uncertainty at each secondary user. After each detection, the detection results are fused to give the final decision. Computer simulation indicates that our proposed algorithm is robust to the changes of noise uncertainties at secondary users. It can achieve better performance than cooperative spectrum sensing with one threshold or two fixed thresholds when the noise uncertainties are not equal at each secondary user. **Index Terms**—Cognitive Radio, Cooperative spectrum sensing, noise uncertainty, two-thresholds

# Cross-Layer Scheduling and Power Control in Cognitive Radio Networks

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Abstract—Cognitive radio is a promising technology, which can alleviate the problem of crowded bandwidth resource with low spectral efficiency. In this paper, we present a cross-layer approach for joint link scheduling and power control in cognitive radio networks, in order to make more efficient use of system resources. The principle behind this algorithm is to find a enhanced without excessive transmit powers. Simulation results are presented to confirm the effectiveness of the proposed algorithm. Keywords—link scheduling; power control; cognitive radio

# Sidelobe Suppression in NC-OFDM Systems using Phase Shift

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Abstract—High sidelobe power could cause strong interference to primary users in the orthogonal frequency division multiplexing (OFDM) based cognitive radio systems, i. e. non-contiguous (NC) OFDM systems. In this paper, a phase shift method for sidelobe suppression for NC-OFDM systems is proposed and investigated. Instead of multiplying the phase shift sequences with all the active subcarriers, we consider applying these sequences to the subcarriers on the border of cognitive user' s band since they affect the primary users most. Simulation results show that significant gain is achieved in sidelobe suppression and little change is introduced to the peak-to-average power ratio (PAPR) in the proposed algorithm. Keywords—Sidelobe Suppression; OFDM; Cognitive Radio

# Spectrum Sharing under Interference Temperature and SINR Constraints

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Abstract In this paper, we develop a multi-user cognitive radio sharing network based on opportunistic spectrum access, where primary and secondary users can peacefully coexist in the

same system to share the spectrum and improve the utility of licensed spectrum. Under this scenario, we introduce two constraints to guarantee their successful transmission, interference temperature limit at the primary users and SINR limit at the secondary users. The objective of our interest is to obtain the number of secondary users who can coexist peacefully with primary users, at the same time maximize the total goodput under the two constraints. Through analysis and simulation, the new strategy of spectrum sharing does improve the goodput performance as well as guarantee the QoS of primary and secondary users. Keywords—spectrum sharing; interference temperature limit; SINR limit; opportunistic spectrum access

# The Spectrum Allocation Algorithm of Cognitive Radio Based on OFDM

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**Abstract** Based on the characteristics of cognitive radio (CR) and the transmission features of OFDM, this article offers the algorithms for the spectrum allocation in OFDM. Aiming at the probability of detection by the CR and the upper limit of the noise which can be suffered by the authorized user, CR achieves the maximal channel capability through the allocation of the sub-carriers and the power. This article provides three algorithms: the Irrigation Algorithm with the capacity optimization, the Revision Greedy Algorithm with the minimum interference to the authorized user and the Grouping Allocation Algorithm with the minimum computation load. These three algorithms emphasize particularly on different characters about CR. The simulation indicates that when the amount of the sub-channels is great, the Revision Greedy Algorithm is suited for the CR; the Grouping Allocation Algorithm has a better real-time performance, although we need choose an appropriate grouping number to balance the complexity of computation and the loss of channel capacity. Keywords—Cognitive Radio; OFDM; Spectrum Allocation; Capacity Loss

# Improved Resource Awareness Channel for Cognitive Radio

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Abstract—Cognitive radio has been considered as an efficient approach to opportunistic spectrum sharing between primary users and cognitive radio users. The most important challenge of a cognitive radio system is to identify the primary users over a wide range of the spectrum. Considering that the existing sensing techniques would be time-consuming and wasteful of power, Holland etc. give the concept of Resource Awareness Channel (RAC)—a fixed frequency random access channel on which all radios periodically transmit information about which resources are being used by the data that are receiving. In this paper, we propose an improvement on the scheme, for the radio's transmission on the RAC, we use five different channel access protocols for the control field. Meanwhile, the transmitter-based code assignment is applied for spreading the data portion of each packet based on the idea of joint detection. The success probability for a radio trying to transmit on the RAC is analyzed and the effects on the performance for the transmission power, the period of radio's transmission on the RAC, and the ratio of data signal lengths in bits for a transmission packet are evaluated. Also, the throughput per packet length is deduced and simulated for different channel access protocols and joint detection capacity. Keywords—Cognitive radio RAC the success probability Throughput

# Improved Resource Awareness Channel for Cognitive Radio

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Abstract—Cognitive radio has been considered as an efficient approach to opportunistic spectrum sharing between primary users and cognitive radio users. The most important challenge of a cognitive radio system is to identify the primary users over a wide range of the spectrum. Considering that the existing sensing techniques would be time-consuming and wasteful of power, Holland etc. give the concept of Resource Awareness Channel (RAC)—a fixed frequency random access channel on which all radios periodically transmit information about which resources are being used by the data that are receiving. In this paper, we propose an improvement on the scheme, for the radio's transmission on the RAC, we use five different channel access protocols for the control

field. Meanwhile, the transmitter-based code assignment is applied for spreading the data portion of each packet based on the idea of joint detection. The success probability for a radio trying to transmit on the RAC is analyzed and the effects on the performance for the transmission power, the period of radio's transmission on the RAC, and the ratio of data signal lengths in bits for a transmission packet are evaluated. Also, the throughput per packet length is deduced and simulated for different channel access protocols and joint detection capacity. Keywords—Cognitive radio RAC the success probability Throughput

# A Channel Allocation Algorithm for Minimizing Handoff Rate in Cognitive radio Networks

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Abstract—Reducing the handoff rate and the handoff latency is one of the best ways to minimize performance degradation during cognitive user ongoing communications. In this paper we introduce an algorithm for dynamic channel allocation which is based on the task allocation model in ant colony. We called this algorithm as Channel Allocation algorithm based on Ant-Colony (CAAC). CAAC not only can enables minimize the cognitive users' handoff rate but also can reduce the handoff latency because of its simple operations and need none or seldom coordination with other cognitive users. Keywords—cognitive radio; channel allocation; handoff; ant colony; ON-OFF model

# Spectrum Sensing for Cognitive Radio Based on Higher-Order Statistics

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[syl\\_peter@163.com](mailto:syl_peter@163.com) Abstract—Cognitive radio is a new intelligent wireless communication technology, which aims to improve the utilization of limited spectrum resources. In a cognitive radio network, efficient sensing of primary (licensed) users is prerequisite to other cognitive tasks. In this paper, spectrum sensing method based on higher-order statistics is discussed. We choose bispectrum estimation method for its good performance in signal processing field and verify our conclusion through computer simulation. Keywords—spectrum sensing; cognitive radio; higher-order statistics; bispectrum;

## Selection of Sensing Nodes in Cognitive Radio System Based on Correlation of Sensing Information

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Abstract—Spectrum sensing is the necessary function to achieve spectrum sharing. Distributed and collaborative spectrum sensing can improve the sensing credibility greatly, however when there are too many sensing nodes in the cognitive radio system, for example IEEE802.22 Wireless Regional Area Network system, it will produce large signaling overhead. To reduce the signaling overhead, the selection of sensing nodes in cognitive radio system based on the correlation of sensing information is proposed in this paper. Our analysis and simulation results show that this method can reduce the number of sensing nodes remarkably and effectively. Index Terms—cognitive radio, spectrum sensing, spectrum Sharing

# Performance Evaluation of a CR-based WRAN System using Spectrum Utilization Efficiency

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**Abstract**—A cognitive radio system is one of promising solutions that can relieve the spectrum shortage problem by using spectrum overlay sharing. The performance of a cognitive radio system can be evaluated by the spectral utilization efficiency. Considering net system coverage, we propose area efficiency in order to measure the spectrum utilization efficiency of a CRbased wireless regional area network (WRAN) system over TV bands. Based on a coexistence scenario between WRAN and DTV systems, we evaluate area efficiency and compare it with the conventional ones such as spectral/coverage efficiency. From simulation results it is observed that area efficiency is more useful than spectral/coverage efficiency under spectrum sharing environment such as the number of available frequency bands and the available amount of given geographical area. **Index Terms**—Spectrum utilization efficiency, cognitive radio, spectrum overlay sharing, DTV, and TV channels.

# Channel Sensing Algorithm Based on Neural Networks for Cognitive Wireless Mesh Networks

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**Abstract**—Spectrum is always a kind of rare resource in wireless communication especially in wireless mesh networks (WMNs) which own the wireless connectivity backbone. But in most cases we seldom take full advantage of the spectrum. This problem can be alleviated by the cognitive radio paradigm that aims at devising spectrum sensing and management techniques, thereby allowing radios to intelligently locate and use frequencies other than those in the ISM band. In cognitive radio, channel sensing should be able to detect the signals from other systems which are using



the same frequency band in order to avoid the mutual interference, which is so important that determine the cognitive radio success. In this paper, we propose a channel sensing algorithm based on ART-2 (Adaptive Resonance Theory) neural networks which well satisfy the WMNs structure. Simulation results show that the proposed algorithm can give the more correct sensing results and remarkably improves the cognitive WMNs performance. Keywords—Wireless Mesh Networks; Cognitive; Neural Networks; ART-2;

# Cyclic Autocorrelation based Blind OFDM Detection and Identification for Cognitive Radio

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Abstract—Cognitive radio is considered as a promising technique to increase the utilization of limited spectral resource. The key issue in cognitive radio is to design a reliable spectrum sensing method that is able to detect the signal in the target channel as well as to recognize different signals. In this paper, focusing on classifying different OFDM signals, we propose a two-step detection and identification approach. The key parameters to separate different OFDM signals are the subcarrier spacing and guard interval. A simple but reliable peak detection method is adopted in the first step, while a peak searching method is used to determine the length of guard interval. Simulations are carried out in AWGN to verify the validation of the proposed method. It is shown that our method can satisfy the detection and identification requirement with a low false alarm probability. Keywords—cognitive radio; spectrum

# A Novel Power Control Algorithm for Cognitive Radio in Environmental Monitoring

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Abstract—Cognitive radio (CR) is a revolutionary technology of wireless mobile communication. Smart users can use the CR technology to sense the surrounding environment, search for available spectrum resources and access spectrum dynamically. Therefore, the efficiency of spectrum can

be improved and the capacity of wireless communication system will be increased. The cognitive radio technology is introduced in the environmental monitoring. And a novel power control algorithm is proposed. This algorithm is based on the interference temperature model, the game theory and the second degree iterative water-filling algorithm, which is applied to the environment monitor wireless network with the restricted energy, memory, computing and communication. The scenario simulations of the environmental monitoring based on the novel algorithm and the traditional one are performed, respectively. The results show that the novel algorithm can obtain favorable network performance while the computational time can be reduced notably. Keywords— Cognitive Radio; power control; Interference Temperature

# Analysis of Linear Receivers in a Target SINR Game for Wireless Cognitive Networks

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**Abstract**—Signal to Interference plus Noise Ratio (SINR) is a key parameter for every user in a wireless network. Different users with heterogeneous QoS requirements have different target SINR requirements. In cognitive radio (CR) networks, secondary users try to access the available spectrum in order to make successful transmissions. However, without proper regulation,

they may transmit at their maximum power to achieve the highest possible SINR, which can be even worse than the current wasteful static spectrum utilization. A target SINR game (TSG) is a powerful tool to regulate each secondary user's behavior, provide them with decent SINRs (i.e. close to their target SINRs) and simultaneously limit the interference they cause to primary users and other secondary users. The goal of this paper is to analyze the performance of the Matched Filter (MF) receiver and the linear MMSE receiver (LMMSE) in a TSG. As expected, the LMMSE shows several advantages in performance over the MF. **Index Terms**—Cognitive radios, target SINR game, game theory, Nash equilibrium, LMMSE receiver.

# Demodulation-Oriented Automatic Modulation

# Identification Algorithm

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**Abstract**—This paper presents a novel Automatic Modulation Identification (AMI) algorithm, named Demodulation-Oriented Automatic Modulation Identification (DAMI) algorithm, in Software Radios. DAMI algorithm may identify each modulated signal with a subset rather than one-to-one scheme because any scheme of a subset can employ the same demodulation algorithm. Aiming at AM, SSB, DSB, FM, OOK, PSK, QPSK, FSK, MSK and GMSK, the developed algorithm was simulated in the AWGN, Rician and Rummier channel, respectively. Simulation results showed that on condition of SNR of 15 dB DAMI algorithm's average running time decreased by 34.6% and its average correct identification rate increased by 7.0% at least in comparison with those of the Ordinary Automatic Modulation Identification (OAMI) algorithm. The DAMI algorithm takes on the main remarkable features of tolerable errors, and improved correct identification rate, and decreased identification time. Because of the Software Radios' specialties, DAMI algorithm is perfectly suitable for Software Radios. **Keywords**—AMI, Software Radio, demodulation, DAMI

# Traffic-demand Dynamic Spectrum Access

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**Abstract**—Cognitive Radio was deemed to an effective solution to the current shortage of spectrum resources. The most important part of the technique is open spectrum access. A naïve spectrum allocation between CR users may lead to significant interference and reduce and reduce the usage of the spectrum. In this paper, we first develop a graph-theoretical model to characterize the different traffic demands between CR users by using interfere graph, on the basis of traditional labeling system we propose a Traffic-demand algorithm base on the graph theoretical model, which can support the different traffic demands of CR users that change with time. Experimental results show that when the traffic demands of CR users are limited and change with time, our algorithm can dramatically improve the fairness and produce high efficiency of the spectrum allocation. **Keywords**—cognitive radio; open spectrum access; dynamic spectrum allocation ;

# Novel Implementation Issues in Spectrum Sensing for Cognitive Terminals

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Abstract—Cognitive Radios is emerging as a promising wireless paradigm, which will integrate benefits of software defined radio with a complete aware communication behavior. By detecting environments in real time and extracting interference characteristic in frequency spectrum, it can use flexible spectrum assign strategy for adaptive communications. To reach this goal many issues remain still open, such as powerful algorithms for sensing the external environment. In this paper, a novel algorithm based on twice spectrum correlation is presented and computational complexity is analyzed. Then the realization scheme is suggested and applied in frequencyhopping communication systems. Computer simulations show that it can exactly provide spectrum occupation in real time for cognitive terminals.

# Achieving Fair Performance by Power Allocation in Opportunistic Cooperation

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Abstract—We consider a wireless opportunistic network where one of the lucky users gets the opportunity to utilize the whole radio resource. However some of unlucky users keep silent during an unexpected time resulting from serious wireless environment. In this paper we propose an opportunistic cooperation protocol that can achieve equal performance measured in terms of outage probability, in which scheme the opportunistic user helps to relay what need retransmitting indicated by the destination and selects the appropriate power allocation to pursue fairness. We utilize superposition coding and successive interference cancellation at relay and destination, respectively. To improve the spectral efficiency we give a modified cooperation architecture involving two opportunistic users which work in turns. The simulation results have proved that the protocol obtains better performance compared with the conventional methods. Keywords—

# Novel study on Cooperative Spectrum Sensing for Cognitive Radio

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**Abstract**—In cognitive networks, cooperative spectrum sensing is employed to detect the presence of primary user quickly. In this paper, we study the improvement in sensing performance of a cognitive user  $U_1$  by allowing another cognitive user  $U_2$  to act as its relay. We derive the expression of SNR, and exploit the improvement in SNR to explain why the sensing performance may be improved by using cooperation. For the situation where there is power constraint for  $U_2$  when acting as a relay, we pay more attention to studying which parameter affects the sensing performance significantly. We first develop a new numerical model for sensing performance analysis, then we address that, the product of transmission power of cognitive radio and channel gain (between cognitive users) is tightly related to the value of SNR. Further, we propose an important parameter  $\beta$  that can be predetermined in a practical cognitive network, and show that  $\beta$  impact the sensing performance greatly. **Index Terms**—cognitive radio, cooperative relay, cooperative spectrum sensing, SNR.

## Design and Research of Fault Diagnosis Based on ANN for the Short-wave Radio

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Abstract: Artificial neural networks (ANN) are an information-processing method of a simulation of the structure for biological neurons. This paper makes a research on the approach of the artificial neural network for fault diagnosis of short-wave radios and constructs a fault diagnosis system of short-wave radios with ANN. And the system can analyze fault phenomena and detect radios fault. It will greatly improve the response to the radio fault diagnosis and maintenance efficiency. Key words: ANN back propagation MATLAB fault diagnosis

# An ACO Algorithm for Sum-Rate Maximization Problem in Opportunistic Spectrum Allocation

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[yangz@njupt.edu.cn](mailto:yangz@njupt.edu.cn) Abstract—A major problem of opportunistic spectrum allocation is how to maximize spectrum utilization given a bunch of available channels, i.e. sum-rate maximization problem, which is considered as a combinatorial optimization problem in our paper. Ant Colony Optimization (ACO) is a well-known metaheuristic in which a colony of ants cooperate in exploring good solutions to a combinatorial optimization problem. In this paper, we present an MMAS algorithm for maximizing spectrum utilization based on ACO. Experimental results show improvements over algorithms for the sum-rate maximization problem in opportunistic spectrum allocation. Index terms—opportunistic spectrum allocation; ant colony optimization; cognitive radio

# An ACO Algorithm for Sum-Rate Maximization Problem in Opportunistic Spectrum Allocation

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[yangz@njupt.edu.cn](mailto:yangz@njupt.edu.cn) Abstract—A major problem of opportunistic spectrum allocation is how to maximize spectrum utilization given a bunch of available channels, i.e. sum-rate maximization problem, which is considered as a combinatorial optimization problem in our paper. Ant Colony Optimization (ACO) is a well-known metaheuristic in which a colony of ants cooperate in exploring good solutions to a combinatorial optimization problem. In this paper, we present an MMAS algorithm for maximizing spectrum utilization based on ACO. Experimental results show improvements over existing algorithms for the sum-rate maximization problem in opportunistic spectrum allocation. Index terms—opportunistic spectrum allocation; ant colony optimization; cognitive radio

# Design of Multiphase Decimation Filter IP Core in Software Radio Receiver

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Abstract—This thesis introduces the design of multiphase decimation filter IP core in software radio receiver in detail. This soft-core could automatically generate Verilog-HDL code with optimized-structure according to input parameters. The application of this core can decrease the design time and cost, and improve reliability; it can also be combined with the dynamic reconfiguration FPGA technology to realize the aim that real-time changing filter performance in order to satisfy the flexible demand of software radio application system. Keywords—Software Radio; Multiphase Decimation Filter; IP Soft-Core; Dynamic Reconfiguration FPGA

# Implementation of an Embedded GPS Receiver Based on FPGA and MicroBlaze

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**Abstract**—A GPS receiver based on FPGA and MicroBlaze was developed. This kind of GPS receiver is made up of a RF Front- End and FPGA, with Nemerix NJ1006A and Xilinx XC2VP30 as its core chips. The RF Front-End chip NJ1006A receives the GPS signal and converts it to IF signal which is transferred to FPGA. The correlators array, C/A code generator, C/A code DCO and carrier DCO were analyzed and designed with Verilog hardware description language on FPGA. The algorithm of acquisition and tracking of GPS signal were discussed and implemented with MicroBlaze soft processor core in XC2VP30. Meanwhile, the MicroBlaze soft processor core is responsible for communicating with FPGA user logic via the interface named OPB Bus. A parallel correlator using three local replica C/A code was developed and implemented on this FPGA-based GPS receiver, which improved the acquiring efficiency and accuracy of the GPS receiver. The simulation and verification results of the algorithm of GPS receiver are provided. The results demonstrated that the availability and reliability of this kind of design scheme of GPS receiver works well.

**Keywords**—Global Positioning System (GPS); FPGA ; MicroBlaze; Parallel correlation; SoC

# Research on Characteristics of the Loss of UHF Propagation in Rectangular tunnels

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**Abstract**—When UHF propagation in a rectangular tunnel, the wavelengths are much smaller than the tunnel dimensions, so the fundamental (1, 1) modes and some lower order modes can realize long distant propagation together. Therefore, the effect of lower modes could not be



negligible, when analyzing the characteristics of the attenuation of UHF propagation. A multi-mode theory of waveguides was deduced in this paper, based on the mode theory of dielectric waveguides. Of prime interest are the loss natures for  $E_h$  and  $E_v$  modes along with frequency and with the shape of the tunnel section. This work would perfect part of theoretical results of the analysis of the dominant mode. Key words—rectangular tunnels, UHF, dielectric waveguides, wave modes

# Software Defined Radio GNSS Receiver

## Design over Single DSP Platform

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Abstract—Compare to previous GNSS receiver, this paper present software defined radio approach to implement the 12 channel GPS receiver in single DSP platform. Different with previous implementation, only single generic DSP chip will be used to complete all functions of a GPS receiver this time. The paper will introduce design of the system architecture, the realtime algorithms and show how to extend them to a GNSS receiver.

Keywords— GNSS Receiver, SDR, DSP

# FPGA Implementation of PN Code Acquisition Based on Software Radio

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Abstract—Spread spectrum technology can effectively solve the problems such as bad channel environment, multi-path fading etc between mobile station and subscribers. At present the research on the synchronization of PN code is more concentrated on how to implement fast acquisition. This paper introduces the sliding correlation method of PN code acquisition, gives out a serial and parallel acquisition method which is suitable for the mobile communication, and designs circuit under electronic design software Quartus II using VHDL. At last the accuracy of this method was

# An Efficient and Simple Method of MPSK Modulation Classification

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Abstract—This paper reports on a novel method that analyses signals'  $M$ th power spectrum to classify the modulation type of MPSK signals without carrier and symbol synchronization. Whether signals through the filter or not makes no difference to this method and the multi-path effect has less influence on it. Simulations show that the correct recognition rate up to 99% for SNR  $>-1$ dB. Keywords—MPSK; Soft Defined Radio; Modulation Classification; Fading Channels

# The Design and Evaluation of a MIMO-OFDM benchmark

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Abstract—The combination of MIMO (Multiple Input Multiple Output) and OFDM (Orthogonal Frequency Division Multiplexing) is considered as a key technology of next wireless communication. In this paper, a MIMO-OFDM benchmark compliant to IEEE 802.16e standard is developed and evaluated on YHFT-DSP/700. We provide a detailed analysis of computation requirement, parallelism, memory requirement and intrinsic operations of the core algorithms along with the interaction between the components. The goal of this paper is to provide a high-level analysis of the architectural implications of one protocol that need to be accommodated in a programmable platform for software defined radio. Keywords—MIMO-OFDM; IEEE 802.16e; Software Defined

# Design of Digital Intermediate Frequency DSSS System Based on Software Define radio

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Abstract—a full digital Intermediate Frequency (IF) differential BPSK direct sequence spread spectrum receiver platform is introduced. In the receiver the FPGA chip based hardware design is adopted and digital signal processing algorithm is combined to realize signal acquisition, tracking and demodulation. A scheme of a parallel combined serial acquisition

is applied, and the Tong decision algorithm is also applied in the receiver. The DDLL and the DPLL are used in order to track the PN phase and the carrier phase of received spread spectrum signals separately. The design is optimized to achieve less hardware complexity and finally implemented on Altera APEX FPGA EP20k using Verilog language and TMS320C5416. The architecture can be used in oversea mobile communication system. Keywords: DS spread spectrum; all digital IF; DSP; FPGA; software define radio, PN acquisition PN tracing

## A Parallel Architecture for Sampling Rate Conversion Based on Pseudo-DFT

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Abstract— A parallel processing architecture for sampling rate conversion in all-digital receiver is proposed in this paper. According to the time shifting property of the FT, the DFT of  $t$  desired output samples can be evaluated by the input samples. And the DFT-like transform in this constructed expression can be fast computed by the famous butterfly structure. To overcome the inherent saddle error of this approach, an overlapping input signal strategy is given.

Keywords— all digital receiver; sampling rate conversion parallel architecture; pseudo-DFT