2015 IEEE COMMUNICAION PROJECT LIST BASED ON MATLAB

1. Block-Diagonalization Precoding in aMultiuser Multicell MIMO System: Competition and Coordination

This paper studies a multiuser multicell system where block-diagonalization (BD) precoding is utilized on a per-cell basis. We examine and compare the multicell system under two operating modes: competition and coordination. In the *competition* mode, the paper considers a strategic noncooperative game (SNG), where each base-station (BS) greedily determines its BD precoding strategy in a distributed manner, based on the knowledge of the inter-cell interference at its connected mobile-stations (MS). Via the game-theory framework, the existence and uniqueness of a Nash equilibrium in thisSNG are subsequently studied. In the *coordination* mode, the BD precoders are jointly designed across the multiple BSs to maximize the network weighted sum-rate (WSR). Since this WSR maximization problem is nonconvex, we consider a distributed algorithm to obtain at least a locally optimal solution. Finally, we extend our analysis of the multicell BD precoding to the case of BD-Dirty Paper Coding (BD-DPC) precoding. We characterize BD-DPC precoding game for the multicell system in the competition mode and propose an algorithm to jointly optimize BD-DPC precoders for the multicell system in the coordination mode. Simulation results show significant network sum-rate improvements by jointly designing the BD or BD-DPC precoders across the multicell system in the coordination mode over the competition mode.

2. Energy Efficient Network Beamforming Design Using Power-Normalized SNR

In this paper, we adopt a novel efficiency measure, namely the received signal-to-noise-ratio (SNR) per unit power, in amplify-and-forward (AF) relay networks. The measure is addressed as the power-normalized SNR (PN-SNR). For several relay network scenarios, we solve the PN-SNR maximization problems and analyze the network performance. First, for singlerelay networks, we find the optimal relay power control scheme that maximizes the PN-SNR for a given transmitter power. Then, for multi-relay networks with a sum relay power constraint, we prove that the PN-SNR optimization problem has a unique maximum, thus the globally optimal solution can be found using a gradient-ascent algorithm. Finally, for multi-relay networks with an individual power constraint on each relay, we propose an algorithm to obtain the globally optimal solution and also a low complexity algorithm for a suboptimal solution. Our results show that with the same average relay transmit power, the PNSNR maximizing scheme is superior to the fixed relay power scheme not only in PN-SNR but also in the outage probability for both single and multi-relay networks. Compared with SNRmaximizing scheme, it is significantly superior in PN-SNR with moderate degradation in outage probability. Our results show the potential of using PN-SNR as efficiency measure in network design.

3. Wireless Information and Power Transfer in Multiuser OFDM Systems

In this paper, we study the optimal design for simultaneous wireless information and power transfer (SWIPT) in downlink multiuser orthogonal frequency division multiplexing (OFDM) systems, where the users harvest energy and decode information using the same signals received from a fixed access point (AP). For information transmission, we consider two types of multiple access schemes, namely, time division multiple access (TDMA) and orthogonal frequency division multiple access (OFDMA). At the receiver side, due to the practical limitation that circuits for harvesting energy from radio signals are not yet able to decode the carried information directly, each user applies either time switching (TS) or power splitting (PS) to coordinate the energy harvesting (EH) and information decoding (ID) processes. For the TDMA-based information transmission, we employ TS at the receivers; for the OFDMA-based information transmission, we employ PS at the receivers. Under the above two scenarios, we address the problem of maximizing the weighted sum-rate over all users by varying the time/frequency power allocation and either TS or PS ratio, subject to a minimum harvested energy constraint on each user as well as a peak and/or total transmission power constraint. For the TS scheme, by an appropriate variable transformation the problem is reformulated as a convex problem, for which the optimal power allocation and TS ratio are obtained by the Lagrange duality method. For the PS scheme, we propose an iterative algorithm to optimize the power allocation,

subcarrier allocation and the PS ratio for each user. Numerical results show that the peak power constraint imposed on each OFDM subcarrier as well as the number of users
in the system play a key role in the rate-energy performance comparison by the two proposed schemes.

4. System Capacity Improvement by On Request Channel Allocation in L TE Cellular Network

Long-term evolution (LTE) femtocells represent a very promising answer to the ever growing bandwidth demand of mobile applications. They can be easily deployed without requiring a centralized planning to provide high data rate connectivity with a limited coverage. Femtocell is low-power, very small and cost effective cellular base station used in indoor environment. However, the impact of Femtocells on the performance of the conventional Macrocell system leads interference problem between Femtocells and pre-existing Macrocells as they share the same licensed frequency spectrum. Frequency Reuse (FR) is an effort of manipulating the frequency resource allocation upon terminal's location to improve system capacity. In this paper, an efficient method to improve system capacity through interference management in the existing FemtoMacro two tier networks has been proposed. In the proposed scheme, a novel frequency planning for two tiers cellular
networks using frequency reuse technique is used where Macro base stations allocate frequency sub-bands for Femtocells users on-request basis through Femtocells base stations to cancel interference.

5. Resource Allocation in Hybrid Access Control Femtocell Network Targeting Inter-cell Interference Reduction

Inter-cell interference is the most challenging issue in femtocell deployment within the coverage of Macro base station (MBS). In this paper, we have explored the role of femtocell in LTE network and proposed a Dynamic Resource allocation management algorithm (DRAMA) for hybrid access control in spectrum shared OFDMA network to optimize the interference and increase the quality of service (QoS). The user gets the privilege to assign the femtocell service level ensuring a minimum level of QoS. A simulation setting is developed to study the performance of DRAMA in hybrid access control Femtocell network and compared it to closed and open access control.

6. BER analysis of conventional and wavelet based OFDM in LTE using different modulation techniques

Orthogonal Frequency Division Multiplexing (OFDM) and Multiple Input and Multiple Output (MIMO) are two main techniques employed in 4th Generation Long Term Evolution (LTE). In OFDM multiple carriers are used and it provides higher level of spectral efficiency as compared to Frequency Division Multiplexing (FDM). In OFDM because of loss of orthogonality between the subcarriers there is intercarrier interference (ICI) and intersymbol interference (ISI) and to overcome this problem use of cyclic prefixing (CP) is required, which uses 20% of available bandwidth. Wavelet based OFDM provides good orthogonality and with its use Bit Error Rate (BER) is improved. Wavelet based system does not require cyclic prefix, so spectrum efficiency is increased. It is proposed to use wavelet based OFDM at the place of Discrete Fourier Transform (DFT) based OFDM in LTE. We have compared the BER performance of wavelets and DFT based OFDM.

7. A Novel detection algorithm for performance analysis of MIMO-OFDM systems using equalizer over a Rayleigh fading channel

Multiple Input Multiple Output (MIMO) Orthogonal Frequency Division Multiplexing(OFDM) systems have recently emerged as key technology in wireless communication systems for increasing data rate and system performance. The effect of fading and interference can be combated to increase the capacity of the link. MIMO systems uses Multiple Transmit and Multiple Receive antennas which exploit the multipath propagation in rich scattering environment. The matrix channel plays a pivotal role in the throughput of a MIMO link since the modulation, data rate, power allocation and antenna weights are dependent on the channel gain. When data rate is transmitted at high bit rate, the channel impulse response can extend over many symbol periods which leads to Inter-Symbol Interference(ISI). ISI always caused an

issue for signal recovery in wireless communication. In order to reduce the complexity of MIMO system, various detection algorithm such as Zero forcing(ZF), Minimum Mean Square Error(MMSE), Maximum Likelihood(ML) and a novel algorithm namely Constant Modulus Algorithm(CMA) are proposed that reduce bit error rate(BER) via spatial multiplexing. QPSK modulation is treated here for simulation purpose.Simulations are done by MatLab that shows BER vs. signal-noise ratio (SNR) curve of Constant modulus algorithm(CMA) equalizer exceeds that of ZF, MMSE and ML equalizer. In this paper antenna configuration is used.

8. Improvement in ber performance by MMSE equalizer with MIMO OFDM

During the research equalizer is always a matter of strategies.When a signal is transmitted over a radio channel,it is subject to reflection,refraction and diffraction and also the type of modulation technique selected at transmitter.The communication environment changes quickly and thus introduce more complexity and uncrtainity to channel response.Ofdm is one of the best multiplexing technique which compensate intersymbol- interference as well as co- channel- interference.In wireless Communication ,scare resources and hence imposes a high cost on the high data rate transmission.fortunately,the emergence of multiple antenna system has opened another very resourceful dimension space,for information transmission in the air.It has been demonstrated that
multiple antenna system provides very promising gain in capacity without increasing the use of gain,throughput, spectrum,reliability,and less sensivity to fading,hence leading to a breakthrough in the data rate of wireless communication system.Since than multiple input multiple output(MIMO) system has become one of the major focuses in the research community of wireless communication and information theory.The study of performance limit of information system become very important,since it gives a lot of insights in understanding designing the practical MIMO system.In order to observe the effect of multipath fading channel on the transmitted signal,a whole digital communication system simulator is developed.Ofdm along with MIMO strategies are very good
to increase the capacity of the system and minimize to intersymbol-interference.MMSE equalizer under the multipath fading and MIMO strategy has improved Bit Error Rate Perfomence in this paper.

9. Performance Evaluation of Static Frequency Reuse Techniques for OFDMA Cellular Networks

The use of orthogonal frequency division multiple access (OFDMA) in Long Term Evolution (LTE) and WiMax cellular systems mitigates downlink intra-cell interference by the use of sub-carriers that are orthogonal to each other. Intercell interference, however, limits the downlink performance of cellular systems. In order to mitigate inter-cell interference, various techniques have been proposed. This paper examines one group of these techniques, static frequency reuse. We present a comprehensive comparison of Reuse-I, Reuse-3, fractional frequency reuse (FFR), and soft frequency reuse (SFR), with varying input parameters, such as inner radius and power ratios. System simulation is used to evaluate the overall system performance in terms of throughput and SINR are evaluated. In addition to the overall system performance, cell-edge user performance, whose performance is severely limited by interference from neighboring cells, for each technique is also evaluated.

10. Spectrum Sharing Scheme Between Cellular Users and Ad-hoc Device-to-Device Users

In an attempt to utilize spectrum resources more efficiently, protocols sharing licensed spectrum with unlicensed users are receiving increased attention. From the perspective of cellular networks, spectrum underutilization makes spatial reuse a feasible complement to existing standards. Interference management is a major component in designing these schemes as it is critical that licensed users maintain their expected quality of service. We develop a distributed dynamic spectrum protocol in which ad-hoc device-to-device users opportunistically access the spectrum actively in use by cellular users. First, channel gain estimates are used to set feasible transmit powers for device-to-device users that keeps the interference they cause within the allowed interference temperature. Then network information is distributed by route discovery packets in a random access manner to help establish either a single-hop or multi-hop route between two device-to-device users. We show that network information in the discovery packet can decrease the failure rate of

the route discovery and reduce the number of necessary transmissions to find a route. Using the found route, we show that two device-to-device users can communicate with a low probability of outage while only minimally affecting the cellular network, and can achieve significant power savings when communicating directly with each other instead of utilizing the cellular base station.

11. A Practical Cooperative Multicell MIMO-OFDMA Network Based on Rank Coordination

An important challenge of wireless networks is to boost the cell edge performance and enable multi-stream transmissions to cell edge users. Interference mitigation techniques relying on multiple antennas and coordination among cells are nowadays heavily studied in the literature. Typical strategies in OFDMA networks include coordinated scheduling, beamforming and power control. In this paper, we propose a novel and practical type of coordination for OFDMA downlink networks relying on multiple antennas at the transmitter and the receiver. The transmission ranks, i.e. the number of transmitted streams, and the user scheduling in all cells are jointly optimized in order to maximize a network utility function accounting for fairness among users. A distributed coordinated scheduler motivated by an interference pricing mechanism and relying on a masterslave architecture is introduced. The proposed scheme is operated based on the user report of a recommended rank for the interfering cells accounting for the receiver interference suppression capability. It incurs a very low feedback and backhaul overhead and enables efficient link adaptation. It is moreover robust to channel measurement errors and applicable to both open-loop and closed-loop MIMO operations. A 20% cell edge performance gain over uncoordinated LTE-A system is shown through system level simulations.

12. Downlink Resource Allocation for Next Generation Wireless Networks with Inter-Cell Interference

This paper presents a novel downlink resource allocation scheme for OFDMA-based next generation wireless networks subject to inter-cell interference (ICI). The scheme consists of radio resource and power allocations, which are implemented separately. Low-complexity heuristic algorithms are first proposed to achieve the radio resource allocation, where graph-based framework and fine physical resource block (PRB) assignment are performed to mitigate major ICI and hence improve the network performance. Given the solution of radio resource allocation, a novel distributed power allocation is then performed to optimize the performance of cell-edge users under the condition that desirable performance for cell-center users must be maintained. The power optimization is formulated as an iterative barrier-constrained water-filling problem and solved by using the Lagrange method. Simulation results indicate that our proposed scheme can achieve significantly balanced performance improvement between cell-edge and cell-center users in multi-cell networks compared with other schemes, and therefore realize the goal of future wireless networks in terms of providing high performance to anyone from anywhere.

13. Minimum Energy Channel Codes for Nanoscale Wireless Communications

It is essential to develop energy-efficient communication techniques for nanoscale wireless communications. In this paper, a new modulation and a novel minimum energy coding scheme (MEC) are proposed to achieve energy efficiency in wireless nanosensor networks (WNSNs). Unlike existing studies, MEC maintains the desired code distance to provide reliability, while minimizing energy. It is analytically shown that, with MEC, codewords can be decoded perfectly for large code distances, if the source set cardinality is less than the inverse of the symbol error probability. Performance evaluations show that MEC outperforms popular codes such as Hamming, Reed-Solomon and Golay in the average codeword energy sense.

14. Spectrum Sensing for Digital Primary Signals in Cognitive Radio: A Bayesian Approach for Maximizing Spectrum Utilization

With the prior knowledge that the primary user is highly likely idle and the primary signals are digitally modulated, we propose an optimal Bayesian detector for spectrum sensing to achieve higher spectrum utilization in cognitive radio networks. We derive the optimal detector structure for MPSK modulated primary signals with known order over AWGN channels and give its corresponding suboptimal detectors in both low and high SNR (Signal-to-Noise Ratio) regimes. Through approximations, it is found that, in low SNR regime, for MPSK (M >2) signals, the suboptimal detector is the energy detector, while for BPSK signals the suboptimal detector is the energy detection on the real part. In high SNR regime, it is shown that, for BPSK signals, the test statistic is the sum of signal magnitudes, but uses the real part of the phase-shifted signals as the input. We provide the performance analysis of the suboptimal detectors in terms of probabilities of detection and false alarm, and selection of detection threshold and number of samples. The simulations have shown that Bayesian detector has a performance similar to the energy detector in low SNR regime, but has better performance in high SNR regime in terms of spectrum utilization and secondary users' throughput.