SNR In MIMO OFDM Downlink System

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Abstract - The goal of future wireless communications systems is to provide a wide variety of high quality high-rate services with minimum requirements on spectrum, power consumption and hardware complexity. Toward this end, proper system structures as well as robust system designs are required to meet the challenges in wireless transmissions, such as multipath fading, limited spectrum resource, and interference. Recent research results have unveiled the multiple-input multiple-output (MIMO) system as a potential candidate to play a key role in future wireless.A MIMO wireless system is commonly deployed by using multiple transmit and receive antennas. Early work on multi-antenna systems involves the use of antenna arrays at the receiver to provide spatial diversity against the random destructive effect of fading. There is a recent rich literature on employing multiple antennas at the transmitter and achieving diversity through space-time coding when there is no channel state information at the transmitter (CSIT), or through transmit beam forming when there is perfect CSIT.

Key Words: *MIMO, OFDM, CSIT, transmitter and receiver*

1. INTRODUCTION

The use of multiple transmits and receive antennas also opens up the spatial domain for boosting data rate. While a flat-fading SISO Gaussian channel provides only a single narrow data pipe, a coherent MIMO channel can be represented as a set of parallel Gaussian channels and thus creates multiple data pipes for data transmission without additional power or spectrum an appealing feature to cope with the scarcity of wireless spectrum and the stringent power constraint on terminals. The gain in terms of ergodic capacity achieved by a coherent MIMO channel over that of aSISO channel is termed the spatial multiplexing gain, which can be reaped using the Bell Laboratories Layered Space-Time (BLAST) architecture. Interestingly, MIMO spatial multiplexing systems harness the randomness of the channel, whereas MIMO space-time coded systems combat it. Although both spatial multiplexing and diversity gains can be simultaneously achieved by a MIMO system, there is a basic tradeoff between them. In bandwidth-limited wireless networks, the spatial diversity of networks arising from the use of antenna arrays at both the transmitter and the receivers can be exploited to mitigate the interference between multiple users and increase the overall performance. Beam forming is a spatial diversity technique used at both the transmitter and the receiver to increase the signal-to-interference-plus-noise ratio (SINR) of each user when multiple users share a common bandwidth. We consider the joint optimization of transmit power, linear transmit beam formers at the base station, and linear receive beam formers at the mobile users in a wireless multiple-input-multiple-output (MIMO) downlink system.

2. OBJECTIVES

1) To study and compare the performance of SIMO MISO and MIMO.
2) To study and compare the performance using power control and without power control.
3) To analysis outage probability.
4) To study of optimal power control in Rayleigh fading.

Optimal Downlink Power Assignment:

Various criteria in downlink weighting vector design are key to exploiting the full potential of smart antenna systems and providing optimal power allocation when the orientations of the weighting vectors are known. Equalize each user's downlink performance by significantly reducing output power. Since base station power amplifiers are the most expensive subsystems, this approach can lead to significant cost reduction for a base station. A smart antenna system can be used to extend base station range, reduce base station cost, mitigate fading, and increase system capacity and performance. The problem of maximizing the sum of bit rates from the base station to multiple terminals is studied. For wireless communications, the problem of maximizing the smallest SINR (signal-to-interference plus noise ratio) among all links originating from the base station to multiple terminals is more interesting. Downlink spatial signatures of all active terminals can be acquired from the uplink, the problem of finding the best set of downlink weighting vectors (DWV) is much more complicated than its uplink counterpart, mainly because the Optimal weight design problem for the uplink can be treated individually while designing the DWVs for all terminals, they are intertwined and cannot be separated. An objective function that is appropriate for real communication applications, that is, in voice communications, it is appropriate to consider a worst-case signal-to-interference-to-noise ratio (SINR) or the minimum SINR for all individuals. . terminals that share the same carrier frequency and time slot. [1]

Beam forming Design Based On Group Maximum SINR:

In the MIMO downlink beam forming problem in which a multi-antenna base station transmits data to many users. Each user is assigned multiple data streams and has multiple antennas on their receiver. The maximum signal-interference-plus-noise ratio (SINR) filter group (GSINR-FB) as our beam former that exploits receiver diversity through cooperation between a user's data streams. Each user's data flows are subject to an average SINR constraint, which has many important applications in wireless communication systems and serves as a good metric to measure quality of service (QoS). The GSINR-FB also optimizes the average SINR of its output. Based on GSINR-FB beam former, a SINR balance structure for optimal power allocation that simplifies the complicated power allocation problem to a linear one. The joint optimization problem of beam forming and power allocation for multi-user, multiple-input, multiple-output (MIMO) downlink channel is considered. Transmit and receive beam forming is used to suppress multi-user interference and exploit the diversity of multiple antennas. Power allocation in the transmitter is done to efficiently utilize the available transmit power. The general channel to completely eliminate multi-user interference on each receiver. This zero-forcing approach suffers from the noise enhancement problem, because it eliminates multi-user interference by ignoring noise. Therefore, performance can be improved if a balance can be found between multi-user interference suppression and noise improvement. Group power allocation, which restricts power equality across each user's data streams, benefits from low-complexity power allocation schemes. This constraint is later relaxed allowing the power of individual data streams to be adjustable. In addition to GSINR-FB based beam forming, this per-flow power allocation scheme is new compared to group power allocation and has better performance than it. One is to minimize the total transmitted power while satisfying a set of average SINR objectives. The other is to maximize the achieved average SINR ratio with respect to the target under a full power constraint. Based on the uplink and downlink duality, GSINR-FB-based beam forming and power allocation matrices can be calculated.[2] [4]

Power Allocation:

The analysis of single cell downlink relies on the uplink-downlink duality which is readily interpreted by the Lagrange duality in convex optimization. The duality is observed for the MIMO multiuser ad hoc network setting, the duality is extended to the multicell setting. A reformulation of the max-min problem is analyzed by conic optimization and a heuristic algorithm is provided. The max-min problem is tackled from the transmit power minimization perspective and a hierarchical iterative algorithm. A distributed algorithm which possesses geometrically fast convergence rate. The designed algorithm, though converging to the optimal solution, requires instantaneous power update within the coordinated cluster through backhaul. The max min SINR problem from the transmit power minimization perspective, and compares several cooperation strategies by assuming a two-cell model with homogeneous channel setting. These asymptotic approximations are used to compute the asymptotic power which only relies on statistical channel information. Intuitively, in a large-scale multiple antenna system, the optimal powers for different users would approach different deterministic values and the obtained power can be utilized for optimal beam former design with local CSI. Moreover, by using nonlinear Perron- Frobenius theory and random matrix theory, we observe an effective network for the dual network and an effective network for the primal network, which capture the characteristic of the power control effect in the large system setting. The established effective network is further leveraged to provide a distributed algorithm with fast convergence rate. Consider a joint optimization of beam forming and power control in a coordinated multicell downlink and employ the max-min formulation to enforce egalitarian fairness across users. The network duality is interpreted via a nonlinear Perron-Frobenius theoretic characterization and utilized to design a distributed algorithm to obtain the optimal solution.[2-5]

3. SYSTEM MODEL AND PROPOSED FORMULATION

Multiuser Massive MIMO downlink system is considered which serves M users at the output side. We have taken a model in which N transmitter antennas and M users (M<N).The block diagram model is used for exhaustive explanation of working model. Zero-Forcing precoding scheme is exploited to combat the level of multi-user interference (MUI). Wn is considered as the precoded vector, all the precoded vectors are reordered and converted into time domain with transform (IFFT) operation and added up by a cyclic prefix (CP) which can to control the intersymbol interference (ISI).All the symbols are converted into analog signals by DAC.Signals propagated over a FSF channel. At the receiver section the converse process is followed up and signals are transmitted among different M users.

Bayesian inference methodology:

It is considered a multi-user massive MIMO downlink system serving M users on the output side. We have taken a model in which N transmitting antennas and M users (M<N). Shown is the block diagram that provides the step-by-step process of our system. Zero Forcing Precoding Technique is utilized in reducing multi user interference MUI and out of band radiation (OBR).

$$R_M = H_N w_N + noise$$

Where H is MIMO channel matrix and w is precoded vectors. Noise vector is assumed as Gaussian distributed over the channel. We applied Bayesian process model to find the parameters automatically with a good balance between desired solution and data fitting error. Also we utilized quasi-constant magnitude solution with finite boundaries to reduce PAPR problem. Truncated Gaussian mixture model is applied as prior model for reducing PAPR followed GAMP strategy which has ability to reduce computational complexity. Expectation step is used to for updating of hidden parameters and maximization step is applied for updating of deterministic parameters. The hybrid algorithm set up is going to reduce PAPR level, so that data rate increases. The precoding helps in reducing MUI and OBR.The hybrid ETG algorithm works well under wireless indoor and outdoor environments where scattering level is high. Applying big O notation strategy to compute the computational complexity ETG is better compared to FITRA algorithm. We used CCDF function for measuring PAPR level which is used for computing PAPR level achievement in later part of the paper.ETG algorithm substantially reduces computation complexity and PAPR level. The specifications we applied in simulation in given in the later part of the paper.

4. CONCLUSION

OFDM based massive mimo downlink model has been implemented by balancing the tradeoff joint PAPR and SER using ETG algorithm. The fundamental objective is to minimize MUI, OBR, joint-PAPR and SER. is being considered. The optimal solution has been found by applying hybrid ETG algorithm .From the performance analysis, hybrid ETG able to converge in less iteration when compared with existing algorithms. And also achieved low PAPR solution proposed ETG algorithm exhibits lowest PAPR of 0.65 dB FITRA PAPR is 2.24dB and clipping PAPR is 4.23dB and ZF scheme PAPR of 9 dB compared with other techniques. This proposed model utilized DOF from several numbers of antennas at the base station to reduce PAPR in the signal. Hence it is concluded that proposed ETG algorithm performed well for balancing better tradeoff between SER and joint-PAPR.

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