MIMO BROADCAST CHANNELS WITH COORDINATION OF BASE STATION FOR DATA TRANSMISSION

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ABSTRACT

Analyze the interference in OFDM/OQAM systems and introduce a precoder based on signal-to-leakage-plus-noise ratio (SLNR) to overcome the effect of interference on the system. Since scheduling changes the spatial transmit signal processing with each time slot, information from neighboring base stations is required for data encoding. This can, in theory, be accomplished by a high-capacity backhaul network through which the base stations exchange channel state information (CSI) and other control signals.

Keywords: Power Consumption, Numerical and Closed form, Observation

I INTRODUCTION

Wireless communications is, by any measure, the fastest growing segment of the communications industry. As such, it has captured the attention of the media and the imagination of the public. Cellular phones have experienced exponential growth over the last decade, and this growth continues unabated worldwide, with more than a billion worldwide cell phone users projected in the near future. Indeed, cellular phones have become a critical business tool and part of everyday life in most developed countries, and are rapidly supplanting antiquated wireline systems in many developing countries. In addition, wireless local area networks are currently poised to supplement or replace wired networks in many businesses and campuses. Many new applications, including wireless sensor networks, automated highways and factories, smart homes and appliances, and remote telemedicine, are emerging from research ideas to concrete systems. The explosive growth of wireless systems coupled with the proliferation of laptop and palmtop computers indicate a bright future for wireless networks, both as stand-alone systems and as part of the larger networking infrastructure. However, many technical challenges remain in designing robust wireless networks that deliver the performance necessary to support emerging applications. In this introductory chapter we will briefly review the history of wireless networks, from the smoke signals of the Pre-industrial age to the cellular, satellite, and other wireless networks of today. We then discuss the wireless vision in more detail, including the technical challenges that must be overcome to make this vision a reality. We will also describe the current wireless systems in operation today as well as emerging systems and standards. The huge gap between the performance of current systems and the vision for future systems indicates that much research remains to be done to make the wireless vision a reality.

In practical cellular systems, explicit CSI in the form of channel coefficients is usually not available at the transmitter. Consequently, the base stations choose the precoders based on implicit CSI that is fed back from the users. In 3GPP LTE, for instance, the mobile users feedback a Precoding Matrix Indicator (PMI), a Rank Indicator (RI), and up to two Channel

Quality Indicators (CQI) with the option for narrowband or wideband reporting. While these reports are based on a predefined fixed codebook of precoders, the base stations can

Employ arbitrary precoders as long as they can map the CQI report, which is computed assuming a fixed codebook, to the CQI under the channel-dependent precoder. Furthermore, if instantaneous CSI is unavailable at the transmitter, one can still use statistical CSI for the precoder design for the joint design of precoders in a network of multiple transmitters; such statistical CSI still needs to be exchanged among the base stations

II RELATED WORK

2.1 Multiple Input Multiple Output (MIMO) Systems

MIMO systems are defined as point-to-point communication links with multiple antennas at both the transmitter and receiver. The use of multiple antennas at both transmitter and receiver clearly provide enhanced performance over diversity systems where either the transmitter or receiver, but not both, have multiple antennas. In particular, recent research has shown that MIMO systems can significantly increase the data rates of wireless systems without increasing transmit power or bandwidth. The cost of this increased rate is the added cost of deploying multiple antennas, the space requirements of these extra antennas (especially on small handheld units), and the added complexity required for multi-dimensional signal processing. Recent work in MIMO systems includes capacity of these systems under different assumptions about channel knowledge, optimal coding and decoding for these systems, and transmission strategies for uncoded systems.

2.2 Fading

For Fades, i.e. when the channel fades between any transmit-receive antenna pair are independent and identically distributed, is a multiple of the identity matrix. Thus without loss of generality, we could choose $c = [1, 0, 0, \cdots, 0]T$. Fades there is no gain from using multiple transmit antennas. However the magnitude of the average received SNR is directly proportional to the number of receive antennas. Hence multiple receive antennas improve average received SNR with Fading.

2.3 Space-Time Codes

The very high throughput predicted by information theory. As we saw earlier, if the transmitter knows the channel it is possible to transform it into several parallel non-interfering SISO channels and the codec technology for SISO channels is well established. However if the transmitter does not know the instantaneous channel, inherently multi-dimensional codes are required. Codewords are now long matrices instead of vectors.

2.4 Smart Antennas

Smart antennas generally consist of an antenna array combined with signal processing in both space and time. The spatial processing introduces a new degree of freedom in the system design with enormous potential to improve performance, including range extension, capacity enhancement, higher data rates, and better BER performance we have seen that multiple antennas at the transmitter and/or receiver can provide diversity gain as well as increased data rates through space-time signal processing. Alternatively, sectorization or phased array techniques can be used to provide directional antenna gain at the transmit or receive antenna array. This directionality can increase the signaling range, reduce delay-spread (ISI) and flat-fading, and suppress interference between users. In particular, interference typically arrives at the receiver from different directions. Thus, directional antennas can exploit these differences to null or attenuate interference arriving from given directions, thereby increasing system capacity. The reflected multipath components of the transmitted signal also arrive at the receiver from different directions, and can also be attenuated, thereby reducing ISI and flat-fading. The benefits of directionality that can be obtained with multiple antennas must be weighed against their potential diversity or multiplexing benefits, giving rise to a multiplexing/diversity/directionality tradeoff analysis.

2.5 MIMO Channel Capacity

This section focuses on the Shannon capacity of a MIMO channel, which equals the maximum data rate that can be transmitted over the channel with arbitrarily small error probability. Capacity versus outage defined the maximum rate that can be transmitted over the channel with some nonzero outage probability. Channel capacity depends on what is known about the channel gain matrix or its distribution at the transmitter and/or receiver. Throughout this section it is assumed that the receiver has knowledge of the channel matrix H, since for static channels a good estimate of H can be obtained fairly easily.

2.6 MIMO Diversity Gain: Beam Forming

The multiple antennas at the transmitter and receiver can be used to obtain diversity gain instead of capacity gain. In this setting, the same symbol, weighted by a complex scale factor, is sent over each transmit antenna, so that the input covariance matrix has unit rank. This scheme is also referred to as MIMO beam forming. A beam forming strategy corresponds to the precoding and receiver matrices described being just column vectors: As indicated, the transmit symbol x is sent over the antenna with weight .On the receive side, the signal received on the antenna is weighted.

III SIMULATION

Two-phase schemes with instantaneous CSI at the transmitter require two feedback phases as the users have to feedback channel coefficients in the first phase and stabilized SINRs in the Second phase. Feedback of the supported rate, however, is not necessary by virtue of perfect CSI at the transmitter. All other schemes require a single feedback phase, either for CSI Acquisition (genie and gambling) or SINR feedback. Those algorithms based on average channel information at the base station have to augment the SINR report with the supported Rate. Two-phasescheduling with eigenbeamforming requires a single feedback phase and no backhaul communication at all.

Furthermore, all CSI is acquired in the uplink. The necessary feedback from the user equipment, namely, the SINR and the rate, are already part of current networks such as the CQI reports in 3GPP LTE. If instead of eigenbeamforming the base stations employ precoders which maximize the average SLNR, they have to broadcast the active user to neighboring cells, introducing additional signaling and overhead. However,

all backhaul communication is of finite word-length and the amount is independent of the number of users or antennas such that each base station simply broadcasts a single integer.

Moreover, no average CSI needs to be exchanged among base stations. The implementation of both algorithms is the same for average and perfect CSI such that they seamlessly transition between the two and the same hardware and software can be used at all base stations. Genie DPC outperforms all other Schemes, however, each user has to estimate and feed back the interference channels to all base stations and the backhaul communication grows quadratically in the number of cells and linearly in the number of users and antennas. In contrast, DPC with two-phase scheduling neither requires neither knowledge of interference channels nor any backhaul communication. Unfortunately, the requirement of perfect CSI at the transmitter might be infeasible for practical networks

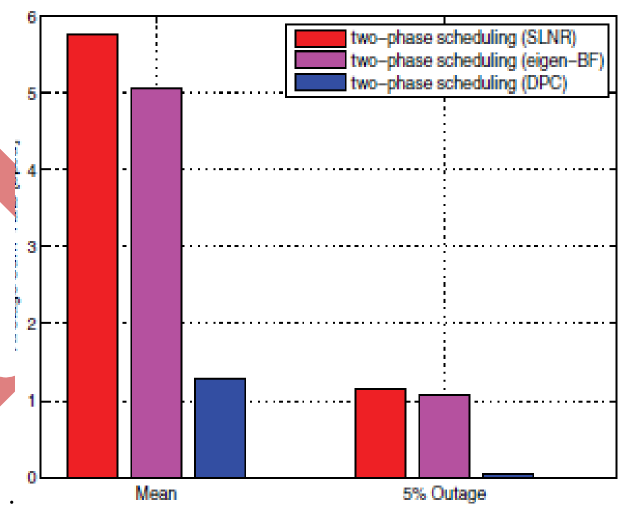

Fig 01: Average Sum-Rates In Bits Per Channel Use Of Consideration Preceding Schemes With Average CSI At The Transmitter

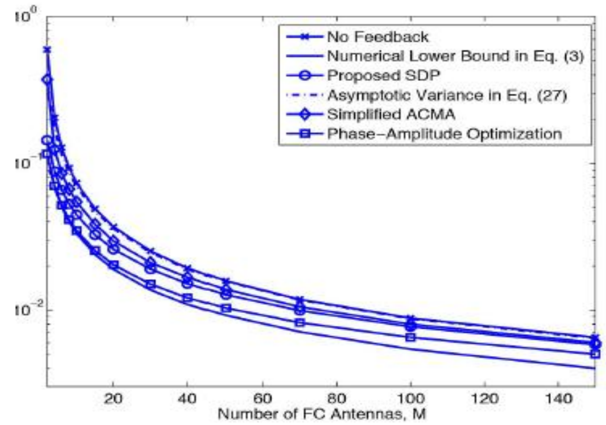

Fig: 02 Performance of Antenna

IV IMPLEMENTATION

In network MIMO, all base stations can transmit data to all users and the whole network effectively represents a MIMO broadcast channel (BC) with distributed antennas. Interference can then be exploited by jointly processing the user data, though symbol level synchronization is necessary among the base stations. Whether the feedback channel is digital or analog, there are bound to be errors either in the received feedback at the sensors or in how the phase shift is actually implemented. Furthermore, the wireless channel may change during the time required for calculation and feedback of , so even if the phase shifts are implemented perfectly at the sensors, they may no longer be valid for the current channel.

In this section, we evaluate the impact of errors in the sensor phase shifts on the estimation accuracy. A distributed WSN with single-antenna sensors that observe an unknown deterministic parameter corrupted by noise. The low-complexity sensors apply a phase shifts (rather than both a gain and phase) to their observation and then simultaneously transmits the result to a multi-antenna FC over a coherent MAC. One advantage of a phase-shift-only transmission is that it leads to a simpler analog implementation at the sensor.

The FC determines the optimal value of the phase for each sensor in order to minimize the ML estimation error, and then feeds this information back to the sensors so that they can apply the appropriate phase shift. The estimation performance of the phase-optimized sensor network is shown to be considerably improved compared with the non-optimized case, and close to that achieved by sensors that can adjust both the transmit gain and phase.

V CONCLUSION AND FUTURE WORK

The most common approach to mitigating this intercell interference in a particular cell is to make available CSI from neighboring base stations. This, however, requires new and expensive infrastructure which is accompanied by additional error and delay sources. Hence, we presented novel scheduling and precoding techniques that employ DPC to serve multiple users per cell and single-layer beam forming to serve a single user per cell. We investigated a distributed network of single antenna sensors employing a phase-shift and forward strategy for sending their noisy parameter observations to a multi-antenna FC. We presented two algorithms for finding the sensor phase shifts that minimize the variance of the estimated parameter, one based on a relaxed SDP and a closed-form heuristic algorithm based on the ACM approach. We analyzed the asymptotic performance of the phase-shift and forward scheme for both large numbers of sensors and FC antennas, and we derived conditions under which increasing the number of FC antennas will significantly benefit the estimation performance. The sensor selection problem was studied assuming either low or high sensor noise with respect to the noise at the FC. For low sensor noise, two algorithms were proposed, one based on linear programming with a relaxed integer constraint, and a computationally simpler greedy approach. For high sensor noise, we showed that choosing the sensors with the smallest noise variances was approximately optimal. Simulation studies of the proposed algorithms illustrate their advantages and the validity of the asymptotic analyses.

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