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BER AND CFO ANALYSIS OF MASSIVE MIMO SYSTEMS WITH QR-RLS TECHNIQUE

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Abstract - The service quality of OFDM system further may improve by using numerous antennas at transmit and receiving side to provide spatial diversity. MIMO system uses many antennas individually at the end of communication system i.e at source (transmitter) and sink (receiver) side. MIMO-OFDM uses advantage of diversity with the intention of using spatially alienated antennas. In latest epoch, there is an interest in combine the OFDM systems with the Multiple-Input Multiple-Output (MIMO) technique. The systems hence formed are well known as MIMO-OFDM system. MIMO-OFDM systems are at this time acknowledged as one of the most cutthroat technology for 4G mobile systems.

1. INTRODUCTION

The aim of digital communication systems is to transmit the information with highest reliability. The general architecture of such a system consists of three basic components: the transmitter, the wireless channel and the receiver as illustrated in Figure 1.1.

At the transmitter side, the source sends the information to the source encoder. The source encoder converts this signal into a binary data stream u of length Kb as short as possible to reduce redundancy and consequently to reduce the bandwidth requirement of the system. The bits stream u is encoded by a channel encoder which outputs a code word c of length Nb. The channel encoder introduces redundancy to the data to make it more reliable to control and correct the errors caused by noise or interference through the transmission channel. The channel coding rate is defined as Rc = Kb/Nb.

The coded data c is then mapped into a carrier signal s through the modulator. Thus, if we consider a M- aray modulation, digital modulation maps Q = log2(Mc) bits to one of the Mc possible coded symbols. The front-end radio-frequency includes many modules such as filter, amplifier and antennas.

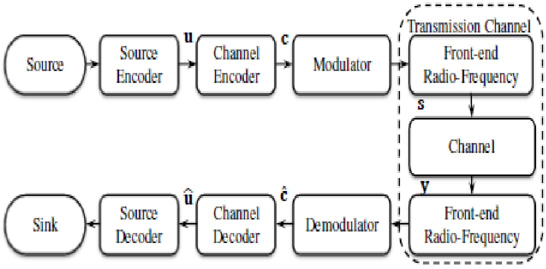

Figure 1: Block diagram of digital communication system

Then the signal passes through radio propagation channel where many perturbations may affect the signal such as noise, reflex ion, diffraction, Doppler Effect and multipath fading. Different channel models have been proposed in the literature to represent these variations.

At the receiver side, a corrupted version y of the transmitted signal s is received. The reverse signal processing happens. The demodulator and the decoder try to recover the original signal and generate an estimate of transmitted information ˆu and send it to the destination (sink).

2. LITERATURE REVIEW

This section discusses numerous research credentials and studied related to the signal detection of MIMO-OFDM System. We go through previous studies that are based on Signal Detection of MIMO-OFDM System and performance of OFDM System under CFO, Phase Noise and Timing Jitter. This chapter introduces the various techniques of Signal Detection of MIMO-OFDM System.

Some of the existing research works in channel estimation for massive MIMO, TDD and FDD system have considered the rich scattering environment. Under rich scattering environment, the channel estimation techniques used in the literature are discussed below.

H. Q. Ngo et al., a Cell-Free Massive MIMO (different info numerous yield) framework involves countless disseminated passageways (APs), which all the while serve an a lot more modest number of clients over a similar time/recurrence assets dependent on legitimately estimated channel attributes. The APs and clients have just a single reception apparatus each. The APs gain channel state data through time-division duplex activity and the gathering of uplink pilot sign transmitted by the clients. The APs perform multiplexing/de-multiplexing through conjugate beam-forming on the downlink and coordinated separating on the uplink. Shut structure articulations for individual client uplink and downlink throughputs lead to max-min power control calculations. Max-min power control guarantees consistently great administration all through the region of inclusion. A pilot task calculation mitigates the impacts of pilot sullying, yet power control is unquestionably progressively significant in such manner. Massive MIMO has significantly improved execution regarding an ordinary little cell conspire, whereby every client is served by a devoted AP, as far as both 95%-likely per-client throughput and resistance to shadow blurring spatial connection. Under uncorrelated shadow blurring conditions, the phone free plan gives almost fivefold improvement in 95%-likely per-client throughput over the little cell plot, and ten times improvement when shadow blurring is related.

Huang A. Burr et al. in this paper, we consider the uplink of sans cell huge MIMO frameworks, where countless conveyed single reception apparatus passageways (APs) serve an a lot more modest number of clients at the same time by means of restricted backhaul. Just because, we explore the presentation of register and-forward (C&F) in such a ultra-thick system with a reasonable channel model (counting blurring, path-loss and shadowing). By using the normal for path-loss, a low unpredictability coefficient determination calculation for C&F is proposed. We likewise give a covetous AP determination technique for message recuperation. Moreover, we contrast the presentation of C&F with some other promising straight systems for conveyed monstrous MIMO, for example, little cells (SC) and most extreme proportion consolidating (MRC). Numerical outcomes uncover that C&F lessens the backhaul load, yet additionally fundamentally expands the framework throughput for the symmetric situation.

H. Al-Hraishawi et al. in this paper, the unfavorable impacts of intra-cell pilot defilement for physical layer secure correspondence in subjective multi-client huge numerous information different yield (MIMO) frameworks with underlay range sharing are researched. The channel gauges at the essential base-station (PBS) and auxiliary base-station are gotten by utilizing non-symmetrical pilot successions transmitted by the essential client hubs and optional client hubs, separately. Henceforth, these channel appraisals are influenced by intra-cell pilot sullying. Besides, an inactive multi-receiving wire busybody is thought to spy upon either the essential or auxiliary secret transmissions. In this specific circumstance, a physical layer security procedure is provisioned for the essential and auxiliary transmissions by means of fake commotion age at the PBS and zero-compelling preorders. For this framework set-up, the normal and asymptotic feasible mystery rate articulations are inferred in shut structure, and in this manner, the mystery rate debasement due to intra-cell pilot sullying is evaluated. Our examination uncovers that a physical layer secure correspondence can be provisioned for both essential and auxiliary enormous MIMO frameworks even with channel estimation mistakes and pilot defilement.

V. D. Nguyen et al., in this paper, the detrimental effects of intra-cell pilot contamination for physical layer secure communication in cognitive multi-user massive multiple-input multiple-output (MIMO) systems with underlay spectrum sharing are investigated. The channel estimates at the primary base-station (PBS) and secondary base-station are obtained by using non-orthogonal pilot sequences transmitted by the primary user nodes and secondary user nodes, respectively. Hence, these channel estimates are affected by intra-cell pilot contamination. Furthermore, a passive multi-antenna eavesdropper is assumed to be eavesdropping upon either the primary or secondary confidential transmissions. In this context, a physical layer security strategy is provisioned for the primary and secondary transmissions via artificial noise generation at the PBS and zero-forcing precoders. For this system set-up, the average and asymptotic achievable secrecy rate expressions are derived in closed-form, and thereby, the secrecy rate degradation due to intra-cell pilot contamination is quantified. Our analysis reveals that a physical layer secure communication can be provisioned for both primary and secondary massive MIMO systems even with channel estimation errors and pilot contamination.

R. Zhao et al., this paper examines the physical layer security issue of psychological decipher and-forward hand-off systems over Nakagami-m blurring channels. We consider the handing-off correspondence between one auxiliary client (SU) source and one SU goal by utilizing a pioneering transfer choice from numerous SU transfers and sharing the authorized range of different essential clients (PUs) in the underlay arrange. While the transmission between the SUs forces impedance on every PU, the handed-off transmission is caught by one SU meddler. Without the busybody's channel state data, the hand-off determination depends on the biggest channel addition of transfer to-goal connect, which is thought to be obsolete because of input delay. We infer the definite likelihood of non-zero mystery limit and the precise mystery blackout likelihood (SOP) in the shut structure. Besides, we determine the asymptotic SOP in two distinct cases, and unequivocally demonstrate the impacts of framework parameters on the mystery decent variety request and the mystery assorted variety gain, individually. Both asymptotic investigation and reenactment results demonstrate that the mystery execution can be improved by expanding either the quantity of transfers or the Nakagami parameter of the authentic hand-off channels, while the mystery decent variety addition disintegrates as the quantity of the PUs increments.
Supraja Eduru et al., in massive Multiple Input Multiple Output (MIMO) systems, spatial correlation is one of the factors, which significantly affects the bit error rate (BER) performance. Therefore, in this paper, linear detection is employed with different decomposition techniques to improve the performance. At a BER of 10-3, with Zero Forcing (ZF) using Singular Value Decomposition (SVD), the channel gain is doubled by doubling the order of the MIMO system when compared to Cholesky and QR decomposition. Further, the BER remains unchanged for Minimum Mean Square Error (MMSE) detection irrespective of the type of decomposition techniques used. However, it is also observed that for 32×32 MIMO system, at a BER of 10-3, MMSE provides nearly 10 dB to 15 dB channel gain when compared to ZF.

3. ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING(OFDM) SYSTEM

Orthogonal Frequency Division Multiplexing may be a style of signal modulation that divides a high data rate modulating stream placing them onto many slowly modulated narrowband close-spaced subcarriers and during this method is a smaller amount sensitive to frequency selective weakening. Orthogonal Frequency Division Multiplexing or OFDM is a modulation format that is being used for many of the latest wireless and telecommunications standards. OFDM has been adopted within the Wi-Fi arena wherever the standards like 802.11a, 802.11n, 802.11ac and more. It has also been chosen for the cellular telecommunications customary LTE / LTE-A, and additionally to the current it's been adopted by different standards such as WiMAX and many more.

OFDM is a style of multicarrier modulation. An OFDM signal consists of variety of closely spaced modulated carriers. When modulation of any form - voice, data, etc. is applied to a carrier, then aspect bands detached either side. It’s necessary for a receiver to be able to receive the whole signal to be able to successfully demodulate the data. As a result when signals are transmitted near each other they need to be spaced so the receiver will separate them using a filter and there must be a guard band between them. This is not the case with OFDM. Although the sidebands from every carrier overlap, they will still be received while not the interference that might be expected because they are orthogonal to each another. This is achieved by having the carrier spacing equal to the reciprocal of the symbol period.

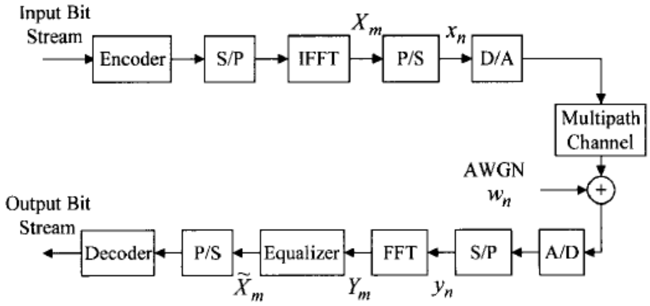

Figure 2: A baseband block diagram for an OFDM system

To see how OFDM works, it is necessary to look at the receiver. This acts as a bank of demodulators, translating every carrier right down to DC. The ensuing signal is integrated over the symbol period to regenerate the data from that carrier. The same demodulator additionally demodulates the opposite carriers. because the carrier spacing capable the reciprocal of the symbol period means that they will have a whole number of cycles in the symbol period and their contribution can total to zero - in different words there's no interference contribution.

4. MIMO GOES MASSIVE

In both SU-MIMO and MU-MIMO, theoretically, the more antennas the transmitter and/or receiver are equipped with, the larger the scale on which the spatial domain can be exploited. This leads to better performance in terms of the above-mentioned MIMO advantages. Let the number of base station antennas grow without limit in MU-MIMO scenarios, the first important phenomenon is that the effects of additive receive noise and small-scale fading disappear, as does intra-cellular interference among users. The only remaining impediment is inter-cellular interference from transmissions that are associated with the same pilot sequence used in channel estimation

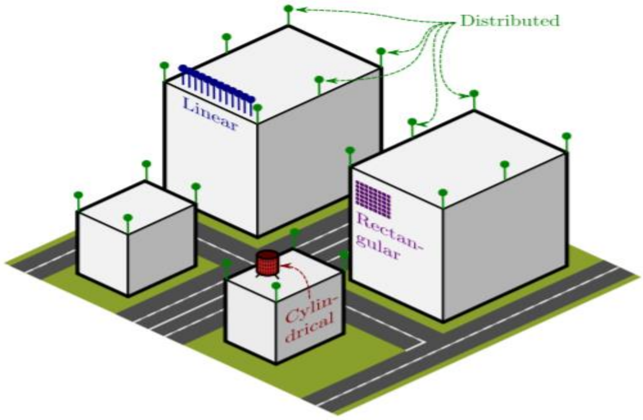

Figure 3: Illustration of possible deployments of massive MIMO antenna arrays

The throughput per cell and the number of terminals per cell are independent of the cell size, the spectral efficiency is independent of the system bandwidth, and required transmit energy per bit vanishes. Scaling up MIMO provides many more degrees of freedom in the spatial domain than any of today’s systems. This rescues us from the situation that wireless spectrum has become congested and expensive, especially in frequency bands below 6 GHz. In contrast to conventional MU-MIMO with up to eight antennas, we call MIMO with a large number of antennas “massive MIMO”, “very-large MIMO” or “large-scale MIMO”.

As a simple illustration, Figure 3 shows possible deployments of massive MIMO antenna arrays. Antennas can be co-located in a linear, planar or cylindrical structure, or can be placed in a distributed manner. In massive MIMO operation, we consider an MU-MIMO scenario, where a base station equipped with a large number of antennas serves many terminals in the same time-frequency resource. Processing efforts can be mostly made at the base station side, and terminals have simple and cheap hardware. Until now, many theoretical and experimental studies have been done in the massive MIMO context, e.g.,. These studies have shown that massive MIMO can greatly improve spectral efficiency while decreasing radiated output power by at least an order of magnitude. In addition, real-time massive MIMO test beds are being implemented and demonstrations reported. Among these contributions, the research work in this thesis has a focus on real massive MIMO channels.

5. CONCLUSION

In TDD system, the signals are transmitted in the same frequency band for both uplink and downlink channel but in different time slots. Hence, uplink and downlink channels are reciprocal. The estimation of the uplink channel is preferred, as the number of pilots used to estimate the channel is less compared to the downlink channel. Most published research works have considered the rich scattering propagation environment in uplink TDD mode (i.e., number of scatterers tend to be infinity or more than the number of BS antenna and users in the cell).

On the other hand, the current cellular network is dominated by FDD system. Hence, it is of importance to explore channel estimation of massive MIMO system in FDD Mode also. In FDD systems, every user obtains CSI by sending the pilot signal and the obtained CSI is fed back to the BS for precoding. The quantity of pilots required for downlink channel estimation is corresponding to the quantity of BS reception apparatuses, while the quantity of pilots required for uplink channel estimation is relative to the quantity of clients.

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