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Performance Comparison of Massive MIMO & Conventional MIMO using Blind Channel Estimation Technique

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ABSTRACT*:* Multiple-Input Multiple-Output (MIMO) technology is becoming nature for wireless communications. This Paper presents to the Blind channel estimation of Massive MIMO, And it has been incorporated into wireless broadband standards like LTE and Wi-Fi. It allows the use of multiple antennas at the transmitter and the receiver to increase the data rate, capacity and the link reliability. Multiple antennas at the transmitter and the receiver are used to exploit the multipath propagation. One of the key techniques that enable MIMO is Orthogonal Frequency Division Multiplexing (OFDM). In OFDM, the multiple symbols are transmitted in parallel on the same frequency band. Each symbol is transmitted sequentially in a narrow frequency band for a greater period of time which enables the receiver to pull each symbol. Even if the symbol is degraded, it is possible to receive one of the best symbol for the fact that it is been transmitted for a longer duration which is important while working in MIMO environment. By using OFDM technique the spectral efficiency can be improved and also by using more number of antennas the overall efficiency of the system can be increased.

Furthermore, Multi-User MIMO is one of the current practices which have advantages over conventional point to point MIMO as it works with cheap single-antenna terminals, it does not require a very rich scattering environment and the resource allocation is simplified because each terminal uses all of the time-frequency bins. MU-MIMO can support multiple users simultaneously which uses the same channel thereby enhancing the spectral efficiency of the spectrum usage. As originally envisioned, MU-MIMO uses roughly equal number of antennas at the transmitter and the receiver and frequency division duplex, which is not a scalable technology and also as the signal is transmitted on the same frequency band; it is likely to have more interference at the receiver which requires a complex hardware to recover the particular signal. These drawbacks can be eliminated by the use of “massive MIMO” which allows asymptotic orthogonality and uses simple processing methods.

KEYWORDS: Antenna, LTE, OFDM, MIMO

I. INTRODUCTION

MIMO is an acronym for ‘Multiple Input Multiple Output’. In this technology, more than one antenna is mounted at each end to improve the performance of a communication system. Multiple-input- multiple-output (MIMO) exploits spatial diversity by having several transmit and receive antennas. This arrangement provides significant improvement in the data throughput and link range without increasing the input power and the bandwidth for transmission. On the other hand, OFDM (Orthogonal Frequency Division Multiplexing) is a technique for encoding the digital data on multiple carrier frequencies prior to transmission. The main advantage of OFDM is that it can overcome a lot of transmission losses like narrowband interference, high frequency attenuation, multi-path fading etc. When both of these technologies are combined together, new technique is emerged namely MIMO-OFDM. The MIMO-OFDM technique emerged out to be a key technique for next generation wireless communication systems. A very high data transfer rate with minimum (ideally zero) bit error rate is desirable for the 4G wireless communication systems. When MIMO technology is employed in any communication system, then the BER response, channel capacity and bandwidth diversity of that system are improved in a desired manner. The BER and channel capacity of the system are respectively inversely and directly proportional to the number of antennas. Hence, when the number of antennas is increased in a MIMO-OFDM system, BER gets reduced and channel capacity gets increased. The MIMO-OFDM technique is widely used in wireless communication in frequency selective fading channels due to its high spectral efficiency and its ability to divide a frequency selective fading channel into multipath flat fading sub-channel (subcarriers). This is the main reason for MIMO-OFDM technology being considered as the best technology for next generation wireless systems.

MIMO system has multiple antennas at the transmitter and receiver side to transmit multiple data streams simultaneously in wireless communication systems. In theory, it is shown that with a large number of antennas, system can improve performance significantly in terms of data rate, capacity, and link reliability and radiated energy efficiency. In MIMO technology, first conventional point to point MIMO is developed, after that multi-user MIMO is developed. Multi-user MIMO provides many advantages over point to point MIMO, but it has some disadvantages like it roughly requires equal number of Base station antennas and terminals and also it is not a scalable technology. So due to these problems after multi-user MIMO, Massive MIMO (also known as Large Scale MIMO) is developed which gives huge advantages over point to point MIMO and multi-user MIMO.

II. RELATED WORK

David Neumann et.al [01] this method proposed for Channel estimation. And it is a crucial part of massive MIMO systems and without accurate channel state information, the promising array and multiplexing gains cannot be achieved. In typical propagation environments, the linear minimum mean squared error (LMMSE) channel estimate significantly outperforms the simple least squares estimate. This is due to the fact that LMMSE estimation can reduce interference in the training phase and thus reduce the impact of pilot-contamination. Unfortunately, LMMSE estimation comes at a high computational cost and is thus prohibitive for a large scale system. Review existing methods for approximate low-complexity LMMSE estimation and show that it is crucial to consider the estimation of the covariance matrices when designing the estimator.

Nayan A. Patadiya et.al [02] described MIMO is an emerging technology in wireless communication that increases capacity largely compared to MIMO systems. & Massive MIMO, also known as very-large MIMO with Massive MIMO, multi-user MIMO (MU-MIMO) has been considered where a base station is equipped with a large number (say, tens to hundreds) of antennas and that serves many single-antenna users in the same time-frequency resource. However, multiple antennas require multiple RF chains which consists amplifier, mixer, ADC, filter, etc. So due to multiple RF chains, cost and hardware complexity of the system is increased. Hence in order to reduce cost and hardware complexity, antenna selection techniques is used that minimizes the complexity with nearly same capacity.

Xiang Gao et.al [03] this method proposed for Massive MIMO, also known as very-large MIMO or large-scale antenna systems, is a new technique that potentially can offer large network capacities in multi-user scenarios. With a massive MIMO system, we consider the case where a base station equipped with a large number of antenna elements simultaneously serves multiple single-antenna users in the same time-frequency resource. So far, investigations are mostly based on theoretical channels with independent and identically distributed (i.e.) complex Gaussian coefficients, i.e., i.e. Rayleigh channels. Here, this paper investigates how massive MIMO performs in channels measured in real propagation environments. Channel measurements were performed at 2.6 GHz using a virtual uniform linear array (ULA) which has a physically large aperture, and a practical uniform cylindrical array (UCA) which is more compact in size, both having 128 antenna ports. Based on measurement data, we illustrate channel behaviour of massive MIMO in three representative propagation conditions, and evaluate the corresponding performance. The investigation shows that the measured channels, for both array types, allow us to achieve performance close to that in i.e. Rayleigh channels. It is concluded that in real propagation environments we have characteristics that can allow for efficient use of massive MIMO, i.e., the theoretical advantages of this new technology can also be harvested in real channels.

III. PROPOSED SYSTEM

According to this block diagram, it shown that the high rate data stream is given to space-time processor where it is converted in to sub-streams through simple multiplexing or space-time coding for OFDM modulation and transmission through different antennas. Then, these space-time processed data streams after passing through OFDM modulators are transmitted through a number of antennas. A suitable technique is adopted for modulation depending upon the channel conditions and other transmission factors like available power and distance of transmission etc. Then, these transmitted data streams are received through a number of antennas at the receiving end. The number of antennas at both the ends may be same or different. Further, after OFDM demodulation, the data is present into its original form for further processing at the receiving end.

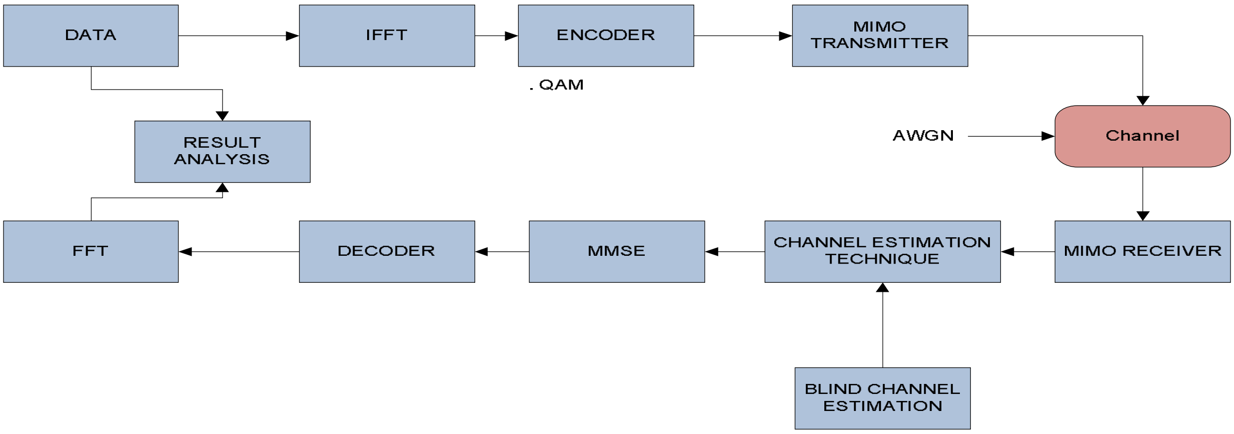

Fig.1 Block Diagram of the proposed System

A. Inverse Fast Fourier Transform (IFFT)

It an efficient implementation of FFT/IFFT processor for multiple input multiple outputs orthogonal frequency division multiplexing (MIMOOFDM) systems with variable length is presented. This paper opts memory scheduling and Multipath Delay Commutate (MDC) as the hardware architecture. RadixNs butterflies are used at each stage, where Ns denote the number of data streams, so that there is only one butterfly is used in each stage. For area and time optimization and to reduce power consumption, the Read Only Memories (ROM‟S) which is used to store twiddle factor is replaced by complex multiplier. The design reduces the use of logic elements & 100% utilization rate is achieved. The result shows the advantages of the proposed scheme in terms of area and power consumption.

B. MIMO Transmitter

Multiple-Input Multiple-Output (MIMO) technology is a wireless technology that uses multiple transmitters and receivers to transfer more data at the same time. MIMO technology takes advantage of a radio-wave phenomenon called multipath where transmitted information bounces off walls, ceilings, and other objects, reaching the receiving antenna multiple times via different angles and at slightly different times.

MIMO technology leverages multipath behaviour by using multiple, “smart” transmitters and receivers with an added “spatial” dimension to dramatically increase performance and range. MIMO allows multiple antennas to send and receive multiple spatial streams at the same time. MIMO makes antennas work smarter by enabling them to combine data streams arriving from different paths and at different times to effectively increase receiver signal-capturing power. Smart antennas use spatial diversity technology, which puts surplus antennas to good use. If there are more antennas than spatial streams, the additional antennas can add receiver diversity and increase range.

Blind channel estimation:

C. Blind channel estimation

Blind Channel Estimation Using the statistical properties of received signals, the channel can be estimated without resorting to the preamble signals. Such a blind channel estimation technique has an advantage of not incurring an overhead with training signals. However, it often needs a large number of received symbols to extract statistical properties. Furthermore, their performance is usually worse than that of other conventional channel estimation techniques that employ the training signal. It consists of a filter, zero-memory nonlinear estimator, and adaptive algorithm. Depending on how the zero-memory nonlinear estimator is constructed, it can be classified as Sato algorithm, CMA (Constant Modulus Algorithm), or Godard algorithm. However, Buss gang algorithm is rarely used in OFDM systems since it is not easy to find a nonlinear estimator appropriate for the received signal in the OFDM system.

D. Channel estimation technique

The performance of channel estimation technique for multiple-input multiple-output MIMO) systems mainly from the point of view of estimation theory by computing a lower bound on the estimation error and studying its properties. Then, based on the insight obtained from the analysis, efficient channel estimators are designed that perform close to the derived limit. The proposed channel estimators compute the long-term features of the multipath channel model through a subspace tracking algorithm by identifying the invariant (over multiple OFDM symbols) space/time. modes of the channel (modal analysis). On the other hand, the fast-varying fading amplitudes are tracked by using least-squares techniques that exploit temporal correlation of the fading process (modal filtering). The analytic treatment is complemented by thorough numerical investigation in order to validate the performance of the proposed techniques. MIMO-OFDM with bit-interleaved coded modulation and MIMO-turbo equalization is selected as a benchmark for performance evaluation in terms of bit-error rate.

IV. **EXCEPTED RESULT**

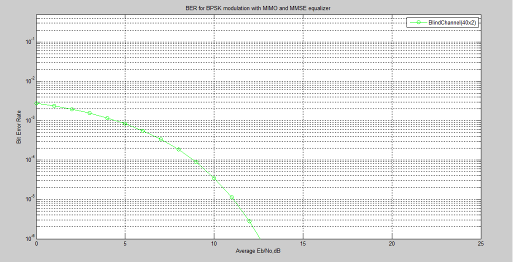

Fig 1 SNR vs. Bit error Rate plot for 40*2 MIMO

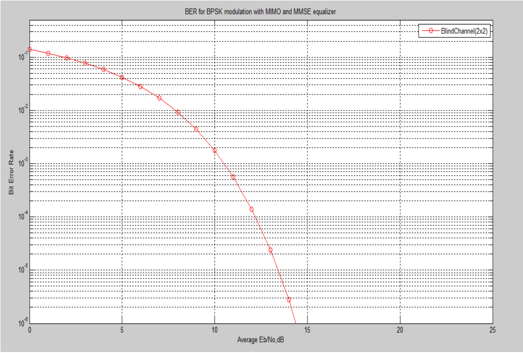

Fig 1 SNR vs. Bit error Rate plot for 2*2 MIMO

V. **CONCLUSION**

This paper presented to investigation shows that in the studied real propagation environments we have characteristics that allow for efficient use of massive MIMO. In all scenarios, the singular value spread decreases considerably, and becomes more stable around a smaller value over the measured bandwidth, when using a large number of antennas. This indicates that massive MIMO provides better orthogonality between channels to different users and better channel stability than conventional MIMO.

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