Review on MIMO-OFDM with Modulation Improvement

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Abstract **-** MIMO-OFDM innovation changes over recurrence specific MIMO channel into number of parallel level blurring MIMO channel. It on a very basic level streamlines the baseband beneficiary handling by taking out the need of complex MIMO equalizer. In this paper each one of the techniques that give expanded BER execution to OFDM has been talked about. Straight Heavenly body Precoding (LCP) with subcarrier gathering procedure has been acquainted with overcome the multipath blurring that outcome from ordinary OFDM. Later on Nonlinear Constellation Precoding (NCP) without subcarrier gathering is acquainted with supplant the LCP system. NCP system is versatile to assorted variety channels and decent variety arrange regardless of their number which isn't if there should arise an occurrence of LCP conspire. At end Nonlinear Constellation Precoding (NCP) with subcarrier gathering is presented. As a conclusion, in future if similar methodology are actualized in the OFDM part of MIMO-OFDM framework it will give enhanced BER than customary MIMO-OFDM framework

Keywords *- BER, MIMO, OFDM*

I. INTRODUCTION

The key challenge faced by future wireless communication systems is to provide high-data-rate wireless access at high quality of service (QoS). Combined with the facts that spectrum is a scarce resource and propagation conditions are hostile due to fading (caused by destructive addition of multipath components) and interference from other users, this requirement calls for means to radically increase spectral efficiency and to improve link reliability. Multiple-input multiple-output (MIMO) wireless technology seems to meet these demands by offering increased spectral efficiency through spatial multiplexing gain, and improved link reliability due to antenna diversity gain. Even though there are still a large number of open research problems in the area of MIMO wireless, both from a theoretical perspective and a hardware implementation perspective, the technology have reached a stage where it can be considered ready for use in practical systems. In fact, the first products based on MIMO technology have become available. Multiple-transmit multiple-receive antenna, i.e., multiple-input multiple-output (MIMO), techniques can basically be split into two groups: space time coding (STC) and space division multiplexing (SDM).

A. MIMO

MIMO stands for Multiple Input Multiple Output which enhanced the performance of the wireless system by using multiplexing and diversity gain method. It provides the energy per bit which enhances the data rate by multiplexing gain and reduces the BER by diversity gain when fading is occurred. The combination of MIMO and OFDM provides effective wireless communication. MIMO has some different formats which are used in the wireless communication that are following:

- SISO
- SIMO
- MISO
- MU-MIMO

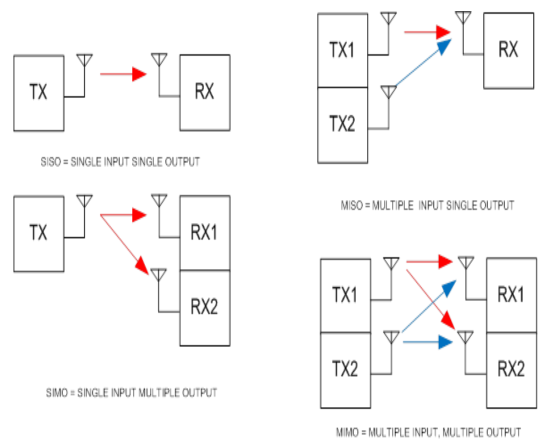

Figure 1.1 Different types of MIMO

B. Orthogonal Frequency Division Multiplexing (OFDM)

Orthogonal frequency division multiplexing (OFDM) is an effective technique to mitigate ISI(Inter Symbol Interference). OFDM is a frequency division multiplexing (FDM) scheme utilized as a digital multi-carrier modulation method. In other words OFDM is frequency division multiplexing of multi-carriers, which are orthogonal to each other i.e. they are placed exactly at the nulls in the modulation spectra of each other. This makes OFDM spectrally more efficient. In OFDM data is divided into several parallel data streams or sub-channels, one for each sub carrier which are orthogonal to each other although they overlap spectrally Each sub-carrier is modulated with a conventional modulation scheme(such as QAM or PSK) at a low symbol rate maintaining total data rates similar to conventional single-carrier modulation schemes in the same bandwidth. In today's scenario MIMO is very useful with the combination of OFDM system. Exploiting the flexibility of MIMO systems in order to have high data rates is an especially attractive research topic for future scheduling scheme designs and their applications. Multiple-input multiple-output (MIMO) systems offer much larger channel capacity over traditional single-input single-output (SISO) system.

Types of OFDM

- Coded-OFDM
- Multiple input multiple output-OFDM
- Vector OFDM
- Wide-band OFDM
- Flash hopped OFDM

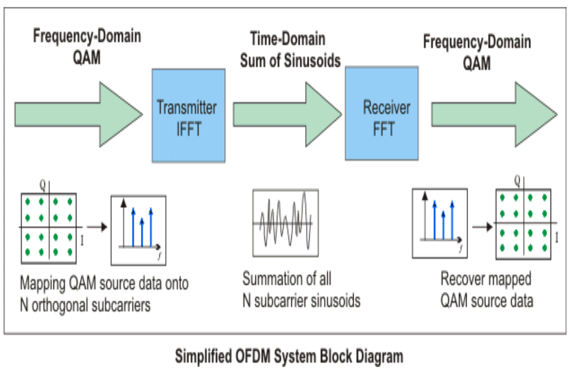

Figure 1.1 OFDM Block Diagram

II. RELATED STUDY

Deshmukh, et al analyzed the different digital modulation schemes like QPSK and BPSK. In this QAM is performed with the help of space time block codes. This method controls the errors by using time and spatial dimensions. OFDM system combines with antenna array at transmitters and receiver which enhance the diversity gain known as MIMO-OFDM. It improves the system capacity on time-variant and frequency selective channels. This method improves the BER rate [1]. MIMO-OFDM is used to avoid the cross talk mitigation. In this a channeled array is formed with the help of steel barriers. In these investigation effects of cross talk is discussed. It shows the effects of transducer misalignment on multi-channel capacity and data transmission rates [2]. MIMO-OFDM by using 4: 8 antenna and OSTBS encoder is propose which combines the different techniques and used to control the inter-symbol interference. Performance evaluation of the proposed system is done by using Bite error rate, signal to noise ratio, constellation plot and MSE [3]. Zheng, Beixiong, et al. Investigates the MIMO-OFDM with index modulation method which provides the flexible trade-off between spectral efficiency and error performance in 5G wireless communication. In this work author detects the interchannel interference which is a challenging task. It is done by using low complexity detectors which is based on Monte carlo theory. These detectors work on the sub-blocks level and sub-carriers level to reduce the complexity. [4]

Bhasker Gupta et. el. show the BER performance improvement of IEEE 802.11a LAN based OFDM systems using these equalizers. Two categories of channels are considered, namely frequency flat channels and frequency selective channels [5]. Basar, Ertugrul. et al. Investigates the MIMO-OFDM with index modulation method which provides the flexible trade-off between spectral efficiency and error performance in 5G wireless communication. In this work minimum means square error detector and maximum likelihood detector are proposed for performance investigation [6]

Masoomeh proposed about the nature of independent time-varying channels across different users in a multi-user wireless system provides multi-user diversity. In addition, multiple antennas that spatially separate the signals from different users can be used to provide multiple access gain. Combining fair scheduling and efficient antenna assignment, we can achieve the goal of fairness and maximum capacity [7]. Nihar Jindal et al. compare the capacity of dirty-paper coding (DPC) to that of time-division multiple access (TDMA) for a multiple-antenna (multiple input multiple-output (MIMO)) Gaussian broadcast channel (BC). They find that the sum-rate capacity (achievable using DPC) of the multiple antenna BC is at most min ( ) times the largest single user capacity (i.e., the TDMA sum-rate) in the system, where is the number of transmit antennas and is the number of receivers. This result is independent of the number of receive antennas and the channel gain matrix, and is valid at all signal-to-noise ratios (SNRs) [8].

Tobias Dahl et al. proposed about a new approach for direct blind identification of the main independent, singular modes, without estimating the channel matrix itself. The right and left singular vectors with maximum corresponding singular values are determined using payload data and are continuously updated while at the same time being used for communication.

The feasibility of the approach is demonstrated by simulating the performance over a noisy, fading time-varying channel [9]. Ravi Narasimhan analysis on spatial multiplexing systems in correlated multiple-input multiple-output (MIMO) fading channels with equal power allocated to each transmit antenna. Under this constraint, the number and subset of transmit antennas together with the transmit symbol constellations are determined assuming knowledge of the channel correlation matrices. They first consider a fixed data rate system and vary the number of transmit antennas and constellation such that the minimum margin in the signal to- noise ratio (SNR) is maximized for linear and Vertical Bell Laboratories Layered Space-Time (V-BLAST) receivers. They also derive transmit antenna and constellation selection criteria for a successive interference cancellation receiver (SCR) with a fixed detection order and a variable number of bits transmitted on each sub stream. They compared with a system using all available antennas, performance results show significant gains using a subset of transmit antennas, even for independent fading channels [10].

Author's Name	Year	Algorithm Used	Observations
Deshmukh et al	2018	Alamouti STBC	It improves the system capacity on time-variant and frequency selective channels. This method improves the BER rate.
Ashdown, Jonathan D., et al.	2018	MIMO-OFDM	It shows the effects of transducer misalignment on multi-channel capacity and data transmission rates.
Kumar, Arun et al	2017	MSE Equalizer	Performance evaluation of the proposed system is done by using Bite error rate, signal to noise ratio, constellation plot and MSE.
Zheng, Beixiong, et al	2017	index modulation	These detectors work on the sub-blocks levbel and sub-carriers level to reduce the complexity.
Basar, Ertugrul et al	2016	index modulation	In this work minimum meas square error detector and maximum likelihood detector are proposed for performance investigation.
Bhasker Gupta et al	2010	Equalization Algorithm	Two categories of channels are considered, namely frequency flat channels and frequency selective channels.
Masoomeh et al	2006	Packet Scheduling	Combining fair scheduling and efficient antenna assignment, we can achieve the goal of fairness and maximum capacity.
Nihar Jindal et al	2005	MIMO-OFDM	This result is independent of the number of receive antennas and the channel gain matrix, and is valid at all signal-to-noise ratios (SNRs).
Tobias Dahl et al	2004	Algebraic Power Method	The feasibility of the approach is demonstrated by simulating the performance over a noisy, fading time-varying channel.
Ravi Narasimhan et al	2003	Spatial Multiplexing	They compared with a system using all available antennas, performance results show significant gains using a subset of transmit antennas, even for independent fading channels.

III. CONCLUSION

In this paper recent improvement over OFDM system has been studied. If the same techniques are implemented in OFDM part of MIMO – OFDM system, it will provide improved BER than conventional MIMO – OFDM system.

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