International Journal of Advanced Research in Engineering Technology & Sciences ISSN: 2394-2819
April-2016 Volume 3, Issue-4
Email: editor@ijarets.org www.ijarets.org

Review on Modulation Technique Using Parameters of OFDM

Vandana Sharma
M. Tech Scholar
Department of ECE
RIMT Rayat Bhahara Group
Chidana, Haryana

Parveen Khanchi
Assistant Professor
Department of ECE
RIMT Rayat Bhahara Group
Chidana, Haryana

ABSTRACT:
Adaptive modulation finds its application in wireless data system which does not necessarily require a constant data rate. This allows the data rate to increase during good channel conditions and overall higher throughputs can be achieved. In order to accurately adapt the modulation scheme, the channel state must be known at the transmitter. An adaptive modulation scheme is proposed and simulated by MATLAB over a frequency-selective fading channel. Comparing with the conventional modulation scheme, this scheme has the advantage of low complexity. Meanwhile, it shows little attenuation of Mean Square Error (MSE) and Bit Error Rate (BER) performances according to the final simulation results, which is promising for practical applications.

KEYWORDS: Orthogonal Frequency Division Multiplexing, Adaptive modulation, bit error rate**.**

I. INTRODUCTION:

OFDM technology is a popular technique for transmission of signals over wireless channels, due to its many advantages such as the high spectral efficiency, robustness to frequency selective fading, and the feasibility of low-cost transceiver implementations [1].

In multiuser communications such as cellular systems, multiple access capability is required to transmit many signals simultaneously over the channel. In a simple frequency division multiplexing (FDM) scheme, non-overlapping frequency bands are allocated for multiplexing signals. These signals can be de-multiplexed by means of filtering at the receiver. The problem with

This kind of non-overlapping FDM is that at least twice the bandwidth of the original data signal is needed to transmit the multicarrier modulated signal. A more efficient and improved version of frequency multiplexing is orthogonal frequency division multiplexing (OFDM) [2, 3]. OFDM is a multicarrier modulation scheme in which a serial data stream is divided into several parallel bit streams, which are transmitted using a large number of orthogonal carriers. The available frequency band is divided into several channels, each used to transmit a narrowband data signal by independently modulating its carrier. In contrast to ordinary FDM, OFDM is made bandwidth efficient by allowing its sub channels to overlap. This is achieved when subcarrier tones are separated by multiples of 1/Ts, where Ts is the symbol duration of the signal in each subcarrier. OFDM could be efficiently implemented by using discrete Fourier transform (DFT) and inverse DFT (IDFT1) techniques [4,5]. During the beginning of 1990's, direct sequence code division multiple access (DS/CDMA) has received greater attention for commercial applications, especially for digital cellular mobile systems. Multiple access capability in DS/CDMA is achieved by allocating distinct codes to different users of the system. Although the signals of all users overlap and interfere with each other in a DS-CDMA system, the receiver may recover the individual signals by correlating the combined signal with the code of the desired user. If the codes are mutually uncorrelated (orthogonal), the original signal is ideally regenerated without any residual interference. In practice, even if the transmitted signals use orthogonal spreading codes, they often become correlated due to the effect of wireless channels. However, by designing these code sequences to have small cross-correlations, the interference from the other users is minimized. One way of achieving low cross correlation is to employ a PN sequence with relatively long period compared to the bit period, which appear like random codes. One disadvantage of a long code is that it requires very precise time base. Usually a short code system uses the same sequence for each data bit. DS/SS schemes rely on bandwidth expansion for supporting several users. Each user's signal bandwidth is expanded to G times the fundamental Nyquist bandwidth, permitting a maximum of K users, K≤G to transmit simultaneously. Unlike TDMA or FDMA, CDMA systems have a soft capacity limit [5-7]. Increasing the number of users gradually degrades the system performance due to increase in interference, whereas, with decreased number of users, performance improves. Multi carrier CDMA systems are based on the combination of orthogonal frequency division multiplexing (OFDM) with DS/CDMA. Section II provides the description of the MC-CDMA system model, where both the transmitter and the receiver are described. Basic characteristics of the mobile radio environment are introduced to highlight the constraints and behavior of the channel under consideration.

II. MULTIPLE INPUT MULTIPLE OUTPUT:

Multiple-Input Multiple-Output (MIMO) technology is a wireless technology that uses multiple transmitters and receivers to transfer more data at the same time. Wireless products with 802.11n support MIMO. This is part of the technology that allows 802.11n to reach much higher speeds than products without 802.11n.

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. Multipath is a natural occurrence for all radio sources. Radio signals bounce off objects and move at different speeds towards the receiver. In the past multipath caused interference and slowed down wireless signals. MIMO takes advantage of multipath to combine the information from multiple signals improving both speed and data integrity.

In radio, multiple-input and multiple-output, or MIMO, is the use of multiple antennas at both the transmitter and receiver to improve communication performance. It is one of several forms of smart antenna technology.

MIMO technology offers significant increases in data throughput and link range without additional bandwidth or increased transmit power. It achieves this goal by spreading the same total transmit power over the antennas to achieve an array gain that improves the spectral efficiency (more bits per second per hertz of bandwidth) or to achieve a diversity gain that improves the link reliability (reduced fading). Because of these properties, MIMO is an important part of modern wireless communication standards such as IEEE 802.11n (Wi-Fi), 4G, 3GPP Long Term Evolution, WiMAX and HSPA+.

III. ADAPTIVE MODULATION AND CODING:

Radio spectrum is the most precious resource in wireless communication. An increasing demand for higher data rates in wireless communication has made it essential to investigate methods to achieve higher data transmission efficiency. Ideas of adaptive modulation were suggested in 1960 but it did not receive a lot of attention because of the complexity of hardware implementation. Starting from1980, adaptive modulation scheme drew attention again and nowadays, adaptive modulation has been proposed for the cdma2000 1xEV-DO, IEEE 802.11 WLAN systems, and further future wireless communication standards. Adaptive modulation which helps to maximize the data rates that can be transmitted over wireless channels is one possible solution to achieve this demand.

Adaptive modulation finds its application in wireless data system which does not necessarily require a constant data rate. This allows the data rate to increase during good channel conditions and overall higher throughputs can be achieved. In order to accurately adapt the modulation scheme, the channel state must be known at the transmitter. This requires the channel quality to be estimated by the receiver and fed back to the transmitter. During this process, channel state information (CSI) might be out-dated due to delay between estimation and application when channel changes fast. Thus, the feedback delay of channel information becomes the limiting factor or performance criterion in adaptive modulation.

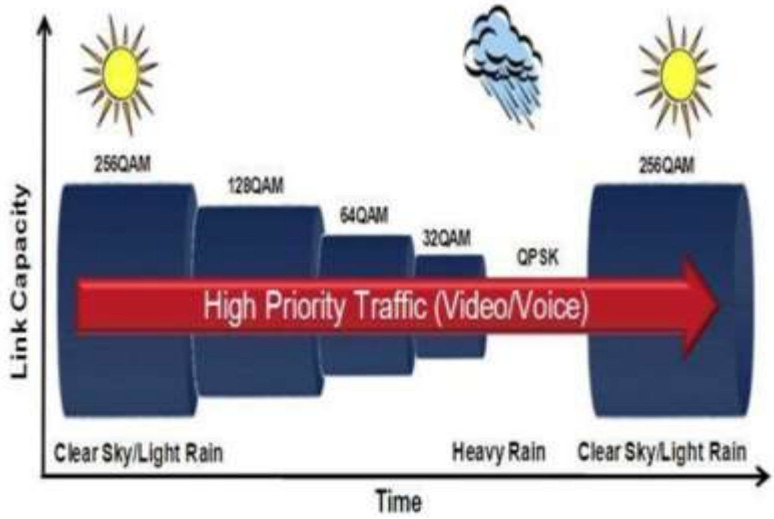

Fig 1Understanding Adaptive Modulation

IV. BACKGROUND THEORY:

The motivation behind taking up this topic is to create a better and more efficient MIMO OFDM System and develop an appropriate Modulation and Coding Scheme Selection Algorithm. An algorithm described in the base paper is the Spatially Adaptive Modulation and Coding (SAMC), which is based on a ppSNR look up table helps in determining which modulation scheme to choose.

In [8], MIMO OFDM systems, which can provide significant space diversity and combat multi-path fading, thus attracting increasing attention for the design of future broadband wireless communication systems have been describe. One enhancement technique commonly used in such systems is Adaptive Modulation and Coding (AMC) for link adaptation. With AMC, the modulation and coding scheme (MCS) is adaptively selected based on channel quality indication (CQI). Here, a comprehensive analysis of mapping between signal to interference plus noise ratio (SINR) fed beck by the mobile station and MCS to be used to transmit data, while taking into account hybrid ARQ (HARQ) operation is provided. Then we apply such mapping criteria to MIMO-OFDM systems and develop a systematic algorithm for MCS selection to maximize the system throughput.

Lots of AMC technologies have been investigated in the existing literature. A systematic evaluation on the channel capacity of various adaptive transmission technologies can be found in [9]. It is shown that when the transmission rate varies continuously according to the channel quality, the effect of varying the transmit power at the same time is very limited. In this paper, the authors propose an effective MCS selection approach for MIMO-OFDM systems based on prediction of successful transmission probability, taking into account the HARQ operation. The objective is to maximize the system throughput as well as maintain the block error rate (BLER) at an acceptable degree. They evaluate the performance of MIMOOFDM systems with enhancement of AMC and HARQ.

In [10], a downlink performance analysis of a link adaptation (LA) algorithm applied to a MIMO-OFDM Physical Layer (PHY), which is a popular candidate for future generation cellular communication systems, is provided. The new LA algorithm attempts to maximize throughput and adaptation between various modulation and coding schemes in combination with both space-time block codes (STBC) and spatial multiplexing (SM) is based on knowledge of SNR and H matrix determinant; the parameters which are found to have the most significant influences on the system throughput. They also compare results for adaptive MIMO-OFDM for the cases of the proposed LA algorithm, an algorithm based on SNR only, an algorithm based on SNR and H matrix determinant with fixed threshold levels for different SM modes and the optimal case.

This paper focuses primarily on the case of delay insensitive applications for which maximization of throughput is the criterion for adaptation, and examines the performance of an adaptive MIMO-OFDM system in a realistic outdoor environment. A sub-optimal LA algorithm based on 2 channel parameters, SNR and H matrix determinant, was proposed in [11] with predefined H matrix determinant threshold levels, and evaluated in terms of its performance over a channel trace. [11] Also showed that adjusting the threshold level governed a trade-off between the ability to avoid severe PER (outage) in some channels and the ability to more closely track the optimal throughput in others. This paper proposes a new LA algorithm referred to as LASD-V (Link Adaptation based on SNR and Determinant – Varying) with further throughput and error performance improvement. No fixed H matrix determinant threshold level is needed for LASD-V, and the SNR thresholds are no longer fixed but vary with the change of H matrix determinant.

The algorithms suggested in [8] and [10] were considered, but the SAMC algorithm used in our work offers superior performance.

In [12] a new link adaptation (LA) approach called the adaptive modulation, coding, and spatial mode (AMCS) scheme has been introduced for multiple-input multiple-output bit interleaved coded orthogonal frequency division multiplexing (MIMO BIC-OFDM) systems. The AMCS technique can provide both minimal performance degradation and significant throughput gain by controlling the spatial streams. This paper introduces a new parameter called instantaneous bit error rate (I-BER). Based on the I-BER, the proposed AMCS scheme chooses an appropriate modulation, coding, and spatial mode (MCS) type that improves the system performance while satisfying the quality of service (QoS) requirement. A simplified MCS type search method is also proposed, which allows the receiver to effectively select a MCS type and then send it back to the transmitter by using only a small amount of information bits.

To provide practical feedback information, a link quality indicator which is based on an instantaneous bit error rate (I-BER) is used. The evaluation of the I-BER may allow a rapid assessment of the system performance without full channel feedback. A system employing LA techniques uses feedback information to adapt to the channel conditions. Full channel state information at the transmitter is impractical because the feedback requirements in MIMO BIC-OFDM systems generally grow with the product of the transmit antennas, receiver antennas, and number of subcarriers.

To address the problem of receiver feedback overhead, we go for the SAMC algorithm that uses look up tables to decide which modulation scheme to be used.

Thus in [13], which serves as the base paper of our work, the authors propose a Spatially Adaptive Modulation and Coding (SAMC) scheme that uses the technique which applies AMC based on the post-processing Signal-to-Noise Ratio (ppSNR) yielded by the selected configuration and additional system constraints. The AMC algorithm uses fixed link tables defined by ppSNR regions for supportable spectral efficiencies.

Adaptive communication systems and cognitive radios have demonstrated the potential to increase spectral efficiency and provide flexible data rates in multipath fading channels. In [13], the authors apply Adaptive Modulation and Coding (AMC) that enables a radio to track the channel variations, and adapt its modulation and coding schemes to yield higher throughput while satisfying a system constraint. This improvement is achieved by transmitting at high information rates when the channel conditions are favorable and at lower rates when channel conditions are degraded. [13] also leverages the capabilities of Multiple Input-Multiple Output (MIMO) technologies that increase the reliability of wireless networks, without additional bandwidth or increased transmission power.

V. CONCLUSIONS:

In this paper, an adaptive scheme is proposed and its performance is numerically confirmed for the OFDM system proposed in the IEEE 802.16 standard. The results show that as compared with conventional modulation scheme, using this scheme can reduce the computational burden and suffer little attenuation of performances. Therefore, it is rather attractive for practical application in OFDM-based communication systems.

REFERENCES:

1. R. Prasad, OFDM for Wireless Communications Systems. Artech House, 2004.
2. S. Hara, R. Prasad, "Overview of multicarrier CDMA", IEEE Communications Magazine, Vol. 35, No. 12, pp. 126-133, Dec. 1997.
3. P. L. Kafle "Channel Coding, Multiuser Detection and Space-Time Diversity for Multicarrier CDMA Systems" Ph.D dissertation, University of CALGARY, ALBERTA, MARCH, 2003.
4. A. Baier, U. C. Fiebig, W. Granzow, W. Koch, P. Teder and J. Thielecke, "Design Study for a CDMA-based Third-Generation Mobile Radio System" IEEE Journal on Selected Areas in Communications, Vol. 12, No. 4, pp. 733-743, May 1994.
5. S. Kaiser, "OFDM-CDMA versus DSCDMA: Performance evaluation for fading channels", Proc. of IEEE ICC'95, pp. 1722- 1726, 1995.
6. R. L. Pickholtz, D. L. Schilling, and L. B. Milstein, "Theory of Spread-Spectrum Communications- A Tutorial" IEEE Trans. On Communications, Vol. COM-30, pp. 855-8٦4, May 1982.
7. S. Hara and R. Prasad, "Design and Performance of Multicarrier CDMA System in Frequency-Selective Rayleigh Fading Channels", IEEE Trans. on Vehicular Technology, Vol. 48, No. 5, pp. 1584-1595, Sept. 1999.
8. "Analysis of Modulation and Coding Scheme Selection in MIMO-OFDM Systems", Shiming Liu, Xing Zhang, Wenbo Wang; First International Conference on Communications and Electronics, 2006. ICCE '06.
9. M-S. Alouini and A. J. Goldsmith, "Capacity of Rayleigh Fading Channels Under Different Adaptive Transmission and Diversity-Combining Techniques", IEEE Trans Veh. Technol., vol. 48, pp. 1165-1181, July 1999
10. C. Han, S. Armour, A. Doufexi, K. H. Ng and Joe McGeehan, "Link adaptation performance evaluation for a MIMO-OFDM physical layer in a realistic outdoor environment," Vehicular Technology Conference, vol. 74, pp.1-5, Issue September 2006
11. C. Han, A. Doufexi, S. Armour, K. H. Ng, J. McGeehan, „Adaptive MIMO OFDMA for Future Generation Cellular Systems in Realistic Outdoor Environment, IEEE VTC Spring, May 2006
12. C. Shin, H. Kim, K. Jin, and H. Park, "High-throughput low-complexity link adaptation for MIMO BIC-OFDM systems," IEEE Trans. Commun.,vol. 59, pp. 1078-1088, Apr. 2011.
13. K. Song, A. Ekbal, J. M Cioffi, and S. T. Chung, "Adaptive Modulation and Coding (AMC) for Bit-interleaved Coded OFDM (BIC-OFDM)," IEEE Transactions on Wireless Communications, Vol. 5, No. 7, Jul. 2006
14. George D. Sworo, Moshe Kam, Kapil R. Dandekar, „Performance of Link Adaptation Algorithms and Reconfigurable Antennas for MIMO-OFDM Wireless Systems", 46th Annual Conference on Information Sciences and Systems (CISS), 2012, pp1-5