Literature Review of BER of Various MIMO-OFMD Communication Channels Using the 2-Order and 3-Order Chaotic Communication

Mr. Pankaj R. Ambilduke,
Student, Electronics & Communication Engineering Department, TIT College, Bhopal, Madhya Pradesh, India.

Prof. Manish Kumar Gurjar,
Head of Department, Electronics & Communication Engineering Department, TIT College, Bhopal, Madhya Pradesh, India.

Abstract **- Wireless technologies have become popular in recent years and usually applied in multimedia broadcasting, environment monitoring, mobile communication, etc. In all applications, keeping information accuracy is very important. To improve the security and accuracy of transmitted information, a wireless communication structure based on two-coupled chaotic communication system is proposed. Chaotic communication systems have been shown to provide certain advantages over conventional communication systems. Firstly, chaotic signals are much easier and faster to generate using a simple circuit. Hence, reduction in hardware cost is obtained. Secondly, the non-periodic and bifurcation behaviors of the chaotic signal can-not easily be intercepted and predicted thus an increase in system security is obtained.**

In addition, a large number of chaotic signals can be generated which is useful in multi-user environment. All kinds of schemes utilizing chaos properties have been proposed in last decade and showed to provide advantage in terms of security, capacity, and BER performance. However, there are still plentiful of issues to be resolved before chaos-based systems can be put into practical use.

Keywords**- OFMD, MIMO, Chaotic Communication System, Adaptive Beamforming, LMS (Least Mean Squares), LMS-LMS (LLMS).**

1. INTRODUCTION:

There is lot of work already done over the BER analysis of MIMO OFDM Systems. The phenomenon of multipath propagation has contributed significantly towards deterioration of quality of signal received in a wireless communication system [2]. Several techniques for multipath mitigation are in use in the current wireless communication technology standards [2]. With the steady rise in the number of wireless devices active in the environment, the concept of beam forming has gained popularity. When multiple communications are carried out simultaneously, then in multipath environment the interference from different directions will also increase. This multipath propagation causes the signal at the receiver to distort and fade significantly, leading to higher bit error rates (BER) [2]. To minimize the interference from different directions, smart antennas can be used at the receivers which form the beam in the direction of the incoming multipath and reject the interference coming from other directions [2].

To maximize the STC-OFDM system efficiency, the problem of CCI introduced by the space-time coding must be solved. The technique of beam forming, stemming from smart antenna is an effective method to remove co-channel interference (CCI) that is induced in the STC-OFDM system. Regarding beam forming techniques for STC-OFDM systems, some research attempts have been mainly focused on the transmit beam forming in downlink since the fact that download intensive services and wireless web browsing are to be introduced in the next generation. Receive beam forming which is widely applied to uplink of cellular mobile systems to suppress CCI and minimize fading effects. In this research work receive beam forming is used to improve the interference rejection capability of the proposed system. The scheme of MIMO wireless systems incorporating a beam forming method before space-time decoder can effectively mitigate interference.

2. LITERATURE SURVEY:

2.1 Introduction to Wireless Communication Systems:

The mechanism of communicating with the peoples according to their movements has been introduced significantly as the Guglielmo Marconi initially started to present the radio systems ability for providing the regular contact with the ships sailing of English Channel. This happened during the year 1897, and hence after that new methods of wireless communications as well as services have enthusiastically adopted by the different peoples all over the world [4].

Since from last decade, Particularly during the past ten years, the mobile radio communications industry has grown by orders of magnitude, fueled by digital and RF circuit fabrication improvements, new large-scale circuit integration, and other miniaturization technologies which make portable radio equipment smaller, cheaper, and more reliable. Digital switching techniques have facilitated the large scale deployment of affordable, easy-to-use radio communication networks [7].

Since the evaluation of wireless communication done, service capacity and quality are the most important task. In order to make sure the trusted communication over the mobile radio channel, the multipath fading must be overcome by the system, interference and polarized mismatch. All such challenges are increases towards the less power hand held transceivers. Even though the allocation of spectrums is done, higher data rate services damage and constantly growing number of users will be motivating the service providers in order seek the ways for increase their systems capacity [7].

There are two ways for improving capacity and reliability used antenna arrays. Initially first, adaptive beam forming and diversity combining can collaborate the signals from the multiple antennas such way that multipath fading is mitigated. The adaptive beam forming with the use of antenna arrays resulted into the enhancement through the interference reduction. The adaptive array use is an alternative for the expensive approach of the cell splitting which basically increasing the overall capacity by increasing base station sites numbers. Most of the adaptive arrays those are considered for this kind of applications which are situated at base station and performing the spatial filtering. [13] [14]

Multi-polarized adaptive arrays, sometimes called polarization-sensitive adaptive arrays, can also match the polarization of a desired signal or null an interferer having the same direction of arrival as the desired signal, if the two signals have different polarization states. If base stations or mobile units in a peer-to-peer system can match the polarization states of hand-held transceivers, link quality and reliability will be enhanced, and power consumption in the hand-held units will be reduced, increasing battery life. [16]

Multi-polarized arrays have been considered as a means of rejecting jammers in military applications [13] [15]. The potential of multi-polarized arrays for interference rejection in wireless communication systems has been investigated in recent years [15] [18]. This research indicates that 20 to 35 dB of interference rejection is possible if interfering and desired signals differ in either polarization state or angle of arrival.

However, neither measurements nor simulations have been reported that show the performance of multi-polarized adaptive arrays in typical mobile multipath channels. Some researchers have proposed diversity combining at handheld radios and shown that significant performance gains can be achieved. The use of adaptive antennas on handheld radios is a new area of research. In 1988, Vaughn [19] concluded that with then-current technology, adaptive beam forming would work for units moving at pedestrian speeds but would be difficult for high-speed mobile units. In 1999, Braun, et al. [20] reported experiments in which data was recorded using a two-element handheld antenna array, and processed using diversity and optimum beam forming techniques.

2.1.1 Evolution of Mobile Radio Communications:

A brief history of the evolution of mobile communications throughout the world is useful in order to appreciate the enormous impact that cellular radio and *Personal Communication Services* (PCS) will have on all of us over the next several decades. It is also useful for a newcomer to the cellular radio field to understand the tremendous impact that government regulatory agencies and service competitors wield in the evolution of new wireless systems, services, and technologies.

While it is not the intent of this text to deal with the techno-political aspects of cellular radio and personal communications, techno-politics are a fundamental driver in the evolution of new technology and services, since radio spectrum usage is controlled by governments, not by service providers, equipment manufacturers, entrepreneurs, or researchers. Progressive involvement in technology development is vital for a government if it hopes to keep its own country competitive in the rapidly changing field of wireless personal communications.

Wireless communications is enjoying its fastest growth period in history, due to enabling technologies which permit widespread deployment. Historically, growth in the mobile communications field has come slowly, and has been coupled closely to technological improvements. The ability to provide wireless communications to an entire population was not even conceived until Bell Laboratories developed the cellular concept in the 1960s and 1970s [16]. With the development of highly reliable, miniature, solid-state radio frequency hardware in the 1970s, the wireless communications era was born. The recent exponential growth in cellular radio and personal communication systems throughout the world is directly attributable to new technologies of the 1970s, which are mature today. The future growth of consumer-based mobile and portable communication systems will be tied more closely to radio spectrum allocations and regulatory decisions which affect or support new or extended services, as well as to consumer needs and technology advances in the signal processing, access, and network areas [4].

2.1.2 Examples of Wireless Communication Systems:

Most people are familiar with a number of mobile radio communication systems used in everyday life. Garage door openers, remote controllers for home entertainment equipment, cordless telephones, hand-held walkie-talkies, pagers (also called paging receivers or “beepers”), and cellular telephones are all examples of mobile radio communication systems. However, the cost, complexity, performance, and types of services offered by each of these mobile systems are vastly different. [19]

The term *mobile* has historically been used to classify *any* radio terminal that could be moved during operation. More recently, the term *mobile* is used to describe a radio terminal that is attached to a high speed mobile platform (e.g., a cellular telephone in a fast moving vehicle) whereas the term *portable* describes a radio terminal that can be hand-held and used by someone at walking speed (e.g., a walkie-talkie or cordless telephone inside a home). The term *subscriber* is often used to describe a mobile or portable user because in most mobile communication systems, each user pays a subscription fee to use the system, and each user’s communication device is called a *subscriber unit*. In general, the collective groups of users in a wireless system are called *users* or *mobiles*, even though many of the users may actually use portable terminals. The mobiles

communicate to fixed *base stations* which are connected to a commercial power source and a fixed *backbone network*.
Mobile radio transmission systems may be classified as *simplex*, *half-duplex* or *full-duplex*. In simplex systems, communication is possible in only one direction. Paging systems, in which messages are received but not acknowledged, are simplex systems. Half-duplex radio systems allow two-way communication, but use the same radio channel for both transmission and reception. [20]
This means that at any given time, a user can only transmit or receive information. Constraints like “push-to-talk” and “release-to-listen” are fundamental features of half-duplex systems. Full duplex systems, on the other hand, allow simultaneous radio transmission and reception between a subscriber and a base station, by providing two simultaneous but separate channels (frequency division duplex, or FDD) or adjacent time slots on a single radio channel (time division duplex, or TDD) for communication to and from the user. [20]

2.2 MIMO Systems and Smart Antenna Systems:

In this section, we will discuss the MIMO systems as well as Smart Antenna Systems. Following figure 1 is showing the Antenna configuration taxonomy which is supported in the release of 8 regarding the LTE standard [1].

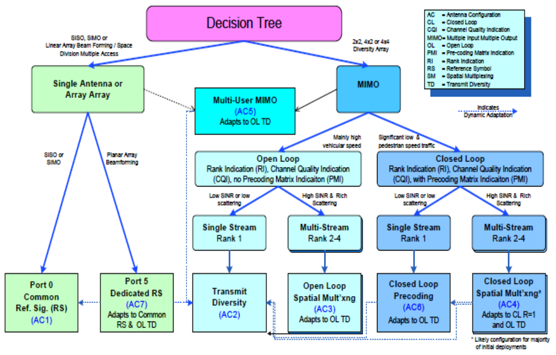

Figure 1: MIMO Systems and Smart Antenna Taxonomy
The technology of base station antenna has been evolved according to requirements of industry as well as trends. The important drivers which are having the continuing addition of cellular bands of frequency, more functionality integration into the single housing, as well the techniques of antenna are contributing additional capacity for the cellular networks. In the following sections, we will first defines the early technologies and then in next sections current technologies [1].

2.2.1Early Technology:

Following figure 2 showing the early technologies antenna evaluation:

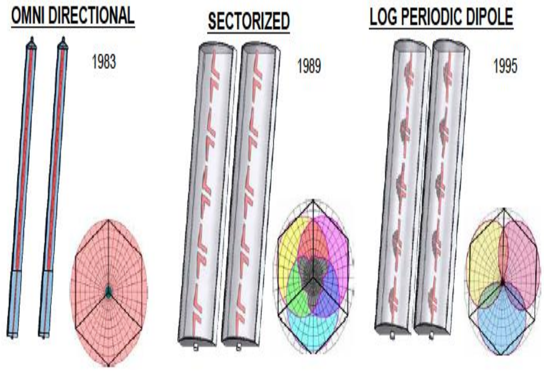

Figure 2: Early Base Station Antenna Systems

1) Omni Directional (1983): Following are features of this antenna.
- First used cell antenna,
- Equally radiates,
- Capacity is less,
- For the diversity of RX spatial, there are two kinds of antennas those are separated by the 10λ.
2) Sectorized (1989): Following are the features of it
- This can increases capacity.
- Coverage shaping is provided by the: E1 based beam width and mechanical tilt.
- Sector to sector based handoffs.
- Beam widths of Azimuth are 65º, 90º, 105º.
3) Lodge Periodic Dipole (1995): Following are features of such antenna.
- Directive element,
- Focuses sector beams,
- Improves handoff and
- Reduces interference
So these are the early technology for the antenna evaluation for the wireless communication systems. [17] [16]

2.2.2 *Current Technologies:*

2.2.2.1 *Extensive Usage:*

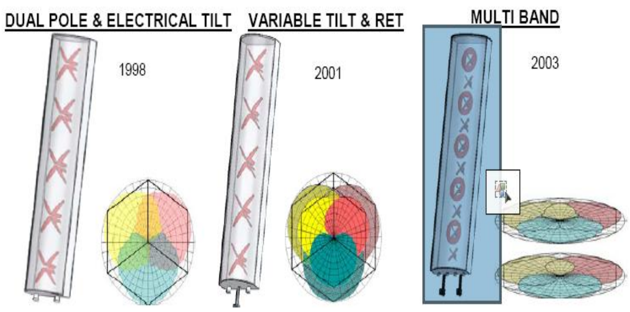

Fig 3: Current base station antenna technology for extensive use.

1) Dual pole and electrical tilt:- following are the features of it

- A spatial diversity replaced by polarization diversity.
- A vertical pole antenna replaced from sland 45 polarization antenna & one dual.
- Mechanical tilting replaced by electrical tilt.
- The beam tilts as undistorted coverage due from electrical tilt.

2) Variable tilt and ret:-following are the features of it:-

- The variable beam tilt controlled from internal phase shifter.
- Optimize interference & handover by beam tilt adjustment of cell radius.
- For Remote Electrical tilt wants to be motorizing the phase shifter.
- After optimizing beam tilt RET are avoid the cost of tower climbs.

3) Multi Band:-following are the features of it:-

- In random available Dual Band combines low band & high band arrays.
- Multi Band also stands for minimizes random count, lease cost, wind loading and tower loading.
- It's also independent RET for separate optimization.
- Tri Band version is offered [17].

3. PROPOSED APPROACH:

In this project, a structure of two coupled as well as three coupled chaotic communication is proposed which can be used for number of applications in wireless communication. In this work the emphasis is given on the reduction in the interference using adaptive beam forming in the chaotic communication based MIMO-OFDM system.

The proposed system uses a technique of chaotic communication based STC and adaptive beam forming algorithm (LMS and LLMS) for MIMO-OFDM system for the improvement of BER performance. This combined technique enhances security and performance of the system in terms of BER. The study has focused on various adaptive beam forming algorithms and its use in the system to improve the performance in terms of BER. Following figure shows the proposed system module for transmitter and receiver.

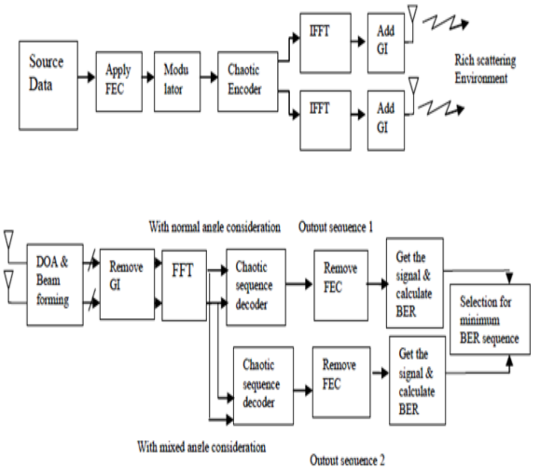

Figure 9: MIMO – OFDM Transmitter & receiver

4. IMPLEMENTATION PLAN AND MODULES STRUCTURE:

4.1 Transmitter Module:

At transmitter first, the data is generated from a random source, consists of a series of ones and zeros. Data input bits are converted into symbol vector using modulation. Modulation scheme used to map the bits to symbols are BPSK, QPSK, 16 PSK, 256 PSK.

Since the transmission is done block wise, when forward error correction (FEC) is used, the size of the data generated depends on the block size used, modulation scheme used to map the bits to symbols (BPSK, QPSK), and whether FEC is used or not [1]. The generated data is passed on to the next stage i.e.to the FEC block.

Forward error correcting codes are applied to normal convolution code sequence and interleaved convolution code sequence. The error correcting codes are used, to avoid long run of zeros or ones, as the data generated is randomized. This results in ease in carrier recovery at the receiver. The randomized data is encoded using tail biting convolution codes (CC) with a coding rate of ½.

4.2 Receiver Module:

This is the final part of the communication system and the most important one. In the receiver the signal is received by forming the beam in the desired signal direction, demodulated and then combined by using receiver, and probabilistic symbol estimation is performed.

At receiver first of all the direction of arrival of the multipath signals are determined. Here the assumption is that the multipath components of the signal are strong enough to distinguish them from noise. The LMS and LLMS beam forming algorithms are used to form the beam in the direction of incoming signal.

4.3 Performance Analysis and Comparative Study:

After the implantation of above two modules, for performance analysis we have to implement the proposed approach using various adaptive beam forming algorithms. We will calculate the BER vs. SNR ratio for without smart antenna system, with LMS and Without LMMS.

5. CONCLUSION:

In this work, performance comparison of chaotic communication based MIMO-OFDM system is given with and without using adaptive beam forming. The use of chaotic communication system can increase the security prospective of the system due to it bifurcation behavior when varying the initial condition. On the other hand, adaptive beam forming can more effectively mitigate interference and enhances the system performance. The proposed scheme has been verified in AWGN channel, Rayleigh Fading channel and Rician Fading channel. It has been observed that BER performance of the system is improved with adaptive beam forming.

The adaptive beam forming improves the system performance greatly using BPSK modulation compared to the QPSK modulation. Many times QPSK and BPSK perform in similar manner especially during non stationary environment. In general BPSK scheme should have least priority compared to other mapping schemes, while considering in terms of spectral efficiency, bandwidth and bit rate support. Channels perform in the following order in terms of best (less SNR requirement) to worst (more SNR requirement) to maintain the required BER: AWGN, Rician, Rayleigh.

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