A Review on Multi-User Beam forming for Sum-Rate Maximization in Frequency Selection Mimo-Mc-Cdma System

M.Tech. Scholar Priyanka Kumari   Asst. Prof. Akhilesh Patel
Department of Electronics & Communication Engineering,
School of Research & Technology, People's University,
Bhopal, M. P., India

Abstract -   **Today's wireless communication requires high data rate and good quality, which is possible only if the received signal is not affected by channel impairments. The diversity combining schemes are applied to combine the multipath received signals of a diversity reception device into a single improved signal. These schemes are applied at the receiver to mitigate the effect of channel fading on the received signal to obtain the signal with maximum signal to noise ratio (SNR).**

Keywords- **, OFDM, MIMO MC CDMA SSTEM**

I. INTRODUCTION

Wireless technologies have evolved remarkably since Guglielmo Marconi first demonstrated radio transmission in the year 1896 by controlling an electric bell through a remote arrangement. The radio transmission has been very much useful for the people to communicate with each other and has timely access to information regardless of the location of individuals. This is supported by the advances in the wireless networking technology and portable computing devices with reduction in the size of physical device leading to the rapid development in mobile communication infrastructure.

The first generation (1G) has been an analog based FDMA (Frequency division multiple access) system for voice transmission only. The 2G cellular systems uses time division multiple access (TDMA) based digital modulation schemes with source and error correction coding techniques to improve user capacity, voice quality and spectrum efficiency. The second generation (2G) systems include Global System for Mobile communications (GSM), IS-54, IS-136, IS-95 and Japan Digital Cellular. These systems were able to perfectly provide basic services and when demand for variety of wideband services increased the evolution towards the 3G started.

The first step in this direction has been commonly accepted as 2.5G with the development of new technologies based on the classical GSM (e.g., General Packet Radio Service (GPRS) and Enhanced Data Rates for Global Evolution (EDGE)).The real third generation (3G) mobile system have been developed to offer both low and high bandwidth services like telephony, Internet access and multimedia at any time and from anywhere through a single device. The first 3G system based on the Wideband Code Division Multiple Access (WCDMA)

transmission protocol offer wideband services, such as wireless Internet services (with peak rate of 384 bps) and video transmissions (with data rate up to 2Mbps). As 3G technology and its first evolution 3.5G congested in few years, telecommunication research community started working for the fourth generation (4G) wireless communication. 4G solution is based on full IP convergence system to meet the needs of high performance applications like wireless broadband access, Multimedia Messaging Service, video chat, mobile TV, High Definition Television (HDTV) content and Digital Video Broadcasting (DVB).

The goal is to have data rates in the range of 100-500 Mbps with premium quality and high security. In order to realize this, it is necessary to tackle the hostile physical properties of wireless channel in the form of rapid time variation, fading (large scale and small scale), multipath propagation and channel interference. The interference created by user of different cells using the same resource is called co-channel interference and interference resulting from users of same cell is called adjacent cell interference. Counter measures were employed to combat these impairments through spreading, space diversity and frequency diversity. Therefore MIMO MC CDMA system is standardized by international telecommunication unit (ITU(T)) for 4G and beyond 4G system.

II. LITERATURE REVIEW

Various types of combating techniques for channel impairments are proposed in the literature based on noise, interference and capacity for OFDM, MC CDMA and MIMO system.   The signals of different SCs are appropriately weighted and summed using EGC [8-11], MRC [12-15], ORC or zero forcing (F) and threshold based ORC (TORC). The MRC technique represents the optimal choice when the system is noise limited; in contrast, when the system is interference limited, the ORC

can completely eliminate MAI in the downlink transmission; yet, it causes noise amplification in the receiver. The MMSE criterion may also be used to derive the equalizer coefficients, whereas an even more powerful optimization criterion is the minimum bit error ratio (MBER) criterion. A lot of research studies have been dedicated to the error performance evaluation of MC CDMA systems and the approximation of the bit error rate (BER) for MC CDMA with MRC, EGC, and MMSEC has been derived.

However, it is based on the law of large numbers, i.e. the spreading code length must be sufficiently large. In the authors have derived the exact BER of a synchronous MC CDMA system with MRC. The BER is calculated based on a moment generating function method with no assumption on the distribution of multiple access interference. The BER performance of MC CDMA with MRC and EGC has been evaluated over a Rayleigh fading channel with correlated envelopes and phases. A lower bound and a tight approximation on the BER of MC CDMA with ORC is presented in [31]Although MRC, EGC and ORC only requires the channel state information (CSI), the MMSE and MBER equalizers are more complex because they exploit additional knowledge of SNR.

Differential demodulation without channel estimation was used in [1] which results in SNR loss of upto 3 dB. The channel tracking method using kalman filter has been analyzed which results in better estimation accuracy but suffers from computational complexity and delay. Various authors have reported the effect of channel estimation error and phase noise. Some authors have tried channel estimation using known data at the receiver. It involves sending pilots (symbols which are known to the receiver) with the data symbols so that the channel can be estimated and therefore the data at the receiver.

Training sequence and optimal training based channel estimation is discussed for MIMO system in which with increasing number of transmitting and receiving antennas, the length of the training sequence needs to be increased, leaving less space for data transmission and reduced overall spectral efficiency. However the optimal choice of training sequence is quite challenging. In the channel estimation is totally avoided by introducing differential modulation at the expense of a performance penalty, however the spectral efficiency of MIMO system depends upon the channel estimation.

Most channel estimation methods for OFDM transmission systems have been developed under the assumption of a slow fading channel, where the channel transfer function is assumed stationary within one OFDM data block. In addition the channel transfer function for the previous OFDM data block is used as the transfer function for the present data block. In practice, the channel transfer function of a wide band radio channel may have significant changes even within one OFDM data block. Therefore, it is preferable to estimate channel characteristics based on the pilot signal in each individual OFDM data block.

To increase the spectral efficiency less number of pilots operating in time varying channels, dynamic pilot symbol arrangement with wiener filter is proposed. Channel estimation technique for MIMO OFDM is studied, concentrating only on OFDM but not on MIMO system. To avoid increasing the length of pilot, optimal/training based channel estimation is discussed for MIMO OFDM system, and MIMO CDMA but real challenge is in arriving the optimal number of pilots Incorporating pilots decreases the spectral efficiency of the system and they usually require averaging over many symbols before obtaining a good estimate which make the scheme inefficient for high speed data communication.

The limitations in training based estimation techniques motivated interest in the spectrally efficient blind approach. They utilize certain underlying mathematical information about the kind of data being transmitted. Existing blind methods can be broadly categorized as statistical or deterministic: The former methods rely on assumptions on the statistics of the input sequence while the latter make no such assumption. In the first category, i.e., statistical approach, blind channel estimation using second order statistics can potentially achieve superior performance for a given time averaging interval than approaches based on higher order statistics. The second category, i.e., deterministic method, is generally favored when the input statistics are unknown, or there may not be sufficient time samples to estimate them. Several interesting deterministic methods were discussed; however most of them are exclusively for SISO or single carrier transmissions.

Variants of the statistics based methods for example by inserting zero padding instead of CP for each OFDM block or by introducing the so called repetition index and remodulation on the received signal. However, the number of required time samples is still implicitly proportional to the size of the IFFT in the OFDM modulator. It is also noted that deterministic approaches still need to accumulate data samples to algebraically obtain channel estimates, and their performance in noise improves as the number of samples increases. Therefore, as the dimension of the parameter space is increased in the MIMO OFDM context, the number of samples required for deterministic methods to achieve an acceptable level of performance will also inevitably be increased. Even though these methods are bandwidth efficient but are notoriously slow to converge, extremely

computationally intensive and hence are impractical to implement in real time systems.

3. MIMO

To improve channel throughput and robustness of a radio link, multiple antennas are employed at both the transmitter and the receiver which is known as MIMO shown in Fig.1. A MIMO system with similar count of antennas at both the transmitter and the receiver is able to multiply the system throughput linearly with every additional antenna. MIMO often employs Spatial Multiplexing to enable signal (coded and modulated data stream) to be transmitted across different spatial domains.
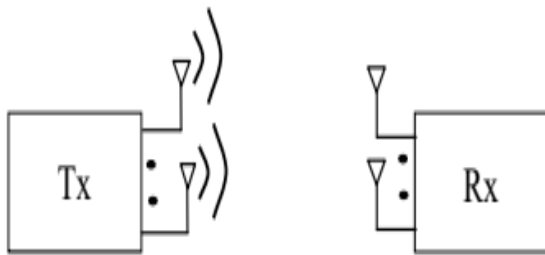

Fig.1 Multiple Input Multiple Output antenna system.

4. OFDM

OFDM is the basic MCM scheme that has been extremely used for high data rate application. In OFDM, the available spectrum is divided into many carriers, each one being modulated by a low rate data stream. Like FDMA, in OFDM also [2-4] the multiple user access is achieved by subdividing the available bandwidth into multiple narrow band channels, which are allocated to users. However, OFDM uses the spectrum much more efficiently by spacing the channels much closer together with no overhead as in FDMA. This is achieved by making all the carriers orthogonal to one another, thus preventing interference between the closely spaced carriers.

OFDM has a serious limitation of being sensitive to nonlinear amplification, frequency and phase errors in SCs. Moreover the mobile community may not be interested in loosing the merits of CDMA and therefore possibilities of mixing CDMA and MCM have been initiated. Researchers have analyzed three different combinations of OFDM and CDMA; multi carrier (MC) CDMA, MC direct sequence (DS) CDMA and multi tone (MT) CDMA [5], out of which MC CDMA is chosen as possible access scheme for beyond 3G mobile communication systems.
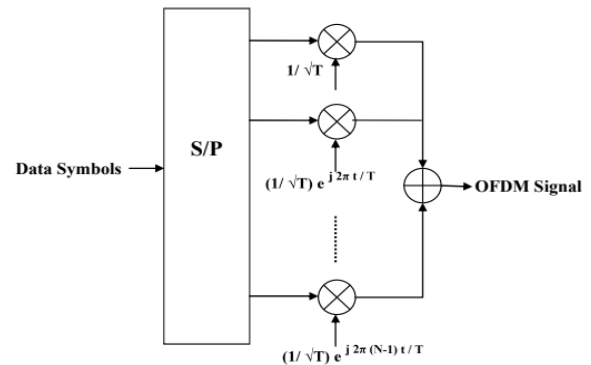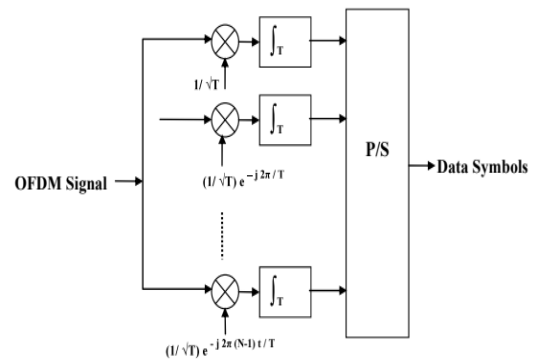

Fig.2 OFDM transmitter

Fig.3 OFDM receiver

V. CONCLUSIONS

To enhance the performance, the MIMO antennas at both ends of a wireless link helps to realize high data rate through spatial multiplexing and drastically improve the spectral efficiency of the system and provide link reliability in rich scattering environments through spatial diversity. In addition, the capacities of MIMO system increases linearly with the number of transmit receive antenna pairs without increasing transmitted power. Even though multicarrier modulation and MIMO mitigate ISI, effectiveness of this suppression is limited and both of these two techniques cannot work perfectly in fast fading environment. To overcome the problem, this work proposes equalization and channel estimation in the receiver BF in the transmitter and relay in the network to reduce the ISI, cater more number of users and improve the performance.

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