

MIMO Systems in Wireless Communications

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Abstract

In this paper, present a general description of MIMO systems in wireless communication systems, which are the advance in wireless communication technology today. MIMO systems are used to improve the noise and interference performance of a channel. In this document, the use of MIMO systems to improve the capacity of the channel and BER is also highlighted. The discussion then moves on to advances in this technology in the modern scenario that includes the merger of OFDM with MIMO. Through the use of MIMO-OFDM, very high data rates are achieved.

KEYWORDS: MIMO, OFDM, BER, SNR, AWGN.**Introduction**

Multiple input and output systems (MIMO) are a natural extension of the development of a communications network antenna. MIMO systems include multiple transmitter transmitting antennas and multiple receiving antennas in the future. The advantages of MIMO communication, which takes advantage of the physical channel between multiple transmitting and receiving antennas, are receiving great attention. MIMO systems offer various advantages over a single antenna for connection to a single antenna. The sensitivity to attenuation is reduced due to the specific diversity provided by multiple spatial channels. Under safe environmental conditions, the capacitance requirements associated with a high spectral communication capacity will be greatly reduced by avoiding the theoretical capacitance pressure area of the related information. Here, the spectral power is described because the total amount of data bits per second per hertz is transferred from one array to another [1]. Significant improvements in capabilities and bit error rates (BER) have recently sparked interest in multiple antenna systems. Along with the gains, however, comes value on the complexity of the materials. The radio interface has a complexity, size and value adapted to the amount of antennas. It is possible to reduce this value and capture many advantages of MIMO systems at a fixed time using a method called antenna selection. The data rate will increase linearly with the signal-to-noise ratio (SNR) at the low signal-to-noise ratio, but it will logically increase with the signal-to-noise ratio (SNR) at the high signal-to-noise ratio (SNR). In the MIMO system, a specific aggregate transmission power will be divided between several spatial paths, which approximates the linear system power for each mode, increasing the combined spectral power [6, 7]. MIMO systems provide high spectral energy with much less energy required for less information. Graph data rate vs. no. Parts of the antenna are shown in Figure 1. From the graph, it is clear that the MIMO capacitance includes a linear relationship, while the SIMO / MISO amplitude includes an exponential relationship with the amount of antenna parts. Therefore, make MIMO the topic of discussion for economical wireless communication.

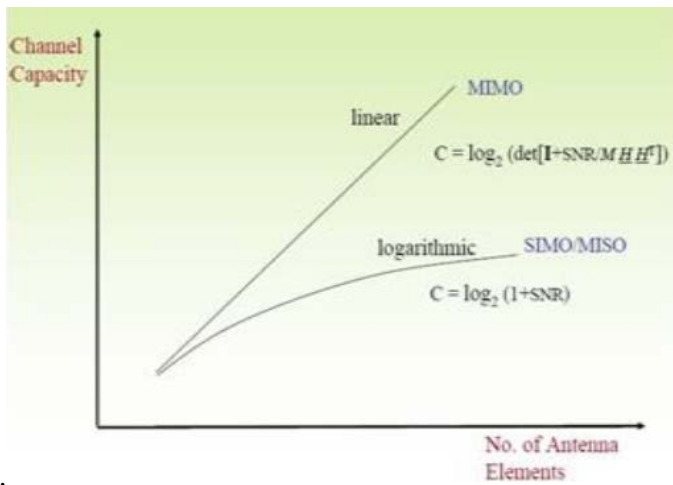


Figure 1 : Graph showing the variation of channel capacity with number of antenna elements

The fourth generation (4G) mobile communication systems are expected to solve the outstanding problems in the third generation (3G) systems and to provide a wide range of new services, from high quality voice to high speed wireless data channels with high definition video. . 4G is MAGIC-Mobile multimedia, anytime, anywhere [9]. As promises for the future, 4G systems, i.e. cellular broadband wireless access systems, have aroused much interest in the sand for mobile communications. 4G systems will not only be compatible with the next generation of mobile services, but will also support fixed wireless networks. 4G system features can be summarized as word integration. In fact, there are three main goals that 4G technologies must achieve. Constant communication, 100 Mbps data rate at the user terminal and other services such as ITS to be implemented. CALM [10], continuous communication of vehicles, it is a new global standard for the operation of smart transportation systems. It includes millimeter wave radar, GPS and 2G air interface to support ITS activities.

OFDM-MIMO in Wireless Communication

There are many schemes that use multiple antennas within the transmitter and hence for the receiver to improve the contrast and performance of communication systems. By far, today's most promising multi-antenna technology is the questionable Multiple Input and Output System (MIMO). Increasing the amount of MIMO transmitters and receivers, however, has greater potential. By doing this, MIMO takes advantage of the benefits of matching reflections seen by the receiver. STC is a technique used in MIMO, which extracts the multiplexes of independent knowledge streams that were transmitted simultaneously at intervals from a spectral channel to measure the information. OFDM-MIMO (STC) will greatly increase the performance of the information as the diversity of the abstract aborted data streams increases.

The MIMO channel can be a wireless link between the M transmitter and receiver N antennas. It consists of MN components that represent MIMO channel parameters. Many transmitting and receiving antennas may belong to electronic equipment used for one user or distributed between completely different users. The following configuration is called MIMO Distribution and Collaborative Communications. Mathematical models applied to MIMO models provide flexibility in parameters for channel selection, time and abstraction correlations, and the MIMO channel simulation tools supported by these models are applied. Various models of MIMO sports channels are available in [6] and [7]. Models

introduced the relationship of abstraction by multiplying unrelated random array variables in nursing by the root of the contrast matrix and each based on similar assumptions. However, they challenge their goal.

MIMO System

A MIMO system uses multiple antennas at both the transmitter and receiver to improve the communication system performance by use of diversity and multiplexing techniques. MIMO system provides higher spectral efficiency, improves the reliability, fading mitigation and improved resistance to interference [2].

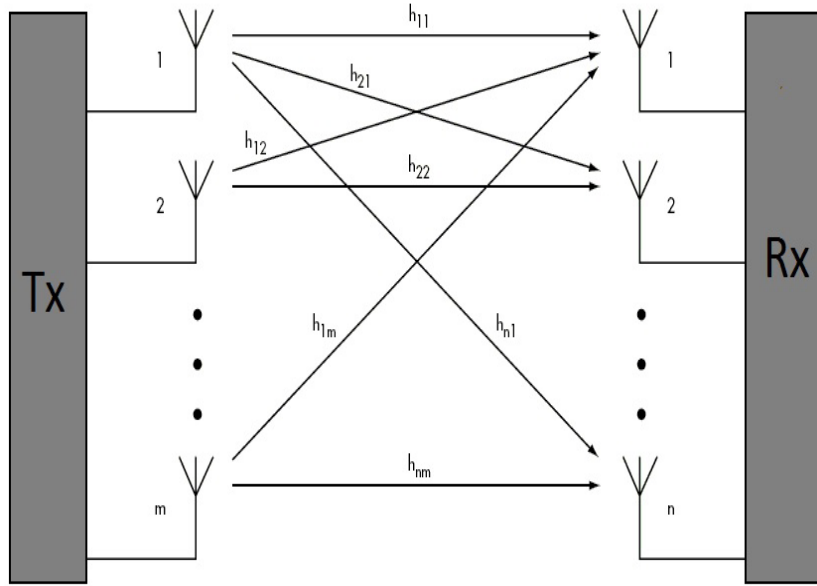


Figure 2 : MIMO System

In the literature, three main MIMO technologies have been proposed, such as spatial multiplexing for pre-coding and varied coding. Preoding is a technology that uses transmitter and receiver CSI knowledge to design a pre-encoder to form multiple streams. In spatial multiplexing, a high-frequency signal is divided into each transmitting antenna with a different data flow at low speed and each flow uses the same frequency band. In the case where the CSI is not available in the transmitter, diversity coding can be used to achieve a better diversity gain similar to the MRC system. In the diversity encoding method, the signal is transmitted by applying the time-encoding to the transmitter. MIMO platform. MIMO consists of transmitting and receiving antennas. The channel between the i-th receiving antenna and the j-th transmitting antenna is specified by h_{ij} . Therefore, the received signal can be modeled as

$$y = Hx + n \quad (1)$$

Where y is the vector of the received signal, x is the vector of the signal, n is the noise vector, H is the channel matrix with (i, j) the Th component is h_{ij} . The beam configuration uses pre-coding technology and multiple antennas to send and receive directional signals [2]. This direction of transmission is obtained by multiplying the transmit / receive signal by the pre-coding carrier to obtain constructive interference in the appropriate direction and destructive interference in other directions. The beam formation methods can be applied to both the transmitter and receiver. In addition, the beam formation greatly reduces interference and improves system capacity. Maximum Transmission Ratio (MRT) is the beam

modulation technology that can achieve diversity gains and matrix with transport beam modulation. MRC is the ideal mix method, as the signals from the receiving antenna elements are combined to maximize instant SNR. MRT with MRC provides a benchmark for the optimum performance that a system can achieve with transmit and receive diversity. During unidirectional beam modulation, the same signal is transmitted through both transmission antennas after preformation with the transmit beam modulation vector. Next, the receive beam modulation vector is designed in the same way as an end-to-end SNR maximization at the input to the receiver. The received signal can be modeled from forming a single

$$y = Hw_1x + n \quad (2)$$

Where w_t is the transmit beam forming vector and x is the transmit signal from all the antennas. At the receiver, receive combining vector w_r is applied to y . This can be expressed as,

$$\hat{y} = w_r^H Hw_1x + w_r^H n \quad (3)$$

Alamouti proposed a new form of transmission diversity schemes using two transmitting antennas when the CSI is not available on the transmitter [2]. This is accomplished by first transmitting a pair of symbols with two antennas, then by sending the converted symbol. This Alamouti Diagram addresses the advancement of time block coding technology. In OSTBC, data is sent with orthogonal coding, so multiple copies of data are sent over multiple antennas. This improves the reliability of data transmission. Transferring multiple copies of data increases the ability to correctly decode the received signal by using frequently received data.

This OSTBC coding exploits the independent fading in the multiple antennas to improve the diversity gain. At the transmitter, OSTBC encoding done with N symbols $s_1, s_2, \dots, s_N$ are mapped to a row orthogonal matrix $X \in \mathbb{C}^{m \times N_T}$, where entries of X obtained by linear combinations of $s_1, s_2, \dots, s_N$ and their conjugates [1]. Also, N_T is the number of symbol periods used to send a code word. Therefore, the code rate is $R = N / N_T$. Let x_k be the transmitted signal during the k th symbol period. We take $X = (x_1, x_2, \dots, x_{N_T})$. During the k th symbol period, we have the received signal at the destination as

$$y_k = Hx_k + n_k, k = 1, 2, \dots, N_T \quad (4)$$

Where n_k is the noise vector at the destination.

MIMO System Channel Capacity

To mitigate the fading problem due to the spread of multiple paths, diversity techniques have been developed. Antenna diversity is a general form of diversity. Information theory has shown that with the spread of multiple paths, multiple antennas and transmission channels operate simultaneously in the same frequency band with the same total radiated power. The antenna correlation varies greatly depending on the dispersion environment, the distance between the transmitter and receiver, antenna configurations and Doppler spread. This representation is also known as spectral efficiency (bandwidth). MIMO channel capacity is largely dependent on the statistical characteristics and relationships

associated with the channel antenna component. The inputs and outputs of the secondary memory channel are represented with the random variables X and Y respectively, the channel capacity is defined as the maximum amount of information exchanged X and Y : the receiver can basically create many parallels.

Conclusion

MIMO will ultimately benefit from all major wireless industries, including mobile phones, wireless LANs, and many other industries. The LAN industry is also driving innovation in mobile phones. That is why MIMO-OFDM is the basis of all MIMO-OFDM IEEE 802.11n proposals. For the same bitrate, MIMO-OFDM is three times larger than non-MIMO systems. This significant improvement in frequency band performance makes MIMO-OFDM the ideal solution not only for wireless local area networks, but also for home entertainment networks and 4G networks). Network networks (such as Muni Wireless), WMAN - WiMAX, 4G, Cellular, RFID, mobile satellite TV, satellite radio, and digital home. In general, MIMO uses several paths through spatial diversity as well as with spatial multiplex techniques. Improving wireless performance, without the additional spectrum cost (adding hardware and complexity only), is largely responsible for MIMO's success as a new research topic and hence a separate topic. MIMO increases the speed to deliver a wide application like multimedia streaming.

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