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LOCATION BASED TRANSMISSION SYSTEM USING VLC

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Abstract:

In any communication system, the emphasis is on estimating the channel response so as to retrieve the transmitted input signal accurately at the receiver's end. Channel Equalisation at the transmitter refers to pre-distorting the input signal so that the effect of the channel is nullified during transmission. This approach works out for slow fading channels where the channel response remains almost constant for a considerable amount of time (coherence time). Our prime objective in this work is to adapt a filter with impulse response (F) to the channel impulse response (H) at the transmitter end. By evaluating the inverse of the filter F and passing the symbols through a filter designed with frequency response F-1, we can equalise the distortions on the input due to channel. Simulation results show that the Bit Error Rate (BER) performance of the system is identical with that of the effect of noise, when this technique is implemented for basic modulation schemes like PAM or QAM. Whereas, when the technique is implemented for Multiple Input Multiple Output (MIMO) system.

Keywords – Equalisation, BER, QAM, PAM.

1. INTRODUCTION

Communication, the activity of conveying information, is the distinctive ability which has made possible the evolution of human society. The history of communication is mankind‟s search for ways to express itself, to share knowledge and to prosper. Humans live related to each other. The initial challenge for a man was to put forth his thoughts. As gestures and body language became inadequate to convey one‟s thoughts, languages were invented. Language is a tool which portrays thoughts in the form of words, though not a very effective tool; it has become a basic necessity for everyone to use it. But as humans explored the world around, more knowledge was dwelled which were to be shared, and, texts and speech alone became insufficient for transferring the vastness of what is known. Better communication techniques were enquired upon and were being discovered, from Pigeon posts to Persian couriers, from telegraphy to telephony, every technique connected people separated by lands, further. Our planet started shrinking as the world of communication began to expand. But nothing changed the destiny of humanity as much as what James Clerk Maxwell‟s discovery did. Electro- magnetic waves redefined limitations, it made wireless communication possible. Wireless communication is the use of EM waves to transfer data between two users. Wireless communications has developed into a key element of modern society. From satellite transmission, radio and television broadcasting to the now ubiquitous mobile telephone, wireless communications has revolutionized the way societies function. Similarly, in a wireless communication system, a transmitter which is actually an electronic circuit with the aid of an antenna creates electromagnetic vibrations which are sent through space. These waves propagate through a channel (free space, buildings etc.). During this propagation various distortions are introduced into the signal. The

receiver receives this signal. To successfully interpret the message in it, the receiver has to know about the nature of discrepancies introduced by the channel. The process of evaluating the way a channel behaves to EM waves is called Channel Estimation.

2. MIMO

The concept of MIMO is briefly explained in this chapter. A MIMO system has two classes namely space-time coding and layered space-time coding. The layered space-time coding is also known as spatial multiplexing. MIMO systems are generally of the form MT×MR, where MT is the number of transmit antenna and MR is the number of receive antenna. However, Alamouti scheme is the most basic model for a MIMO system having a unit code-rate.

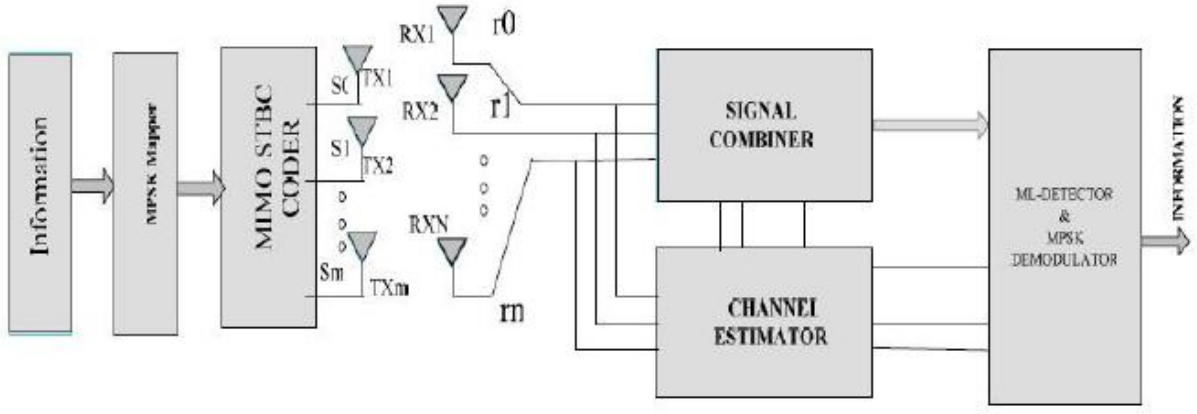

Fig.1.MIMO System

Array gain is the average increase in the SNR at the receiver that arises from coherent combining effect of Multiple Antennas. The signals arriving at the receiver have different amplitudes and phases. The receiver can combine the signals coherently to enhance the resultant signal. This can improve the reliability, and hence the capacity of the system. This offers a linear increase in transmission rate (in the number of transmit-receive antenna pair) for the same bandwidth without any additional power expenditure. SM is discussed for a 2x2 system. This can however be extended to any MIMO system. The bit stream to be transmitted is demultiplexed into two half rate sub-streams, modulated and transmitted simultaneously from each transmit antenna. The spatial signatures of these signals induced at the receiver antenna are well separated. The receiver having the knowledge about the channel, can differentiate between the co-channel signals and extract both, after this demodulation gives the yields original sub stream which is combined to get back the original signal.

3. SYSTEM DESCRIPTION

The WPMCM system is same as the OFDM system except a few major changes. Here, IDWT replaces IFFT block in transmitter side and DWT replaces FFT in receiver side. First, the data stream is modulated and then is passed through a serial to parallel converter. After this successive levels of IDWT are performed so that finally we get a serial data stream. Here, we don‟t need to perform parallel-to-serial

conversion as is the case with OFDM because IDWT takes care of that. The final serial data is then transmitted. In the channel, noise is added. In the receiver side, DWT is performed successively, the same number of time as performed in transmitter side. Then, parallel to serial conversion takes place. Finally, the serial data is passed through a demodulator block. The diagram shown below will give a better picture. In theory, any time and frequency limited function may be used. In practise, the wavelet bases cannot be arbitrarily chosen and have to satisfy a number of requirements. In general, the choices to make can be in regard to the system of representation(continuous or discrete), properties of wavelets desired(orthogonality/biorthogonality, regularity/smoothness, frequency selectivity), the application in hand and the context of use. A framework that accounts for these requirements must first be defined and the wavelet selected in a principled approach through optimisation of the wavelet design parameters.

4. CHANNEL ESTIMATION

A radio channel used for majority of the communication purposes is frequency selective and time variant. For an OFDM system the channel transfer function is different both in frequency and in time domain for different sub-carriers. The pilot based approach is preferred to estimate the channel and equalize the channel effect to receive the correct

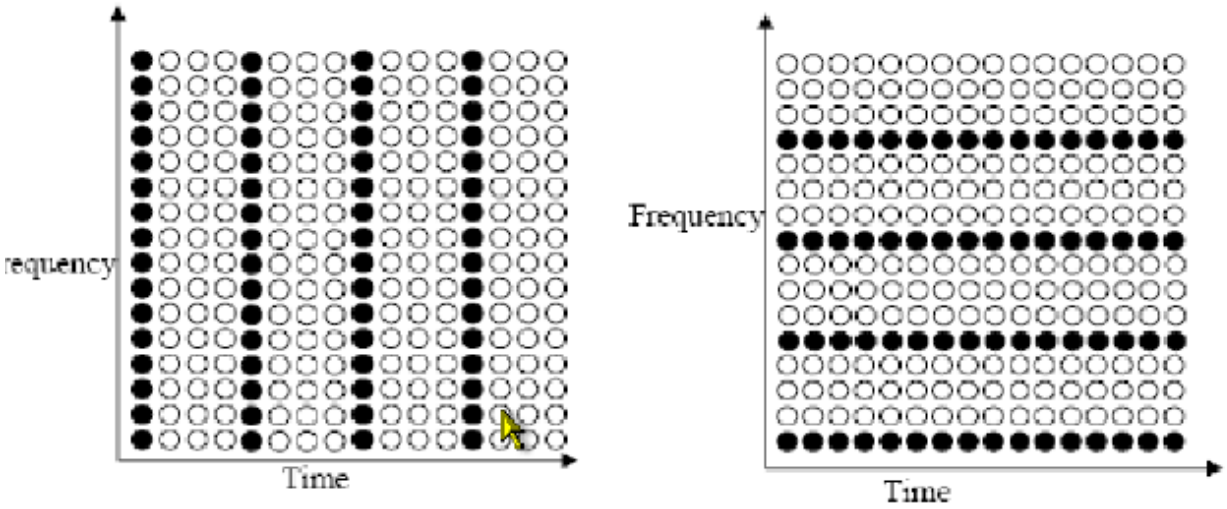

Fig.2. Channel Descripton

signal. The first kind of pilot arrangement shown in Fig 2 is denoted as block-type pilot arrangement. The pilot signal assigned to a particular OFDM block is sent periodically in time-domain. This type of pilot arrangement is especially suitable for slow-fading radio channels. Because the training block contains all pilots, channel interpolation in frequency domain is not required. Therefore, this type of pilot arrangement is relatively insensitive to frequency selectivity. A combination of block and comb type pilot arrangement is used to counteract the frequency selectivity of a channel for different periods of time. Results of the channel estimation for OFDM system‟s is not directly applicable to MIMO-OFDM system. In MIMO systems, the number of channel paths increases by Nt X Nr-folds, where Nt and Nr is the number of transmit and receive antenna, respectively. This significantly increases the number of unknowns to be

solved. Conventional estimation techniques for single input single output (SISO) systems have to be modified to be applicable in MIMO systems. In block-type pilot based channel estimation, OFDM channel estimation symbols are transmitted periodically, in which all sub-carriers are used as pilots. If the channel is perfectly constant during the block, there will be no channel estimation error since the pilots are sent at all carriers. The QR decomposition is preferable because of the clever implementation of the scheme in a highly parallel systolic array architecture QR decomposition is an orthogonal matrix triangularization technique that reduces a full rank matrix into a simpler form.

5. SIMULATION AND RESULTS

The simulation of the proposed technique for SISO system is done and a graph is plotted between the number of iterations, i.e, the number of bits transmitted from the receiver to the transmitter vs MSD. It is observed that there is a steep decrease in MSD from 0-50 iterations after which an oscillatory behaviour is seen.

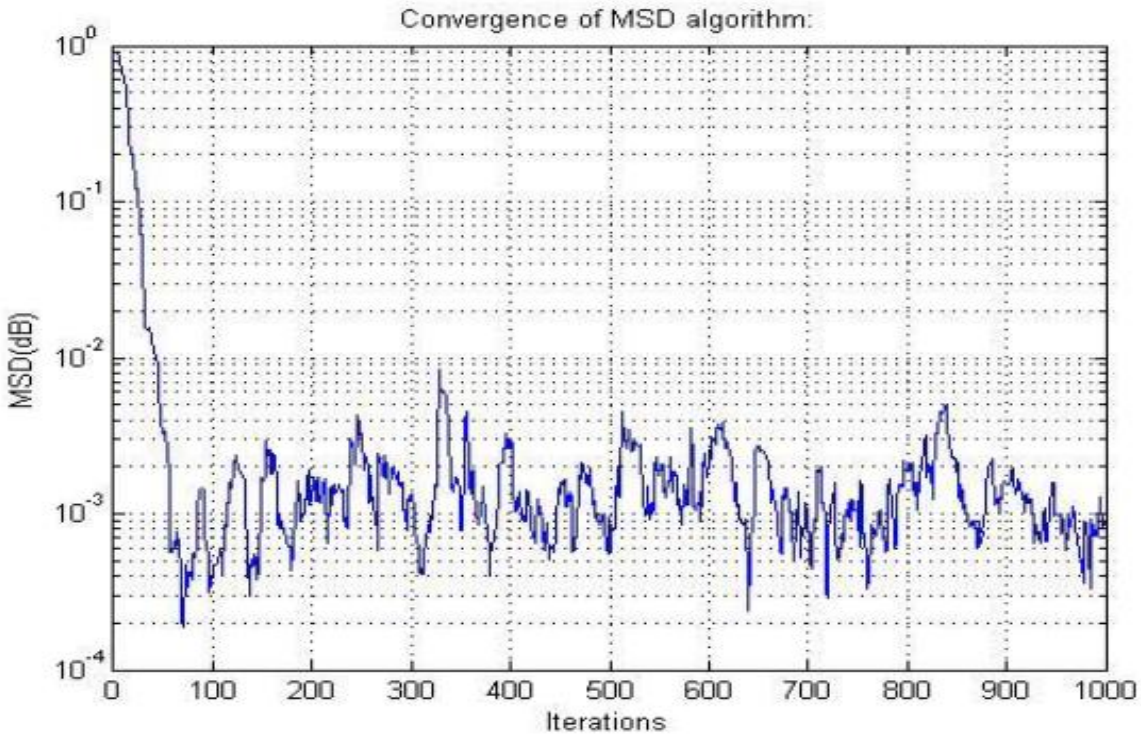

Fig.3. Convergence of MSD Algorithm

Thus, we conclude that maximum of 30-50 iterations is sufficient for the convergence of MSD algorithm in the proposed technique. It is observed that pre-distortion at the transmitter provides considerable BER vs SNR improvement for a MIMO system(BER of 10-3 is achieved at 8dB for an ordinary MIMO system with channel equalisation at the receiver while it is achieved at 7 dB for the MIMO system incorporated with our proposed technique).

CONCLUSION

Pre-distorting the data symbols at the transmitter end using an adaptive equalisation filter is an effective technique proposed for communication systems. This model ensures considerable reduction in receiver complexity. The MATLAB simulation results show considerable improvement in BER performance for a MIMO- OFDM system (BER of 10-3 is achieved at a SNR value of 10 dB). The receiver detects the incoming symbols with basic minimum distance algorithm, as the channel equalisation is carried out at transmitter end itself thereby reducing the receiver complexity. This technique is well suited for multi-receiver communication system in a slow-fading, „mirror" channel environment. WPMCM is a relatively young and promising communication concept which shares most of characteristics of an orthogonal multi carrier system and in addition offers the advantage of flexibility and adaptability.

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