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Technique for the Channel Estimation Using 2-Phase Filtering Technique

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Abstract: A technique which can provide higher bit rate as well as transmitting the data at higher speed from source to destination is known as the OFDM technique. The numerous signals are multiplexed collectively within the OFDM and are thus transferred orthogonally towards the destination across the network. For the purpose of transmitting data, the most efficient technique being used is the MIMO technique. There can be a splitting of one signal into multiple signals within the MIMO. For receiving and demodulating these multiple signals at the receiver end, multiple receiver antennas are provided. However, these techniques have a major drawback which is the higher bit rate error they provide. A novel technique is proposed in this study for minimizing the bit rate error within the MIMO OFDM technique. The Kalman filter is utilized here within this system which helps reducing the bit rate error and enhancing the performance of the system.

Key words: MIMO, OFDM, bit rate error, Kalman filter, performance, drawback

INTRODUCTION

The multipath propagation signals are present within the Multiple Input Multiple Output (MIMO) systems which are not available within the other traditional systems. There is no need of applying the various techniques for handing the multipath signals in MIMO. Here, they can be handled by applying multiple transmitting and receiving antennas which can send and receive numerous signals within the similar frequency band and at the same instant (Rappaport, 2002). Through which the communication is taking place, there are different types of affects caused by the various paths in which the multipath signals travel. These affects can also be caused due to the channels. There are various signal parameters as well on which the multipath channel can be affected (Hanzo and Keller, 2007). For the purpose of removing ISI from various signals, there are various kinds of equalizers being utilized within this process. The changes made within the channel can be handled with the help of various techniques. The received signal can be prevented to enter within the transmitted signal only by providing knowledge which is required by the receiver across the Channel Impulse Response (CIR) (Calmon and Yacoub, 2009). The physical medium that is connected by the transmitter and the receiver is recognized with the help of the SISO/MIMO communication model. There are two types of communication mediums which are the wired line and the wireless connection medium. There are various factors, that might affect the signal and corrupt it completely. The noises caused from the electronic devices, non-linear distortion, interference, fading and various other factors can be the reason for causing such interruptions which might corrupt the signals. There are numerous receiving antennas at the receiver side of the digital communication system. A weighted and filtered sum of various transmitted waveforms is received by every antenna present within the system (Gounai and Ohtsuki, 2006). There are some RF chains placed at the transmitter and/or receiver end which also include the new antenna selection technique for preventing such problem to occur again. Through this technique, the complexity of the system is minimized as well as the merits of the MIMO technique are also sustained. The MIMO channels that are not related can utilize this technique for better results. Due to the absence of space between antennas, there is a fading correlation that occurs within the cellular channels. This might also be caused due to the presence of small angular spread within the system. The performance of full-complexity schemes is much better in such cases as compared to the hybrid selection schemes. This is mainly due to the correlation present within the various antenna elements which also further causes a decrement in the benefits provided for antenna selection within the system.

Literature review: Armstrong (1999) proposed in this study, that there are various frequency errors that occur within the OFDM which can affect the cellular networks in different ways. Due to the carrier frequency off set the

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ICI of the network can be presented in certain aspect which mainly involves the complex weighting coefficients within the system. There has been proposed a new self ICI cancellation scheme. Through this scheme, the higher order components can also be canceled. Due to the frequency offset there have been a lot of minimizations in various factors within the ICI. The mapping of each complex value that is to be transmitted on the weighted groups of the sub carriers can be done with the help of the ICI cancellation methods. These methods also have a drawback that mentions that the ICI methods can transmit so very less number of complex data values per symbol period. In terms of DFT, the orthogonality of the windowing schemes can be attained.

Zhao and Haggman (2001) proposed in this study, that for fighting against the effects caused by ICI on the OFDM systems a new ICI self-cancellation method has been derived. There have been various improvements provided by this new scheme as per the simulation results achieved after implementation. In cases, where multipath radio channels are included with the Doppler frequency spread, this method has provided better results. As compared to the previous OFDM method, the new technique has provided better results in cases where similar bandwidth efficiency and larger frequency offsets are available. It is easy to implement this scheme by ensuring that the complexity is not increased. This is possible as there is no channel equalization required here for the reduction of ICI.

He *et al*. (2008) proposed in this study, a proposer analysis on the ICI and the ISI methods in the case of fading channels. Within this study, the two types of interferences are analyzed along with the implementation of Kalman filter. The feedback equalizer is utilized for minimizing the noise along with the channel estimations for uncertain interference across the channel within this study. The analysis of the method is done on the basis of time and frequency here and the simulation results are achieved.

Kang *et al*. (2011) proposed in this study, a study related to the channel prediction on the basis of CQI table adaptation. For the purpose of channel prediction within the OFDM systems, the effective modulation and coding scheme is proposed here. On the basis of the statistical parameters the analysis of the channel is being done. For providing the analysis of noise, various filters are being utilized within this research. The analysis is done on the quality of the channel here. There is an adaptive utilization table generated for providing verification related to the limitations of the channel when various parameters are present.

Agrawal and Raut (2011) proposed in this study, the study related to the fading channel and the Gaussian noise. With respect to different modulation schemes, the research has been analyzed. The BER performance of the MIMO OFDM system is analyzed within this study. There are various modulation techniques utilized here for providing such analysis. The analysis of BER is done mainly within this study and this study is provided as a base paper for the research. There are two different ways in which the research has been elaborated. The first is to analyze the BER and minimize the ICI. The second is to analyze BER with the help of Kalman filter.

Sarma and Mitra (2010) proposed in this study, a study related to the MIMO channel modeling which involves the Temporal Artificial Neural Network (ANN) architectures in it. The statistical nature of the network is adapted by the researcher. The channel estimation and symbol recover are achieved by combining this nature of the network with the Neural Network. The multi-layered perception architecture is provided as a base within this study. The performance of the system is analyzed as per the results and the comparison made with the traditional systems.

OFDM technology: As compared to the earlier single-carrier modulation methods, the Orthogonal Frequency Division Multiplexing (OFDM), a broadband multi-carrier modulation method is developed which is helpful in providing better performance within the high speed networks. The Multi-Carrier Modulation (MCM) systems include various techniques and the OFDM technique is one of them. The multiple carriers are involved here in transmitting the signals. There are different frequencies for all these carriers and they are also orthogonal with respect to each other (Kang *et al*., 2011). This is possible even in cases of multipath environments (Hanzo and Keller, 2007). Large numbers of narrow bandwidth carriers are utilized for transmitting data in the OFDM systems. A block of spectrum is created with the help of carriers that are spaced regularly in the frequency (Agrawal and Raut, 2011). Along with the selection of frequency spacing and time synchronization of the carriers, it is to be ensured that the carriers are orthogonal. This will ensure that there is no interference caused amongst them. Even, when the carriers overlap each other within the frequency domain, the necessities are to be ensured. As the name itself describes the method, the technique ensures that the digital data is transferred across the users with the help of various carriers and each carrier has different frequency. With the help of comparative studies provided with single carrier systems, it can be judged that the OFDM technique can

be considered a transmission technique or not. The two major properties of OFDM technology are to be mentioned. The first is that the OFDM technique is spectrally efficient. The second is that the dispersive slow fading channels can be dealt with in a proper manner with the help of this method. A proper multiple access scheme can be utilized for extending the OFDM in the case of multi-user systems. This is similar to be followed by the single carrier transmission systems as well. OFDM is a versatile modulation scheme which can be utilized for multiple access systems such that it can facilitate in both, TDMA as well as FDMA systems. These techniques are not possible in the single carrier systems. With all such benefits, there have been various applications that have been utilizing the OFDM technology within them.

Kalman filtering: In radio communication systems, filtering is a desirable factor. As radio communication signals are often corrupted with noise, a good filtering algorithm is required to remove noise from electromagnetic signals while retaining the useful information (Mackay, 1999). DPSS is an effective method to filter impurities in linear systems. This filter is basically consists of a set of mathematical equations that provides an efficient computational means to estimate the state of a process that minimizes the mean of the squared error. It operates recursively on streams of noisy input data to produce statistically optimal results the filter is very powerful in several aspects: it supports estimations of past, present and even future states and it can do, so even when the precise nature of the modeled system is unknown.

MATERIALS AND METHODS

With the help of multi-carrier modulation, the emergence of the MIMO OFDM technique is brought up which provides efficient communication within the systems. There are huge applications that have introduced this approach within them. The channel frequencies across the network are a base for the OFDM communication. Within the network, there is intercarrier interference seen which is basically a certain type of orthogonal distortion. For the purpose of analyzing and resolving this problem being faced within the network, a two phase Kalman filter is utilized. Within the initial phase with the help of Kalman filter, the signal is analyzed for PAPR. Once there is a reduction in the PAPR, the noise present within the signal is to be analyzed. Through various measures, the noise detected here will be reduced. For the purpose of reducing bit error rate within the MIMO-OFDM technique, the Kalman filtering channel

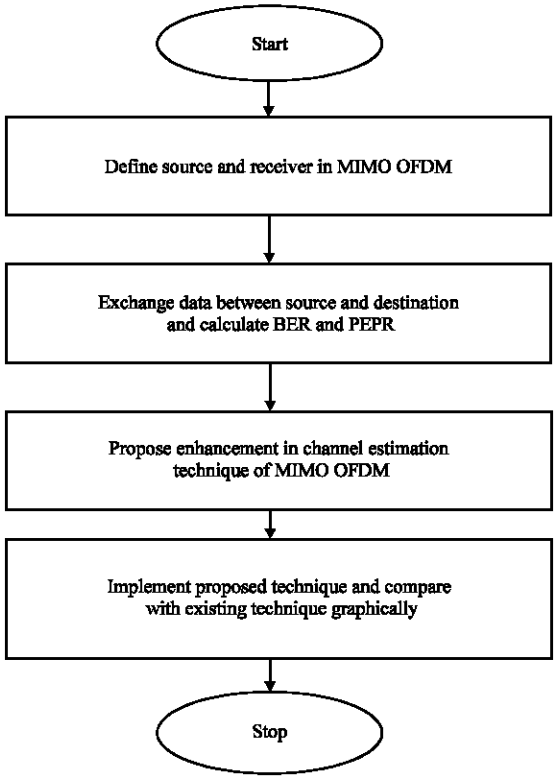

Fig. 1: Flowchart of methodology

estimation technique is applied along with forward propagation. Amongst, the finite as well as infinite channel values, the orthogonal property is double within the Kalman filter method. The bit error rate within the MIMO-OFDM technique is also minimized in the cases where windowing techniques were included for estimating the channels within these networks. This method is performed along with the utilization of the back propagation method which will help in providing iterations in the Kalman filtering method. There is a reduction in error after each iteration is performed (Fig. 1).

RESULTS AND DISCUSSION

The MATLAB tool has been used for implementing this complete scenario. As shown in Fig. 2, the noise ration within the MIMO-OFDM transmission is depicted through the red line.

As shown in Fig. 3, the noise ratio within the MIMO-OFDM technique is depicted by the green line. It uses Kalman filtering technique for calculating the noise ratio.

As shown in Fig. 4, the comparisons are made within the two outcomes achieved which are one having the

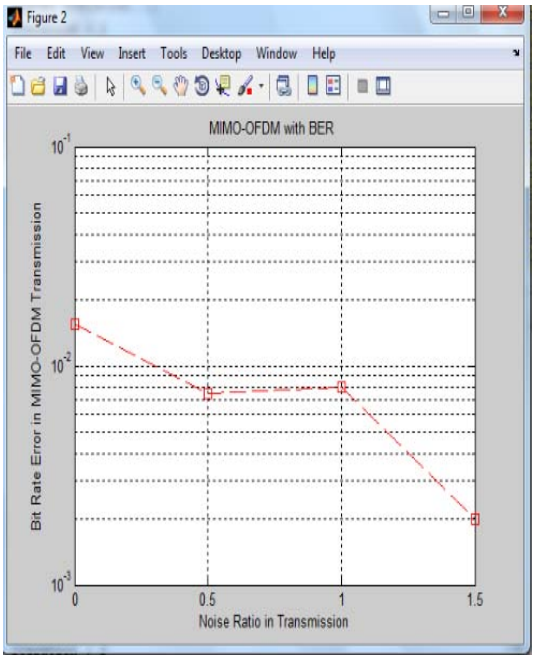

Fig. 2: MIMO-OFDM due to noise

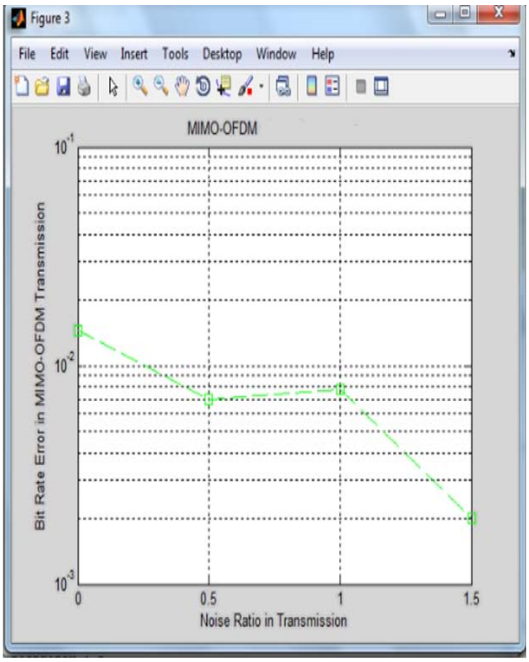

Fig. 3: MIMO-OFDM with Kalman

noise ratio without Kalman filter and the other showing noise ratio with the application of Kalman filter. As per the results, there is a reduction in the noise ratio and bit error when Kalman filter is utilized.

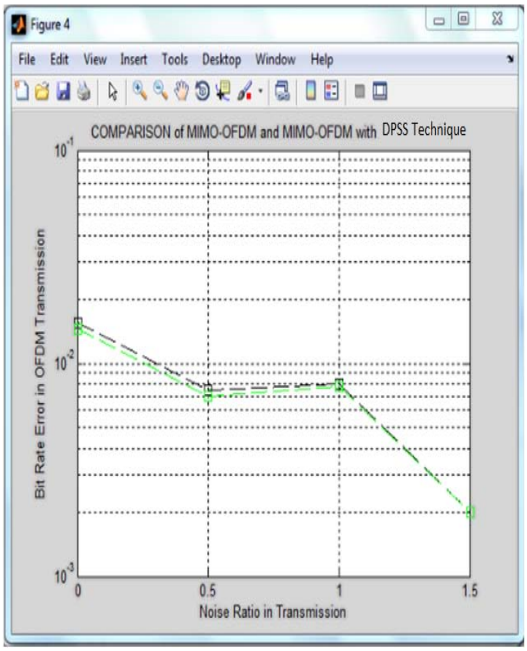

Fig. 4: Comparison of both techniques

CONCLUSION

As per the simulation results achieved, it is concluded in this study that for the transferring of data at a higher bit rate, the OFDM MIMO technique has been very efficient. With the presence of MIMO alone, the efficiency of the network had been reduced due to its higher bit rate error. In this study, Kalman filtering technique has been applied for the purpose of minimizing the bit error rate within the network. As compared to the earlier present techniques, the performance of this technique has been more efficient as per the results achieved.

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