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Review Article

Channel Estimation in BPSK-QPSK-PSK 16 & 64 QAM MIMO-OFDM System

Anshu Jaiswal[Ȧ*], Ashish Dubey[Ȧ] and Manish Gurjar[Ȧ]

[Ȧ]Dept. of Electronic & Communication, TIT College, RGPV University, Bhopal, India

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Abstract

This paper presents the review of channel estimation in MIMO-OFDM system. The objective of this paper is to show the information about the improvement of channel estimation accuracy in MIMO-OFDM system. The MIMO-OFDM system is the combination of the MIMO technique and OFDM technique, which is enhancing the capacity, improve the link reliability high data rate transmission for future broadband wireless communication and also use for avoid Inter Symbol Interference (ISI).

Keywords: *Channel estimation, MIMO OFDM*

1. Introduction

In broadband wireless channel multiple input multiple output (MIMO) communication system combine with the orthogonal frequency division multiplexing (OFDM) modulation technique can achieve reliable high data rate transmission and to mitigate inter symbol interference. High data rate system suffer from inter symbol interference (ISI). To estimate the desire channel at the receiver channel estimation techniques are used and also enhance system capacity of system. The MIMO-OFDM system uses to independent space-time codes for two sets of two transmit antennas. To improve channel estimation accuracy in MIMO-OFDM system because channel state information is required for signal detection at receiver and its accuracy affects the overall performance of system and it is essential for reliable communication. This presents channel estimation scheme based on Leaky Least Mean Square (LLMS) algorithm proposed for BPSK-QPSK-PSK MIMO OFDM System. By designing this we analyze the terms of the Minimum Mean Squares Error (MMSE), and Bit Error Rate (BER) and improve Signal to Noise Ratio.

The channel estimation technique for OFDM systems based on pilot arrangement are investigated. The channel estimation based on comb type pilot arrangement is studied through different algorithm for both estimating channel at pilot frequencies and interpolating the channel. The estimation of channel at pilot frequencies is based on LS and LMS while the channel interpolation is done using linear interpolation, second order interpolation, low pass interpolation, spline cubic interpolation,and time domain interpolation. Time-domain interpolation is obtained by passing to time domain through IDFT (Inverse discrete fourier transform), zero padding and going back to frequency domain through DFT (Discrete fourier transform). In addition, the channel estimation based on block type pilot arrangement is perform by sending pilots at every sub-channel and using this estimation for a specific number of following symbol. Also implemented decision feedback equalizer for all sub-channels followed by periodic block- type pilots. Compare the performances of all schemes by measuring bit error rate with 16QAM, QPSK, DQPSK, and BPSK as modulation schemes and multipath Rayleigh fading and AR based fading channels as channel models.

Present an improved channel estimation algorithm for orthogonal frequency- division multiplexing mobile communication systems using pilot sub carriers. This algorithm is based on a parametric channel model where the channel frequency response is estimated using an L-path channel model. In the algorithm, employ the ESPRIT (estimation of signal parameters by rotational invariance techniques) method to do the initial multipath time delays acquisition and propose an interpath interference cancellation delay locked loop to track the channel multipath time delays. With the multipath time delays information, a minimum mean square error estimator is derived to estimate the channel frequency response. It is demonstrated that the use of parametric channel model can effectively reduce the signal subspace dimension of the channel correlation matrix for the sparse multipath fading channels and, consequently, improve the channel estimation performance.

2. Proposed Work

The previous section provides the information about the channel estimation through the different technique. The limitation of previous work is that it use the BPSK-QPSK-PSK MIMO-OFDM System for channel estimation by used Leaky Least Mean Square (LLMS) Algorithm. Which is reduce the BER and increase the capacity, but this is not reduce the more Bit Error Rate. However to overcome on these problem a work is proposed for

*Corresponding author: **Anshu Jaiswal**

increasing the capacity of channel and reduce the BER by the use of Channel Estimation BPSK-QPSK-PSK 16 &64 QAM MIMO-OFDM System.

Phase-shift-keying (**PSK**)is a digital modulation scheme that conveys data by changing, or modulating, the phase of a reference signal (the carrier wave). Any digital modulation scheme uses a finite number of distinct signals to represent digital data. PSK uses a finite number of phases, each assigned a unique pattern of binary digits. Usually, each phase encodes an equal number of bits. Each pattern of bits forms the symbol that is represented by the particular phase. The demodulator, which is designed specifically for the symbol-set used by the modulator, determines the phase of the received signal and maps it back to the symbol it represents, thus recovering the original data.

Binary-phase-shift-keying (BPSK) (also sometimes called PRK, phase reversal keying, or 2PSK) is the simplest form of phase shift keying (PSK). It uses two phases which are separated by 180° and so can also be termed 2-PSK. It does not particularly matter exactly where the constellation points are positioned, and in this figure they are shown on the real axis, at 0° and 180°. This modulation is the most robust of all the PSKs since it takes the highest level of noise or distortion to make the demodulator reach an incorrect decision. It is, however, only able to modulate at 1 bit/symbol and so is unsuitable for high data-rate applications. In the presence of an arbitrary phase-shift introduced by the communications channel, the demodulator is unable to tell which constellation point is which. As a result, the data is often differentially encoded prior to modulation. BPSK is functionally equivalent to 2-QAM modulation.

Quadrature-phase-shift-keying (QPSK) sometimes this is known as **quadriphase** *PSK*, 4-PSK, or 4-QAM. (Although the root concepts of QPSK and 4-QAM are different, the resulting modulated radio waves are exactly the same). With four phases, QPSK can encode two bits per symbol, with Gray coding to minimize the bit error rate (BER) — sometimes misperceived as twice the BER of BPSK. QPSK can be used either to double the data rate compared with a BPSK system while maintaining the same bandwidth of the signal, or to maintain the data-rate of BPSK but halving the bandwidth needed. The advantage of QPSK over BPSK becomes evident: QPSK transmits twice the data rate in a given bandwidth compared to BPSK - at the same BER.

Quadrature amplitude modulation (**QAM**) is both an analog and a digital modulation scheme. It conveys two analog message signals, or two digital bit streams, by changing (modulating) the amplitudes of two carrier waves, using the amplitude-shift keying (ASK) digital modulation scheme or amplitude modulation (AM) analog modulation scheme. The two carrier waves, usually sinusoids, are out of phase with each other by 90° and are thus called quadrature carriers or quadrature components — hence the name of the scheme. The modulated waves are summed, and the resulting waveform is a combination of both phase-shift keying (PSK) and amplitude-shift keying (ASK), or (in the analog case) of phase modulation (PM) and amplitude modulation. In the digital QAM case, a finite number of at least two phases and at least two amplitudes are used. PSK modulators are often designed using the QAM principle, but are not considered as QAM since the amplitude of the modulated carrier signal is constant. QAM is used extensively as a modulation scheme for digital telecommunication systems. Arbitrarily high spectral efficiencies can be achieved with QAM by setting a suitable constellation size, limited only by the noise level and linearity of the communications channel. QAM is being used in optical fiber systems as bit rates increase; QAM16 and QAM64 can be optically emulated with a 3-path interferometer.

Multiple-input and multiple-output (MIMO) is the use of multiple antennas at both the transmitter and receiver to improve communication performance. It is one of several forms of smart antenna technology. MIMO technology has attracted attention in wireless communications, because it offers significant increases in data throughput and link range without additional bandwidth or increased transmit power. It achieves this goal by spreading the same total transmit power over the antennas to achieve an array gain that improves the spectral efficiency (more bits per second per hertz of bandwidth) and/or to achieve a diversity gain that improves the link reliability (reduced fading). Because of these properties, MIMO is an important part of modern wireless communication standards such as IEEE 802.11n (Wi-Fi), 4G, 3GPP Long Term Evolution, WiMAX and HSPA+.

Orthogonal-frequency-division-multiplexing (**OFDM**) is a method of encoding digital data on multiple carrier frequencies. OFDM has developed into a popular scheme for wideband digital communication, whether wireless or over copper wires, used in applications such as digital television and audio broadcasting, DSL Internet access, wireless networks, powerline networks, and 4G mobile communications. OFDM is a frequency-division multiplexing (FDM) scheme used as a digital multi-carrier modulation method. A large number of closely spaced orthogonal sub-carrier signals are used to carry data on several parallel data streams or channels. Each sub-carrier is modulated with a conventional modulation scheme (such as quadrature amplitude modulation or phase-shift keying) at a low symbol rate, maintaining total data rates similar to conventional single-carrier modulation schemes in the same bandwidth. The primary advantage of OFDM over single-carrier schemes is its ability to cope with severe channel conditions (for example, attenuation of high frequencies in a long copper wire, narrowband interference and frequency-selective fading due to multipath) without complex equalization filters. Channel equalization is simplified because OFDM may be viewed as using many slowly modulated narrowband signals rather than one rapidly modulated wideband signal. The low symbol rate makes the use of a guard interval between symbols affordable, making it possible to eliminate intersymbol interference (ISI) and utilize echoes and time-spreading (on analogue TV these are visible as ghosting and blurring, respectively) to achieve a diversity gain, i.e. a signal-to-noise ratio improvement. This mechanism also facilitates the design of single frequency networks (SFNs), where several adjacent transmitters send the same signal simultaneously at the same frequency, as the signals from multiple distant transmitters may be combined constructively, rather than interfering as would typically occur in a traditional single-carrier system.

MIMO-OFDM System is the combination of MIMO System and OFDM System, which is used to provide high data rate for channel capacity, good quality for minimize probability of errors, minimize complexity/cost of implementation of proposed system, minimize transmission power required (translates to SNR), and minimize bandwidth (frequency spectrum) used.

3. Software used

This section provides the information about the software which is using in the work. The software name is MATLAB Software. This software is using because it is easy to use in compare to other software and easy to formed simulation result through coding.

MATLAB (**mat**rix **lab**oratory) is a multi-paradigm numerical computing environment and fourth-generation programming language. Developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, and Fortran. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing capabilities. An additional package, Simulink, adds graphical multi-domain simulation and Model-Based Design or dynamic and embedded systems. MATLAB has structure data types[3]. Since all variables in MATLAB are arrays, a more adequate name is "structure array", where each element of the array has the same field names. Although MATLAB has classes, the syntax and calling conventions are significantly different from other languages. MATLAB has value classes and reference classes, depending on whether the class has handle as a super-class (for reference classes) or not (for value classes). MATLAB supports developing applications with graphical user interface features. MATLAB includes GUIDE (GUI development environment) for graphically designing GUIs. It also has tightly integrated graph-plotting features. For example the function plot can be used to produce a graph from two vectors x and y.

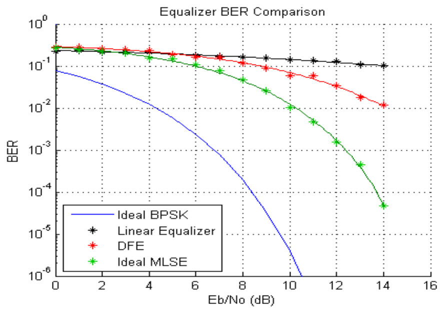
Simulink, developed by MathWorks, is a data flow graphical programming language tool for modeling, simulating and analyzing multi domain dynamic systems. Its primary interface is a graphical block diagramming tool and a customizable set of block libraries. It offers tight integration with the rest of the MATLAB environment and can either drive MATLAB or be scripted from it. Simulink is widely used in control theory and digital signal processing for multidomain simulation and Model-Based Design. MATLAB has several methods for plotting – both in two- and three-dimensional settings. MATLAB's plot function has the ability to plot many types of "linear" two-dimensional graphs from data which is stored in vectors or matrices. The user has control over the data points to be used for a plot, the line styles and colors and the markers for plotted points. The markers used for points in plot may be any of

- point
- circle
- cross
- plus
- star

4. Simulation Window

The general simulation window of MATLAB is shown below.

Run the linear equalizer, and plot the equalized signal spectrum, the BER, and the burst error performance for each data block. Note that as the Eb/No increases, the linearly equalized signal spectrum has a progressively deeper null. This highlights the fact that a linear equalizer must have many more taps to adequately equalize a channel with a deep null.



Conclusion

In this paper, section 1 is provides the review of channel estimation. After that next section provide the information about propose work. This work is show that the technique for channel estimation in BPSK-QPSK-PSK 16 & 64 QAM MIMO-OFDM System, which has been increasing the capacity of channel and reduce BER in past. This system use MATLAB software for the coding and simulate the result. The result will may be increases 1 to 3 percent from previous work.

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