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(REVIEW ARTICLE)

Channel Estimation of MIMO OFDM System

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Abstract

The channel can be estimated by using several estimation algorithms. The various types of pilot arrangements for the channel estimation are Initial estimation is a considerable issue in channel estimation techniques, since all of the following processes depends on it, which in this paper its improvement is discussed. Least Square (LS) method and Least Square Mean (LMS) are a common simple way to estimate a channel initially but its efficiency is not as significant as more complex approaches. Due to the increasing demand if high data rate in communications links and with respect to QoS parameters keep the developers inventing new methods and techniques to increase the capacity and the reliability of the communication network. One of the main problems in wireless communication is the communication channel which affected with a nonlinear and random noise sources, which decrease the quality of the service on the network, in this term the channel must be equalized to serve in better performance with a minimum error. In this project a design and simulate an MIMO - OFDM in order to estimate the channel and the performance of the network through using two main methods LS and LMS. After study and analysis of OFDM system, Study and analysis of MIMO techniques and their performance mathematical model and Simulate the system based on MATLAB.

Keywords: QoS; OFDM; MATLAB; Algorithms

1. Introduction

The focusing on the communication become a matter of concern in the world, because of the increased daily used of the telecommunication types and the high rated applications and due to increasing demand for the high data rates with effective utilization of available limited spectrum. To fulfil these requirements Multiple Input.

Multiple Output-Orthogonal Frequency Division Multiplexing (MIMO-OFDM) techniques have been adopted. MIMO technology is one of the major attracting techniques in wireless communications, because it offers significant increases in data throughput and coverage without additional bandwidth or transmitter power. It also provides high spectral efficiency and link reliability. Because of these properties, MIMO is an important part of modern wireless communication standards such as IEEE 802.11n (Wi-Fi), 4G, 3GPPLTE, WiMAX and HSPA+. In Mobile communication systems prior to transmit the information certain characteristics of the radio waves are changed in accordance with the information bits. At the receiving end the information bits are retrieved accurately, if the channel characteristics are known. The channel may vary instantaneously because of the propagating medium, which leads to the signal degradation. The Channel State information (CSI) provides the known channel properties for a wireless link. It provides the effects of fading and scattering on a signal propagating through the medium. Normally the CSI estimated at the receiver fed back to the transmitter. If it is not estimated accurately at the receiver, leads to system degradation. It can be estimated by using different channel estimation algorithms. This estimation can be done with a set of well-known sequence of unique bits for a particular transmitter and the same can be repeated in every transmission burst. Thus the channel estimator estimates the channel impulse response for each burst separately from the well-known transmitted

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bits and corresponding received samples. This paper describes the fundamentals of MIMO-OFDM system and study of various channel estimation techniques and their performance.

Objectives

The objective of this research to design and simulate an MIMO OFDM in order to estimate the channel and the performance of the network through using two main methods LS and MMSE.

2. Descriptive analysis

The following analysis is done to estimate the performance of channel, through The following block starts with generate random data the data illustrates the input of the system to the modulation block which uses QAM, BPSK and QPS modulation, after the modulation is completed a spread stage using OFDM modulation, to a MIMO 2x2 Antenna, the single transmitted through a wireless channel which affected with AWGN and Fading, then the MIMO receiver 2x2 receive the signal, to the OFDM demodulation for the process of De-Spreading, to demodulation stage.

Moreover, an error rate calculation block was used to compare the transmitted bits and the received bits to give three major performance analysis matric "Total Number of Bits, Error Bits and Bit Error Rate".

Simulating different types of modulation techniques such as BPSK and QAM modulation. The LS and MMSE channel estimations were used to evaluate the system performance and the channel characteristics.

3. Mathematical model

The impulse response of MMSE equalizer is given by:

Where Ch denotes the covariance matrix of the channel, that becomes a diagonal matrix if fading coefficients are statistically independent each other the diagonal component of Ch is equivalent to a power delay prof1ile of the channel. H MMSE requires the prior information of the power delay pro-file and the noise power, σ2.

4. Simulation environments

The following table showing the consider parameter:

Table 1 Simulation environments

Parameter	Value
Network	Wireless Network
Estimation Algorithms	LS and MMSE
SNR	0 to 30 dB
Bandwidth	20 MbPS
Modulation	BPSK-4QAM-8QAM

4.1. Simulation

4.1.1. Channel Estimation based on BPSK:

In following figure, the x axes represent the signal to nose ration (SNR) and the y axes represent the mean square error.

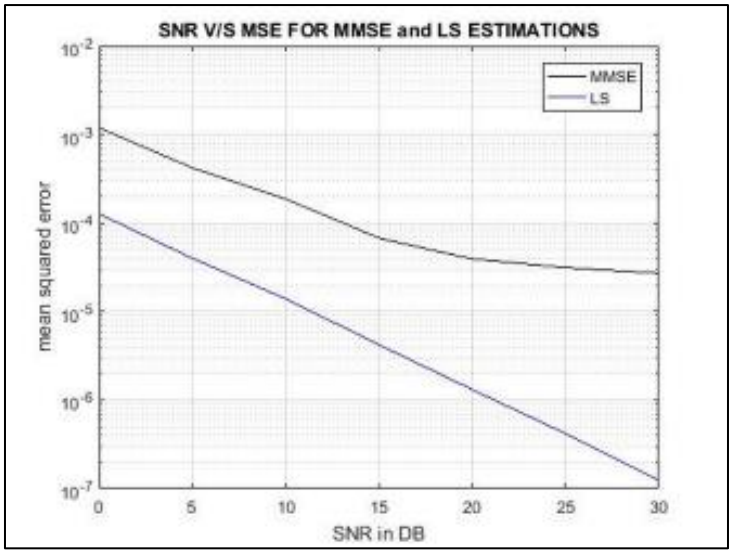

Figure 1 Channel Estimation based on BPSK

The figure represents an evaluation of LS and MMSE and through the graph it was found that LS method requires less SNR compared to MMSE.

4.1.2. Channel Estimation based on 4QAM:

In following figure, the x axes represent the signal to nose ration (SNR) and the y axes represent the mean square error.

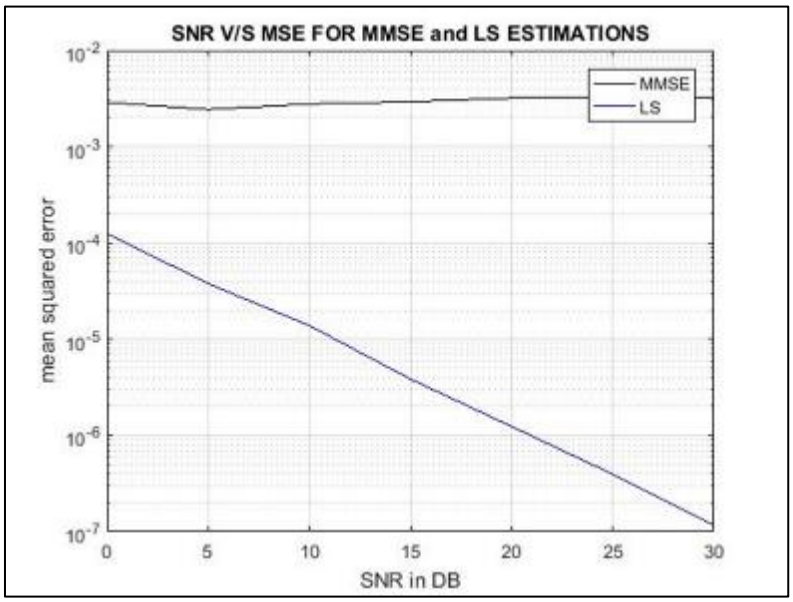

Figure 2 Channel Esti1mation Based on 4 QAM

The figure represents an evaluation of LS and MMSE and through the graph it was found that LS method requires less SNR compared to MMSE.

4.1.3. Channel Estimation based on 8QAM:

In following figure, the x axes represent the signal to nose ration (SNR) and the y axes represent the mean square error.

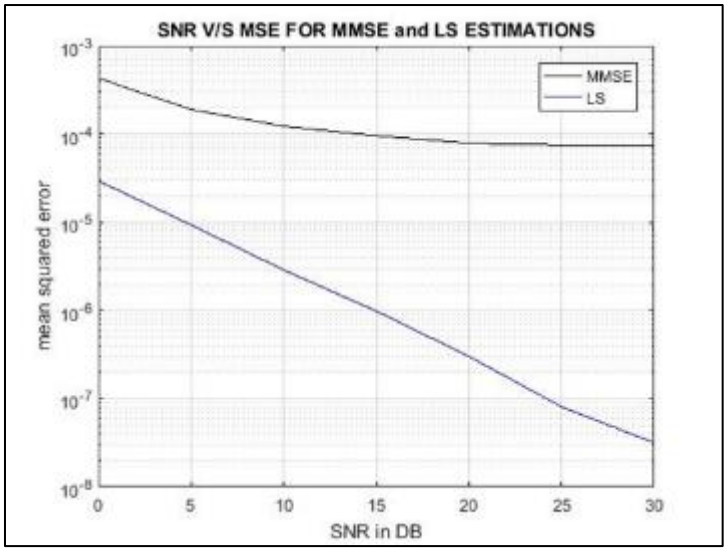

Figure 3 Channel Estimation Based on 8 QAM

The figure represents an evaluation of LS and MMSE and through the graph it was found that LS method requires less SNR compared to MMSE.

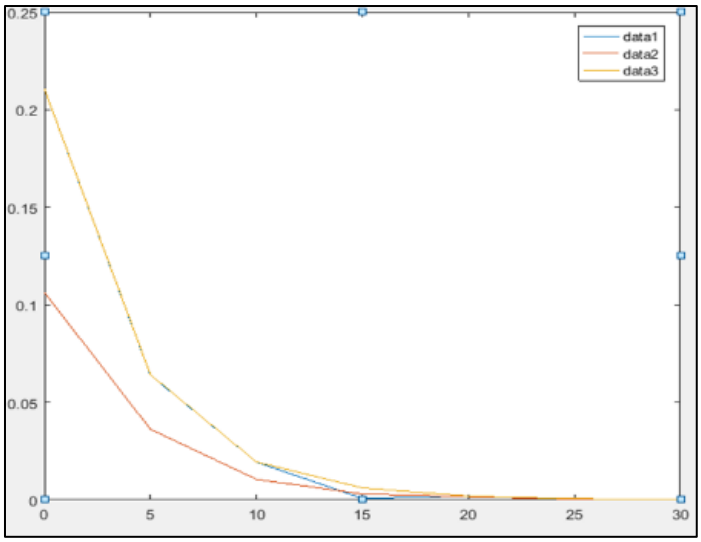

Figure 4 LSE TABLE

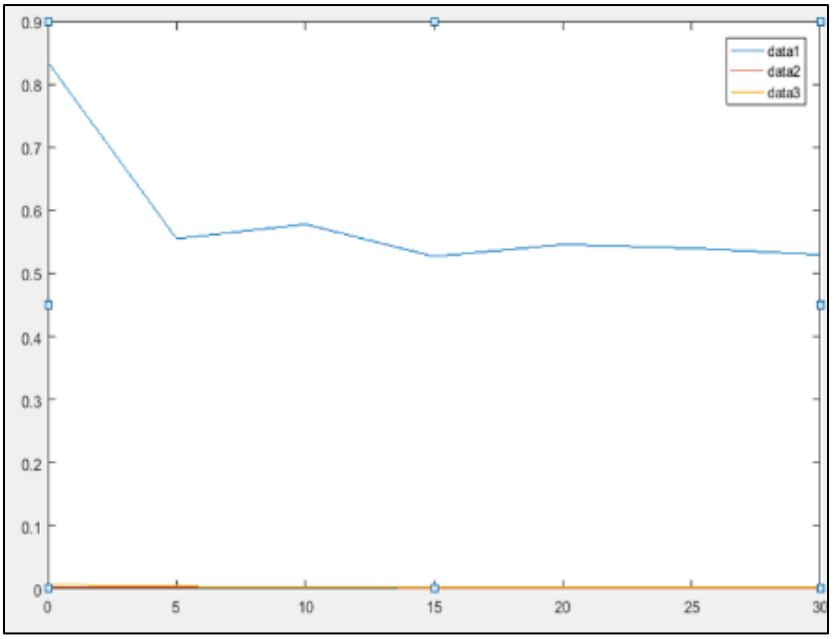

Figure 5 MMSE TABLE

5. Conclusion

In this project the main problems in wireless communication is the communication channel which affected with a nonlinear and random noise sources, which decrease the quality of the service on the network, in this term the channel must be equalized to serve in better performance with a minimum error. A design and simulation of MIMO/SISO OFDM in was done and the estimation of channel and its performance was done through using two main methods LS and MMSE.

The channel estimation technique based on pilot aided block type training symbols using LS and MMSE algorithm. The Channel estimation is one of the fundamental issues of OFDM system design. The transmitted signal under goes many effects such reflection, refraction and diffraction. Also due to the mobility, the channel response can change rapidly over time. At the receiver these channel effects must be canceled to recover the original signal. The MMSE is compared with LS and the MMSE performs better than the LS where the performance metric is Bit error rate, symbol error rate, mean square.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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Authors short biography

Majzoub Hassan Abdelwahab Khairi received his bachelor of Electronic Engineering degree in Telecommunication Engineering from University of Gezira, Sudan in 2014. He worked in Sudanese Mobile Telephone Co.Ltd. (Zain Sudan) for telecommunication in Sudan at the years 2015 till 2017. Engineer Majzoub has been appointed as purchasing coordinator at DUN Trading Establishment, Riyadh, Saudi Arabia in September 2017 till September 2019. In addition to his experience in the computer and the ability to speak English.