Advances and Applications in Mathematical Sciences
Volume 21, Issue 9, July 2022, Pages 5145-5151

PERFORMANCE ANALYSIS OF RICIAN CHANNEL IN ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING

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Abstract

Orthogonal frequency division multiplexing (OFDM) is a particular multi carrier transmission scheme example capable to maintain data at high rate for wireless systems. Although estimation of communication channel is a very necessary component of orthogonal frequency division multiplexing, the relevant technique is involved applied. Approximation of the channel at pilot frequencies is purely based on Least Square and Minimum Mean Square Estimation method, making utilization of 16- QAM scheme for modulation. In this research paper we have used MATLAB for Simulation purpose of OFDM signal. Also to examine the Bit Error Ratio (BER) variation when Multi propagation effects and Signal to Noise Ratio are varied on transmission channel. The performance of the Rician channel is also analyzed by using LS and MMSE channel estimation schemes.

1. Introduction

OFDM is preferred for large data transmission in the wireless system, larger Band width competence ability plus the stoutness towards the well-known phenomena called as the multi- path propagation [1]. The extensive utilization is in the Local Area Network standards such as IEEE802.11a along with the various European standards such as the Hyperlan/2. A suitable estimate of the channel is quite necessary before the process of the demodulation is done for a particular OFDM received signal in the wireless environment. Ever since the channel utilized for the wireless communication

2020 Mathematics Subject Classification: 94A11.

Keywords: Orthogonal Frequency Division Multiplexing, BER, ISI.

Received January 19, 2022; Accepted May 11, 2022

is time varying in nature as well as frequency selective for the broad band communication in wireless communication systems [4].

Utilization of sub-carriers in large numbers for the purpose of transmitting the data information. As spaced broadly also possess band that is narrow. The distance between the carriers is very less as it is provides large spectral efficiency. The specialty of OFDM is its immunity towards the multi path propagation effect at the receiving end [2]. It gives rise to the selective frequency fading. The major drawbacks caused due to fading can be solved by flat channel concept which is due to the large number of narrow band carriers, it can be called as easy equalizing.

Simulation model for OFDM

The MATLAB Code utilized in this work is for demonstrate the execution channel estimators such as LS and MMSE estimators. Also the channel estimation is done by making usage of 16-QAM Modulation arrangement. The arrangement of every fragment of the operation can be depicted in figure. No 1 as shown below. For transmission in the final portion, at the receiver side when the information is acquired, the analysis of received data for comparison and to investigate the (BER) bit error rate. The work is not explaining the process of running the code does not explain the simulation Code still it emphases over the outcomes that is achieved after running the simulation code.

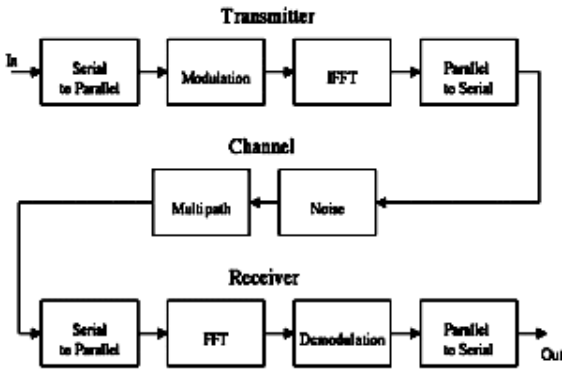

Figure 1. OFDM System.

Approximation of Channel

Two important OFDM transmission schemes are depicted in the figure. no 2. The basic organization is called as the block type arrangement, as the arrangement is designed considering the channel in drawn-out attenuation assumption, also the arrangement is done by insertion of pilot tones inside all the sub-carriers of the specific duration in the OFDM symbols of OFDM [6]. As shown the next structure is called as the comb like pilot arrangement, it is especially introduced to meet the requirement of equalizing during the shift of channel from one block of OFDM to the consequent. This is all done with the help of inserting the pilot tones inside the sub-carriers for every OFDM symbol, as the need of the interpolation is there for the approximation of the entire process [10] [14].

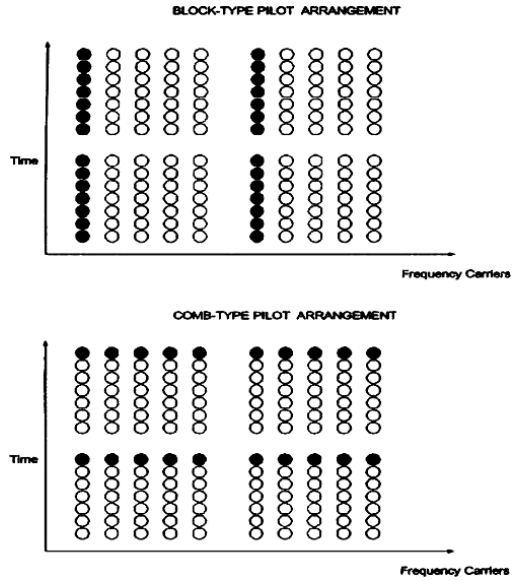

Figure 2. Arrangement of the Pilot.

As shown in the figure.no.2 above the block type of channel estimation method the symbols of the channel evaluation are sent or transmitted in equal duration, and it is observed that all the carriers are used as the pilots for the transmission purpose. It is been observed that the Least square estimate is assailable to the carrier interference and also the noise, Minimum mean square estimation scheme is introduced for the MMSE is proposed while settle of the quality.

A. AWGN Channel

For analyzing the modulation schemes Additive white Gaussian noise channel (AWGN) is utilized for communication. In which the insertion of noise into signal that is varying. Due to this the signal will acquire dual conditions. The flat response for amplitude frequency is achieved, as it will go inside the transmission achieving no rise loss and will acquire a large bandwidth. Also the phase frequency response will be linear in the nature, therefore there will be no phase distortion [4]. This channel can be given by

$$r(t) = s(t) + n(t) \tag{6}$$

Rayleigh Channel

Due to the multi path propagation phenomenon in the wireless communication, the radio signal will reach at the receiver end with different paths [9]. Ducting causes due to the multipath propagation which also includes the ionosphere reflection and the refraction occurs due to the mountains and the terrestrial objects. The arrangement is utilized as there could not be direct line between the sender and the recipient system [7]. The Multipath signal flat fading in the absence of LOS can be approximated by the Rayleigh channel and is given by

$$r(t) = s(t) * h(t) + n(t) \tag{7}$$

$n(t)$ is the additive white Gaussian noise and the received signal is given by r(t). The channel matrix is given by $h(t)$.

C. Rician Channel

When the transmitter and receiver have direct path between each other the rician channel channel comes into highlight to study the OFDM signal [5]. Rician distribution is used to estimate this type of signal when the major signal component is driven into the fading condition, the signal characteristics gets transformed into Rayleigh distribution from rician distribution and can be presented by

$$r(t) = s(t) * h(t) + n(t) \tag{8}$$

In the equation shown above $r(t)$ is called as the as $r(t)$ is the standard

signal and the random channel matrix is given by $h(t)$. The additive white Gaussian noise is $n(t)$. The Rician distribution can be given by

$$p(r) = \frac{r}{\sigma^2} e^{\frac{r^2+A^2}{\sigma^2}2} I = \left(\frac{Ar}{\sigma^2}\right) \text{ For } A \geq 0 \geq 0 \tag{9}$$

The modified Bessel function is denoted by 'Io' which is of the first kind and zero order and the peak amplitude of the signal can be denoted by 'A'. The K factor is ratio of signal power and scattered power.

$$K = C^2\alpha/2\sigma^2 \tag{10}$$

The power can be given as

$$\sigma^2 = P/(K+1) \tag{11}$$

The line of site amplitude is

$$C = (2KP/(K+1)) \tag{12}$$

It is seen as the SNR is increased the Bit error rate is reduced that BER, as the K factor value is modified the Bit error rate will remain stable [15].

IV. Simulation Results

The simulation for the channel is done by using MATLAB software. By making use of it the bit error ratio verses signal to noise ratio response is plotted in case of Rician channel. The channel estimators are included. It is be distinctly seen from simulation results that the bit error rate is becoming less as the signal to noise ratio is enhanced. As shown in this paper the simulation code is utilized to verify the execution of both the channel estimators such as the Least square and the minimum mean square channel estimators. Also assumed in this code FFT length is 64 along with carriers. The pilot is not assigned with carrier specifically. Length of the guard interval is sixteen, three hundred is the frame count for the system, as it is increased for the requirement. The frequency for the sampling is set to 20 MHz. As the performance is shown in the figure for Rician channel by making use of 16 QAM scheme. The simulation results are providing a perfect view of two types of channel estimators, firstly the least square channel estimator

and the other is the Minimum mean square estimator. From the above outcomes. It is seen that after applying channel estimator in the sub-carrier system performance upsurges, the performance of the Rician channel is enhanced in the situation when the Least square estimator is functional.

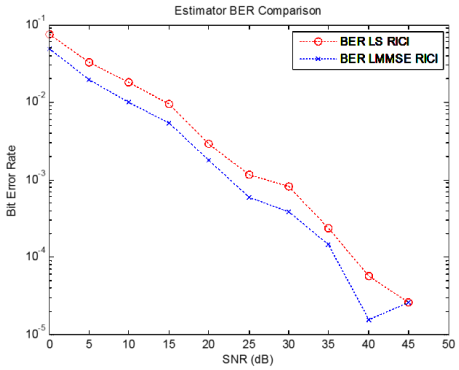

Figure 4. Least Square and Minimum Mean square Estimators response for Rician channel using 16-QAM modulation scheme.

V. Conclusion

The sub-carrier modulation system can be efficiently evaluated by using these channel channel estimators. Also giving us a certain knowledge about the evaluated channel statistics. In addition the complexity of Minimum Mean Square Error Channel estimator is more as compared to Least square estimator. The above results of simulation are obtained by using 64 sub carriers in OFDM system. We can also see the effect of implementing the estimators such as the least square and the minimum mean square error estimator in the multi-carrier arrangement. The above outcomes show us the BER verses SNR plot for with and without channel estimator based receiver using 16- QAM modulation scheme.

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