iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** I **Month of publication:** January 2022

DOI: https://doi.org/10.22214/ijraset.2022.39776

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue I Jan 2022- Available at www.ijraset.com

Channel Estimation for MIMO Systems

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Abstract: ***A combination of multiple-input multiple-output (MIMO) systems and orthogonal frequency division multiplexing (OFDM) technologies can be employed in modern wireless communication systems to achieve high data rates and improved spectrum efficiency. For multiple input multiple output (MIMO) systems, this paper provides a Rayleigh fading channel estimation technique based on pilot carriers. The channel is estimated using traditional Least Square (LS) and Minimum Mean Square (MMSE) estimation techniques. The MIMO-OFDM system's performance is measured using the Bit Error Rate (BER) and Mean Square Error (MSE) levels.***
Keywords: MIMO, MMSE, Channel estimation, BER, OFDM

I. INTRODUCTION

Mobile communication systems use changes in the amplitude and phase of radio waves to deliver bits of data. The receiving side of a mobile system's amplitude or phase may vary significantly. This lowers system quality since the receiver's performance is strongly reliant on the correctness of the estimated instantaneous channel. As a result, a channel estimate technique is utilised to improve the accuracy of the received signal. Inter symbol interference (ISI) occurs in the received signal in mobile communication systems because radio channels are frequently multi path fading channels. A variety of detection methods are used on the receiver side to remove ISI from the signal. The channel impulse response (CIR), which can be produced using a different channel estimator, is required by these detectors.

OFDM (Orthogonal Frequency Division Multiplexing) is a multi-carrier modulation technology that allows high-speed data streams to be transmitted across wireless networks. It divides the high-rate data stream into multiple lower-rate data streams that are delivered simultaneously over many subcarriers. This approach also eliminates inter-symbol interference (ISI).

It also permits sub-carrier bandwidth to overlap without causing inter-carrier interference (ICI). In OFDM, a specific set of orthogonal carrier frequencies can be used to obtain high spectral efficiency.

II. OFDM SYSTEMS

Each channel in a digital communications system must operate at a specified frequency and with a specific bandwidth. In truth, communication systems have evolved to allow for the transmission of the greatest quantity of data over a finite frequency range. In this paper, we'll look at how communications systems have recently evolved to use a variety of strategies to effectively use the frequency spectrum. We'll go through how frequency division multiplexing (FDM) and orthogonal frequency division multiplexing (OFDM) can effectively use the frequency spectrum in more detail. Furthermore, we will separate the two and explain why OFDM systems are now being used in some of the most modern and cutting-edge communications systems.

III.MIMO SYSTEMS

Multiple-Input MIMO (Multiple-Input Multiple-Output) is a wireless technology that increases the data capacity of an RF radio by using multiple transmitting and receiving antennas. In a MIMO system, the same data is supplied across several antennas along the same channel and in the same bandwidth. As a result, each signal reaches the receiving antenna through a different path, resulting in more reliable data. The number of transmit and receive antennas is similarly proportional to the data rate. The receiver is designed to account for minor delays in signal reception as it travels via several paths, as well as any added noise or interference, and even lost communications.

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A. Benefits of MIMO systems

Because they use bounced and reflected RF waves, MIMO systems give better signal strength even when there is no clear line-of-site.

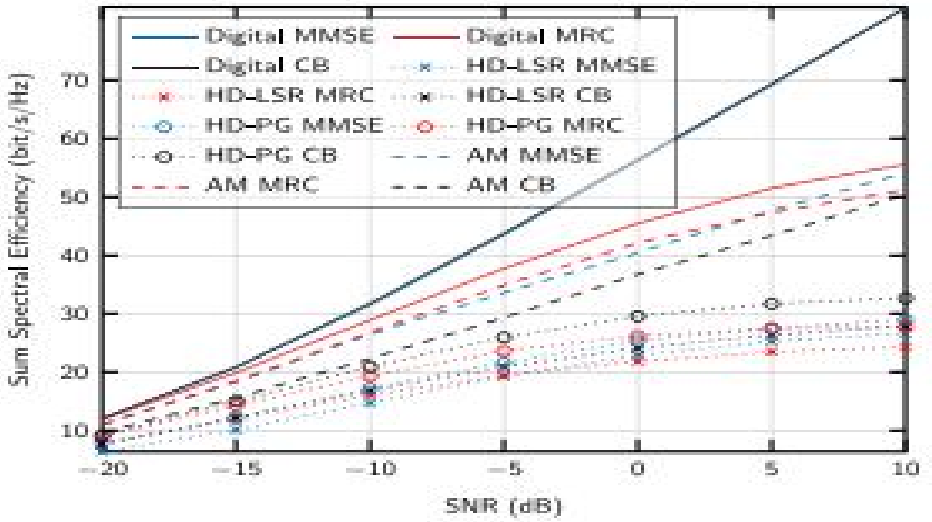
Because of the faster throughput, the quality and quantity of video broadcast via the network can be improved.

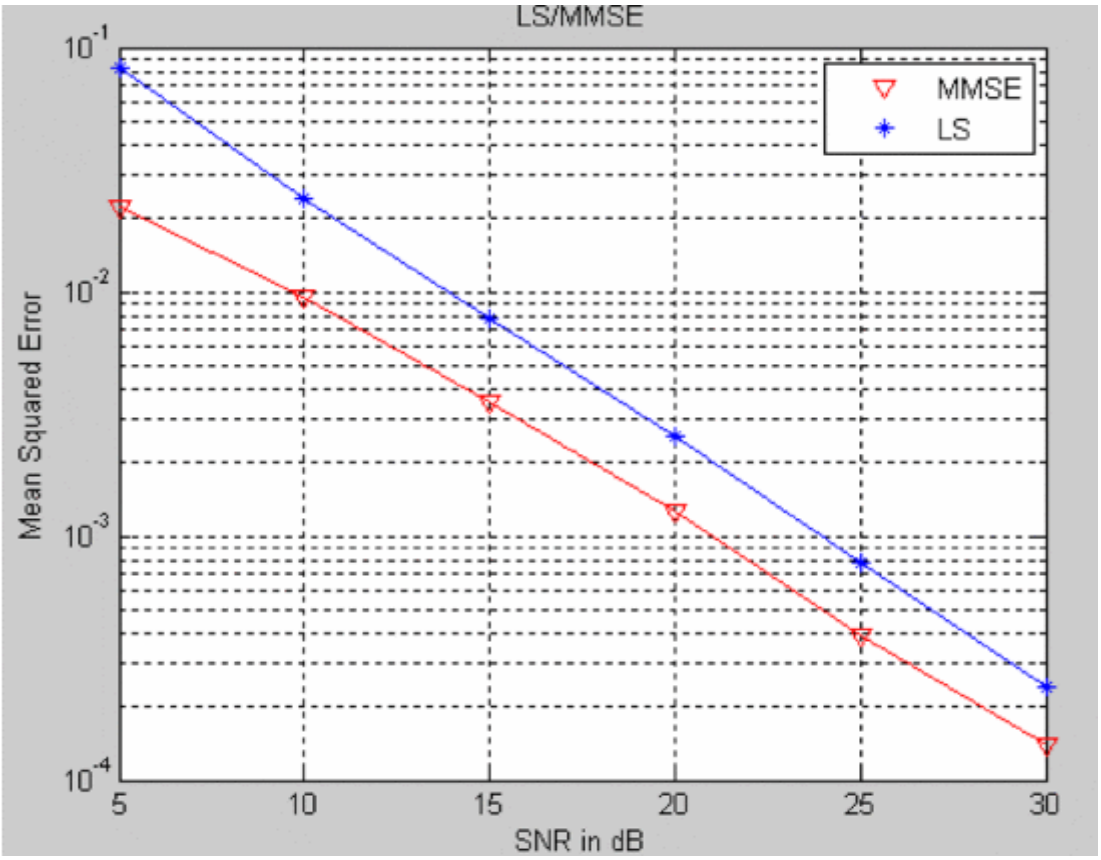
The frequency of lost data packets is reduced when many data streams are used, resulting in greater video or audio quality.

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Typical MIMO setups include:
MIMO 2x2 (two transmit antennas, two receive antennas)
MIMO 3x3 (three transmit antennas, three receive antennas)
MIMO 4x4 (four transmit antennas, four receive antennas)
MIMO 8x8 (eight transmit antennas, eight receive antennas)

IV. RESULTS





V. CONCLUSION

The channel estimation on a MIMO-OFDM system for a Rayleigh fading channel is investigated in this study. Two alternative techniques, LS channel estimation and MMSE channel estimation, are used, and simulation is carried out. The simulation findings show that in a MIMO- OFDM system, MMSE channel estimation has lower MSE and BER than LS channel estimation, and that channel estimation utilising comb type pilot carrier has lower BER than block type pilot carrier. As a result, the MMSE channel estimator outperforms the LS channel estimator.

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VII. CONCLUSIONS

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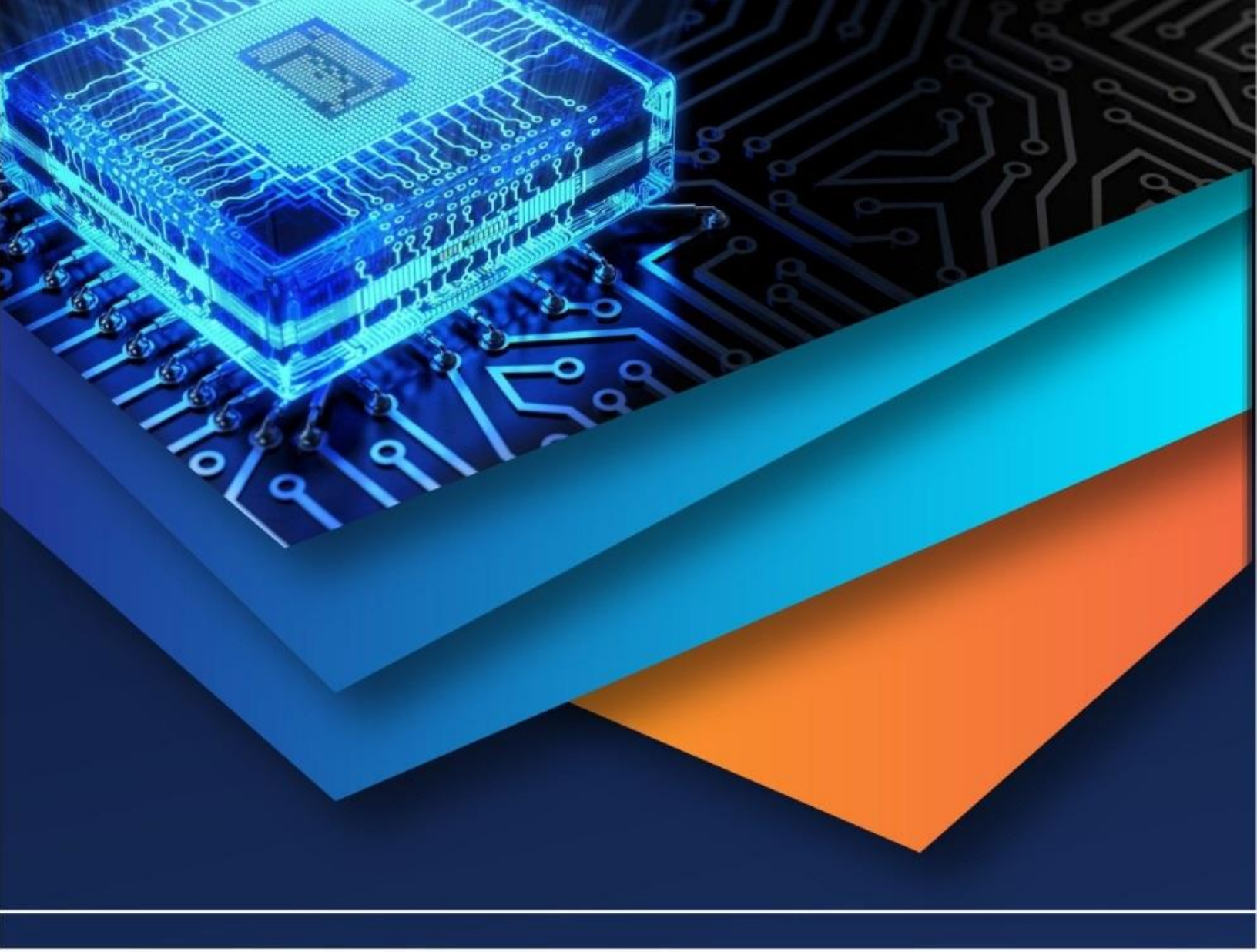
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