

MIMO-OFDM Techniques for Wireless Communication System: Performance Evaluation Review

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ABSTRACT

The use of multiple antennas in wireless communication systems has resulted in multiple channels that facilitate the speed of data transfer and improved channel capacity. This technique that basically involves multiple input and multiple output (MIMO) antennas helps to improve system performance by reducing bit error rate (BER) while increasing signal to noise ratio (SNR). Also, the use of orthogonal frequency division multiplexing (OFDM) has helped in mitigating inter-symbol interference (ISI). A combination of MIMO and OFDM produces the MIMO-OFDM scheme. This paper reviewed the performance of BER in MIMO-OFDM system considering various digital modulation techniques. An empirical review of previous studies on MIMO-OFDM system regarding BER performance evaluation was carried out. The study demonstrated the performance of digital modulation schemes in OFDM system with respect to the Quadrature Amplitude Modulation (QAM). The results of the simulation based on MATLAB code revealed that lower order modulation yielded better BER performance than higher order. Furthermore, MIMO-OFDM system was modeled in MATLAB/Simulink and simulated to show that the use of multiple antennas at the transmitter and receiver helps in improving the performance of wireless communication system by reducing BER while increasing SNR considering two multipath channels – Rayleigh and Rician.

Keywords -Bit error rate, MIMO, MIMO-OFDM, OFDM, Signal to noise ratio

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1. INTRODUCTION

Communicating effectively over a large distance has been a challenge in wireless communication and the transition of modulation systems from analog to digital has further complicated the situations. Digital modulation schemes offer more information carrying capacity, better quality communication, data security and RF spectrum sharing to accommodate more services. Nevertheless, the implementation of digital modulation techniques like the Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) and Phase Shift Keying (PSK) comes with the different compromise. There is a tradeoff needed to be made between the available bandwidth and the number of bits/symbol that can be transmitted over the line, which in turn limits the maximum data rate on the link. Thus the selection of digital modulation techniques is absolutely critical, especially in an environment like the satellite uplink-downlink where resources are very limited and time slots are assigned at very high cost. The primary standards to determine modulation scheme depends on Bit Error Rate (BER), Signal to Noise Ratio (SNR), Available Bandwidth, Power efficiency, better Quality of

Service (QoS), cost effectiveness. Hence, it is necessary to ascertain which modulation technique that is capable of transmitting more bits per symbol and is more immune to error caused by noise and interference induced in the channel.

The digital modulation technique is an indispensable module for transmitting and receiving information instead of analog modulation. Compared to analog modulation, the digital modulation has improved noise immunity and robustness to channel impairment. However, the transmission of audio or video signal requires more cost of bandwidth and need to have no loss of information at receiving end. Hence, it is very important and useful to analyze the performance of digital modulation schemes in wireless communication system.

One of the key determinant performance factors of wireless communication system is the Bit Error Rate (BER). Thus selecting the best modulation scheme that can transmit more data and offer low error rate will be economically worthwhile.

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Advanced Techniques to Improve the Performance of OFDM Wireless LAN Michail Segkos, 2004-06-01 OFDM systems have experienced increased attention in recent years and have found applications in a number of diverse areas including telephone line based ADSL links digital audio and video broadcasting systems and wireless local area networks WLAN Orthogonal frequency division multiplexing OFDM is a powerful technique for high data rate transmission over fading channels However to deploy OFDM in a WLAN environment precise frequency synchronization must be maintained and tricky frequency offsets must be handled In this thesis various techniques to improve the data throughput of OFDM WLAN are investigated A simulation tool was developed in Matlab to evaluate the performance of the IEEE 802.11a physical layer We propose a rapid time and frequency synchronization algorithm using only the short training sequence of the IEEE 802.11a standard thus reducing the training overhead by 50% Particular attention was paid to channel coding block interleaving and antenna diversity Computer simulation showed that drastic improvement in error rate performance is achievable when these techniques are deployed

Theory and Design of Digital Communication Systems Tri T. Ha, 2010-10-28 Providing the underlying principles of digital communication and the design techniques of real world systems this textbook prepares senior undergraduate and graduate students for the engineering practices required in industry Covering the core concepts including modulation demodulation equalization and channel coding it provides step by step mathematical derivations to aid understanding of background material In addition to describing the basic theory the principles of system and subsystem design are introduced enabling students to visualize the intricate connections between subsystems and understand how each aspect of the design supports the overall goal of achieving reliable communications Throughout the book theories are linked to practical applications with over 250 real world examples whilst 370 varied homework problems in three levels of difficulty enhance and extend the text material With this textbook students can understand how digital communication systems operate in the real world learn how to design subsystems and evaluate end to end performance with ease and confidence

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Cable and Wireless Networks Mário Marques da Silva, 2016-01-06 Cable and Wireless Networks Theory and Practice presents a comprehensive approach to networking cable and wireless communications and networking security It describes the most important state of the art fundamentals and system details in the field as well as many key aspects concerning the development and understanding of current and emergent services In this book the author gathers in a single volume current and emergent cable and wireless network services and technologies Unlike other books which cover each one of these topics independently without establishing their natural relationships this book allows students to quickly learn and improve their mastering of the covered topics with a deeper understanding of their interconnection It also collects in a single source the latest developments in the area typically only within reach of an active researcher Each chapter illustrates the theory of cable

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WiMax Operator's Manual Daniel Sweeney,2004 This operational handbook covers the planning construction and day to day operation of a standards based broadband wireless network It explains the advantages of broadband wireless and where it constitutes a best solution and it also delineates the unique difficulties challenges and limitations of broadband wireless

Globecom ,2000 **Electrical & Electronics Abstracts** ,1997 **Towards the Wireless Information Society: Heterogeneous networks** Ramjee Prasad,2006 Accompanying DVD ROM contains further details on critical topics related to the research discussed in the book **The 13th IEEE International Symposium on Personal, Indoor, and Mobile Radio Communications** ,2002

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