

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 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

Date of Submission: 20, Nov 2022

Date of Acceptance: 26, Dec 2022

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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**Jacques Blanc-Talon, Don Bone, Wilfried
Philips, Dan Popescu, Paul Scheunders**



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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

PERFORMANCE ANALYSIS OF MIMO-OFDM SYSTEM USING CODING AND EQUALIZATION G.KRISHNA REDDY, **Ofdm Based Relay Systems for Future Wireless Communications** Milica Pejanovic-Djurisic, Enis Kocan, Ramjee Prasad, 2022-09-01 Relay systems have become a subject of intensive research interest over the recent years as it is recognized that they can improve performances and extend the coverage area of wireless communication systems Special attention has been dedicated to them since the proposal appeared for their implementation in mobile cellular systems Numerous researches conducted after that proposal have enabled incorporation of OFDM based relay systems in both accepted standards for IMT Advanced systems Nowadays researches are ongoing with the aim to define new solutions for performance improvement of the standardized OFDM relay systems for cellular networks and one of the interesting solutions is implementation of subcarrier permutation SCP at the relay R station The book OFDM based relay systems for future

wireless communications presents a comprehensive research results in analyzing behavior and performance of the OFDM based relay systems with SCP Dual hop relay scenario with three communication terminals and no direct link between the source S and the destination D has been analyzed as it is compliant with the accepted solutions for IMT Advanced systems The book includes performance analysis and performance comparison of OFDM based amplify and forward AF relay systems with fixed gain FG amplify and forward AF relay systems with variable gain VG decode and forward DF relay systems each including two SCP schemes known to maximize the system capacity and or improve the bit error rate BER performances Performance comparisons have enabled definition of optimal solutions for the future wireless communication systems in a given conditions and for the given optimality criteria OFDM based relay systems for future wireless communications contains recent research results in this area and is ideal for the academic staff and master research students in area of mobile communication systems as well as for the personnel in communication industry

Advanced Concepts for Intelligent Vision Systems Jacques Blanc-Talon, Don Bone, Wilfried Philips, Dan Popescu, Paul Scheunders, 2010-12-06 This book constitutes the refereed proceedings of the 12th International Conference on Advanced Concepts for Intelligent Vision Systems ACIVS 2010 held in Changchun China in August 2010 The 78 revised full papers presented were carefully reviewed and selected from 144 submissions The papers are organized in topical sections on image processing and analysis segmentation and edge detection 3D and depth algorithms and optimizations video processing surveillance and camera networks machine vision remote sensing and recognition classification and tracking

Advanced Wireless Communication and Sensor Networks Ashish Bagwari, Geetam Singh Tomar, Jyotshana Bagwari, Jorge Luis Victória Barbosa, Musti K.S. Sastry, 2023-07-12 This book covers wireless communication security issues advanced wireless sensor networks WSNs routing protocols of WSNs with cross layer solutions emerging trends in the advanced WSNs power management distributed sensing and data gathering techniques for WSNs WSNs security applications research of advanced WSNs with simulation results and simulation tools for WSNs Features Covers technologies supporting advanced wireless communication systems sensor networks and the conceptual development of the subject Discusses advanced data gathering and sharing distributed sensing techniques with its business applicability Includes numerous worked out mathematical equations and formulas as well as essential principles including figures illustrations algorithms and flow charts Provides pervasive background knowledge including both wireless communications and WSNs Covers wireless networks as well as sensor network models in detail This book is aimed at graduate students researchers and academics working in the field of computer science wireless communication technology and advanced WSNs

WiMAX Networks Ramjee Prasad, Fernando J. Velez, 2010-06-10 Ignited by the mobile phone s huge success at the end of last century the demand for wireless services is constantly growing To face this demand wireless systems have been and are deployed at a large scale These include mobility oriented technologies such as GPRS CDMA or UMTS and Local Area Network oriented technologies such as WiFi WiMAX Networks covers aspects of

WiMAX quality of service QoS security mobility radio resource management multiple input multiple output antenna planning cost revenue optimization physical layer medium access control MAC layer network layer and so on Advances in Mobile Computing and Communications M. Bala Krishna,Jaime Lloret Mauri,2016-08-19 By 2020 if not before mobile computing and wireless systems are expected to enter the fifth generation 5G which promises evolutionary if not revolutionary services What those advanced services will look like sound like and feel like is the theme of the book *Advances in Mobile Computing and Communications Perspectives and Emerging Trends in 5G Networks* The book explores futuristic and compelling ideas in latest developments of communication and networking aspects of 5G As such it serves as an excellent guide for advanced developers communication network scientists researchers academicians and graduate students The authors address computing models communication architecture and protocols based on 3G LTE LTE A 4G and beyond Topics include advances in 4G radio propagation and channel modeling aspects of 4G networks limited feedback for 4G and game theory application for power control and subcarrier allocation in OFDMA cellular networks Additionally the book covers millimeter wave technology for 5G networks multicellular heterogeneous networks and energy efficient mobile wireless network operations for 4G and beyond using HetNets Finally the authors delve into opportunistic multiconnect networks with P2P WiFi and cellular providers and video streaming over wireless channels for 4G and beyond *MAC Protocol Design in Full-Duplex Enabled Wireless Networks* Liquan Fu,Shengbo Liu,Wen Wu,Ning Zhang,Weihua Zhuang,2024-05-09 This book thoroughly examines the design of full duplex medium access control MAC protocols in wireless networks It is organized into three main sections a Fundamentals and preliminaries of full duplex communications b A comprehensive review of the existing full duplex MAC protocols and c Designs of full duplex MAC protocols in three typical wireless networks i e wireless local access networks WLANs multi hop networks and millimeter wave networks Also the authors extensively address key challenges in these three wireless full duplex networks such as the hidden node problem accumulative interference and deafness and blockage problems Solutions to these challenges are meticulously devised to enhance the overall network performance The wireless full duplex communication technique facilitating simultaneous transmission and reception within the same frequency band holds immense potential for enhancing spectrum efficiency and network capacity It emerges as a pivotal technology in the sixth generation 6G networks This book provides a comprehensive review and in depth exploration of full duplex MAC design across various networks encompassing WLANs multi hop networks and millimeter wave networks Acknowledging the challenges faced by full duplex WLANs particularly the hidden node problem it also introduces a pioneering hidden node free design and a MAC protocol design which features a full duplex enhanced carrier sensing mechanism Addressing the need to augment end to end throughput in multi hop networks employing full duplex relaying the authors present an analytical model for end to end throughput and propose a multi hop full duplex MAC protocol designed to optimize network performance Furthermore the exploration extends to full duplex millimeter wave networks delving into

issues of deafness and blockage A directional full duplex MAC protocol is introduced to enhance network capacity and mitigate blockage problems This book concludes by outlining prospective research directions within the related fields of study and offers valuable insights for future exploration This book targets researchers and advanced level students in computer science and electrical engineering It also caters to professionals engaged in the fields of wireless networks full duplex system protocol design and network optimization will also buy this book **Introduction to Mobile Computing** Dr. Shamsul Haque,Dr. Manali Gupta,Dr. Sonia Arora ,Ms. Gagandeep Bhatia,2025-09-26

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In a global inundated with screens and the cacophony of fast interaction, the profound power and mental resonance of verbal beauty usually disappear into obscurity, eclipsed by the continuous onslaught of noise and distractions. Yet, set within the lyrical pages of **Advanced Techniques To Improve The Performance Of Ofdm Wireless Lan**, a captivating function of literary beauty that impulses with natural emotions, lies an unique journey waiting to be embarked upon. Published by way of a virtuoso wordsmith, that enchanting opus guides viewers on an emotional odyssey, lightly exposing the latent possible and profound affect embedded within the intricate web of language. Within the heart-wrenching expanse of this evocative analysis, we shall embark upon an introspective exploration of the book is key styles, dissect their captivating writing type, and immerse ourselves in the indelible impression it leaves upon the depths of readers souls.

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