

الإستهلال



قال تعالى:

" إِنْ أُرِيدُ إِلَّا الْإِصْلَاحَ مَا اسْتَطَعْتُ وَمَا تَوْفِيقِي إِلَّا بِاللَّهِ عَلَيْهِ تَوَكَّلْتُ
وَإِلَيْهِ أُنِيبُ "

صدق الله العظيم

سورة هود

الآية (٨٨)

DEDICATION

To Our Precious Mothers

To Our fathers, brothers and Sisters

To Our teachers & our colleagues

We dedicate this work

AKNOWLEDGMENT

Deep and sincere gratitude to our supervisor, Dr. Ashraf Gasim Elsid. For his guidance in order to complete this project. We have to thank our teachers in electronic engineering department for their endless and continuous efforts. Our gratitude couldn't be finished without giving our families and friends appreciation. They had always given us continuous encouragement and love specially our mothers.

Abstract

Wireless communication field is in continuous enhancement. Modern receivers and transmitters play an important role in the transmission process. They must be simple but more reliable to handle different applications. This Thesis concerned with simulating NOAA Microsatellite transmission. There are many types of signals that affect the satellite communication which is a transmission of data through wireless channel. The noise is the most common problem facing the satellite. The communication here will have high bit error rate, and hence high power consumption. In addition, many power saving methods were developed each has its own performance. That makes it difficult to use the suitable one. The microsatellite has been proposed as a solution to overcome the high power consumption with the use of two different models to be compared with Saleh model that reduce the BER value.

The performance of the system is analyzed by the error probability called Bit Error Rate (BER) along with calculating the system capacity, throughput and delay time. The simulation was performed and successfully tested using three main different models which are: Saleh model, Rapp model and cubic polynomial model. The simulation results of the system resemble very good performance and it was found that the Saleh model is the best method used that uses low power to optimize the transmission, and the delay time.

المستخلص

ان مجال الاتصالات اللاسلكيه في تطور مستمر. أجهزة الارسال والاستقبال المتطورة تلعب دورا مهما في عمليات ارسال البيانات. هذه الاجهزة يجب ان يتم تحديثها باستمرار بحيث تراعي البساطه والموثوقيه والقدرة على التعامل مع التطبيقات المختلفه.

هناك العديد من العوامل المؤثره سلبا على اشارات القمر الاصطناعي. و يعتبر الضجيج من اهمها، حيث يزيد من معدل الأخطاء في النظام ومقدار الطاقه المستهلكه في النهايه. و بالإضافة لوجود العديد من الطرق المستخدمه لتحسين استهلاك الطاقه في النظام، فان اختيار الطريقه المثلى يعد تحديا في حد ذاته.

هذا المشروع يقوم بعمل محاكاة للقمر الصناعي المصغر "نوا" المختص باستقبال صور مراقبه الارض والغلاف الجوي.

ان اداء النظام تم تحليله باستخدام معدل الاخطاء في البيانات المرسله، و زمن التأخير في استقبال البيانات، والطاقه الانتاجيه للنظام. وتم استخلاص النتائج عن طريق استقبال البيانات ومقارنه اداء النظام باستخدام ثلاثه مكبرات مختلفه.

تم تحسين الاداء عن طريق استخدام مكبر صالح ليعطي معدل اخطاء اقل من بقيه المكبرات التي تمت مقارنتها مع بعضها.

Contents

الاستهلال.....	I
DEDICATION.....	II
ACKNOWLEDGMENT	III
ABSTRACT	IV
ABSTRACT IN ARABIC	V
CONTENTS.....	VI
LIST OF TABLES	X
LIST OF FIGURES	XI
ABBREVIATIONS and SYMBOLS	XII
1. Chapter One: Introduction	1
1.1 Preface.....	2
1.2 Problem Statement	3
1.3 Proposed Solution	3
1.4 Aim and Objectives.....	3
1.5 Methodology	3
1.6 Thesis Outlines.....	4

2. Chapter Two: Literature Review	5
2.1 Background	6
2.2 Literature Review.....	6
2.2.1 Microsatellite	8
2.2.1.1 Defense Advanced Research Projects Agency.....	8
2.2.1.2 SMART Microsatellite Bus	9
2.2.1.3 AEGIS.....	9
2.2.2 Microwave Propagation	10
2.2.3 Applications of Satellite Communications	11
2.2.3.1 Major Application	11
2.2.3.2 Issues Related to Applications	13
2.2.4 User terminals and satellites	14
2.2.5 Frequency Allocation for SService	15
2.2.6 Satellite Services	15
2.2.7 Satellite Transmission Frequency Bands	16
2.2.8 Classification of Satellite Orbits	18
2.2.9 Satellite Power	20
2.2.10 Satellite Function	20
2.2.11 Satellite Communication System.....	21
2.2.12 Advantages & Disadvantages of satellite communication	22
2.2.12.1 Satellite communications advantages	22
2.2.12.2 Satellite communication disadvantages	22
3. Chapter Three: Methodology	24
3.1 Transponder	25

3.2 Modulation	27
3.3 Bit Error Rate (BER).....	28
3.4 Signal-to-Noise Ratio	28
3.5 Bandwidth	29
3.6 Throughput	30
3.7 Path Loss	31
3.8 Additive White Gaussian Noise (AWGN).....	31
3.9 Simulation Scenario	32
3.9.1 Blocks Description.....	33
3.9.1.1 Data Source Block.....	34
3.9.1.2 IQ Mapping.....	34
3.9.1.3 Memoryless Nonlinearity to Complex	34
3.9.1.4 Downlink Path	34
3.9.1.5 Noise Emulator	34
3.9.1.6 Signal PreProcessing	34
3.9.1.7 IQ De-Mapping.....	35
3.9.1.8 Analysis Block.....	35
4. Chapter Four: Simulation Results	37
4.1 Matlab Simulation.....	38
4.2 Results.....	38
4.2.1 SNR/BER Comparison of Three Models	38
4.2.2 Delay Time Comparison.....	39
4.2.3 Throughput Comparison	40
4.2.4 NOAA Bandwidth	41

4.2.5 Saleh Model Power Spectrum	42
4.2.6 Rapp Model Power Spectrum.....	42
4.2.7 Cubic Model Power Spectrum.....	43
4.2.8 Transmitted and Received Data.....	43
4.2.9 Result justification	44
 5. Chapter Five: Conclusion and Recommendations	45
5.1 Conclusion.....	46
5.2 Recommendations	46
 References.....	48

List of Tables

Table No	Title	Page No
2-1	Satellites Classification	8
2-2	AEGIS Mass Distribution	10
2-3	Satellite Communications Bandwidths	17
2-4	Circular Satellite Orbit Classifications	18
4-1	Delay Time Values for all Models	39

List of Figures

Figure No.	Title	page No.
2-1	Microwave Propagation	11
2-2	Satellite Applications	14
2-3	Satellite Regions	15
2-4	Satellite Main Services	16
2-5	Different Frequency Bands Attenuations	16
2-6	Satellite Orbits	19
2-7	Satellite Communication System	21
3-1	Elements of a Basic Satellite Link	26
3-2	Baseband Bandwidth	29
3-3	Microsatellite Simulink Scenario	33
3-4	Analysis Block	35
3-5	BER Calculator	36
4-1	SNR/BER Models Comparison	39
4-2	Delay Time Comparison	40
4-3	Throughput Comparison	41
4-4	NOAA Satellite Bandwidth	41
4-5	Saleh Model Power Spectrum	42
4-6	Rapp Model Power Spectrum	42
4-7	Cubic Model Power Spectrum	43
4-8	Transmitted and Received Data	43

Abbreviations & Symbols

AEGIS	Air-launched Earth-observing Ground Information System
3G	Third Generation
AWGN	Additive White Gaussian Noise
BER	Bit Error Rate
BSS	Broadcasting Satellite Service
COTS	Commercial Orbital Transportation Services
DARPA	Defence Advanced Research Projects Agency
dB	Deci bell
FSS	Fixed Satellite Service
Geo	Geostationary Orbit
GHz	Giga Hertz
GPS	Global Positioning Systems
GSM	Global System Mobile
GSO	Geosynchronous Orbit
HEO	High Earth Orbit
HPA	High Power Amplifier
HZ	Hertz
ITU	International Telecommunication Union
KHz	Kilo hertz
LAN	Local area network
Leo	Low Earth Orbit
LNA	Low Noise Amplifier
LOS	Line Of Sight

LPA	Low Pass Amplifier
MATLAB	Matrix Laboratory
MEO	Medium Earth Orbit
MHz	Mega Hertz
MSS	Mobile Satellite Service
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
Rx	Receiver
SNR	Signal to Noise ratio
SSPA	Solid State Power Amplifier
TT&T	Tracking, Telemetry and Telecomm
TWTA	Travelling Wave Tube Amplifier
TX	Transmitter
U.S	United States
UHF	Ultra High Frequency