PERFORMANCE STUDY ON EFFECT OF CONVOLUTIONAL CODING IN WCDMA SYSTEM WITH DIFFERENT CHANNEL CONDITION

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To my beloved parents, brothers and sisters

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ABSTRACT

WCDMA system is meant for high data rate transmission such as implementation of the third generation (3G) mobile system. Any mode of mobile transmission is not free from channel impairment such as noise, interference and fading. These channel impairments caused signal distortion and degradation in signal to noise ratio (SNR). Thus one method to overcome this problem is by introducing channel coding in the mobile transmission system. Convolutional coding with coding rate = 1/2 is a standard determined by the 3GPP committee for the 3G system. In order to visualize the effect of convolutional coding in communication channel, simulation method of the WCDMA system is carried out. Thus computer simulation software, MATLAB has been used to evaluate the performance of convolutional coding in AWGN and Multipath Rayleigh Fading channel. Further analysis and discussion is made based on the results obtained. In general, channel coding has improved bit error rate of WCDMA system. However, as the speed of mobile terminal increases the capability of channel coding also degrades. Thus it is suggested that implementation of interleaver to improve quality of the system.

ABSTRAK

Pemodulatan Pembahagian Kod Pelbagai Capaian Lebar Jalur Luas (Wideband Code Division Multiple Access, WCDMA) adalah digunakan untuk transmisi data capaian tinggi seperti aplikasi sistem bergerak generasi ketiga (3G). Secara amnya, sebarang transmisi sistem bergerak adalah tidak terlepas daripada kerosakan saluran yang disebabkan oleh kebisingan, gangguan dan kepudaran isyarat. Kerosakan saluran ini menyebabkan pengherotan isyarat dan juga pengurangan terhadap nisbah isyarat kebisingan (signal to noise ratio-SNR). Salah satu cara untuk mengatasi masalah ini adalah dengan memperkenalkan kod saluran kepada transmisi sistem bergerak. Kod konvolusi dengan kadar kod = 1/2 merupakan standard yang telah ditetapkan oleh Jawatankuasa 3GPP untuk sistem bergerak generasi ketiga. Dalam mengkaji kesan kod konvolusi terhadap saluran komunikasi, simulasi terhadap sistem WCDMA telah dijalankan. Oleh itu, sistem simulasi MATLAB telah digunakan untuk menilai prestasi kod saluran terhadap saluran yang terdiri daripada Pertambahan Bunyi Hingar Putih Gaussian (AWGN) dan kelenturan pelbagai laluan Rayleigh (Multipath Rayleigh Fading). Analisa dan perbicangan lanjut telah dijalankan ke atas keputusan-keputusan simulasi yang diperolehi. Secara amnya, kod komunikasi mempunyai keupayaan untuk memperbaiki nilai kesilapan bit (bit error rate-BER) di dalam sistem WCDMA. Walau bagaimanapun, keupayaan kod komunikasi untuk memperbaiki BER berkurangan dengan pertambahan kelajuan terminal bergerak. Oleh itu, adalah dicadangkan penggunaan *'interleaver'* untuk memperbaiki kualiti sistem

TABLE OF CONTENT

CHAPTER	TITLE	PAGE
	TITLE	i
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENT	vii
	LIST OF TABLES	xi
	LIST OF FIGURES	xiii
	LIST OF ABBREVIATION	xv
	LIST OF APPENDIX	xvi
1	**INTRODUCTION**	**1**
1.1	Project Background	1
1.2	Problem Statement	2
1.3	Project Objectives and Scope of Work	2
1.4	Thesis Outline	3

2 WCDMA SYSTEM DESIGN 5

2.1 Evolution of Communication Systems 5
2.2 International Mobile Telecommunication 2000 (IMT2000) 7
2.2.1 Comparisons between WCDMA and Cdma2000 9
2.2.1.1 WCDMA 9
2.2.1.2 Cdma2000 10
2.2.1.3 Technical Comparison of WCDMA and Cdma2000 11
2.3 WCDMA-DSSS 13
2.4 Noise and Interference 15
2.4.1 Additive White Gaussian Noise (AWGN) 15
2.4.2 Rayleigh Fading 17
2.4.2.1 Doppler Shift 18

3 CHANNEL CODING 20

3.1 Overview of Channel Coding 20
3.2 Convolutional Coding 22
3.2.1 Convolutional Encoder Representation 23
3.2.2 The State Diagram 25
3.2.3 The Trellis Diagram 26
3.3 Channel Decoding (Viterbi) 28

4 WCDMA SYSTEM CONFIGURATION 29

4.1 Simulation Methodology 29
4.1.1 WCDMA Key Parameters 31

4.2 Simulation Phase I – WCDMA Configuration in AWGN channel without convolutional coding. 32
4.2.1 Transmitter design 34
4.2.1.1 User Data Sequence Generator 34
4.2.1.2 Spreading Sequence Generator 35
4.2.1.3 Spreader 37
4.2.1.4 QPSK Modulator 38
4.2.2 Communication Channel 39
4.2.3 Receiver Design 39
4.2.3.1 QPSK Demodulator 39
4.2.3.2 Despreader 40
4.2.3.3 Error Rate Calculation 41
4.2.3.4 Display 42
4.2.4 Performance Analysis for Phase I 43
4.3 Simulation Phase II – WCDMA Configuration in AWGN channel with convolutional coding 45
4.3.1 Transmitter Design 45
4.3.1.1 Convolutional Encoder 45
4.3.2 Communication Channel 49
4.3.3 Receiver Design 49
4.3.3.1 Viterbi Decoder 49
4.3.3.2 Error Rate Calculation 52
4.3.4 Performance Analysis for Phase II 54
4.4 Simulation Phase III – WCDMA Configuration in AWGN and Rayleigh Fading channel without convolutional coding 55
4.4.1 Transmitter Design 56
4.4.2 Communication Channel 56
4.4.2.1 Multipath Rayleigh Fading Channel 56
4.4.3 Receiver Design 60

4.4.4 Performance Analysis for Phase III 60
4.5 Simulation Phase IV – WCDMA Configuration in AWGN and Multipath Rayleigh Fading channel with convolutional coding 62

5 RESULTS AND DISCUSSION 64

5.1 Results for AWGN channel 64
5.2 Results for AWGN and Multipath Rayleigh Fading in communication channel. 67
5.2.1 For v = 60 kmph 67
5.2.2 For v = 90 kmph 69
5.2.3 For v = 120 kmph 71
5.3 Analysis and Discussion 74

6 CONCLUSION 75

6.1 Conclusion 75
6.2 Suggestion for Future Work 76

REFERENCES **78**

APPENDIX **81**

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
2.1	System comparison (Air Interface for 3GPPs' Release99)	11
4.1	General parameters for WCDMA system	32
4.2	Parameters for Bernoulli Data Generator block	34
4.3	Parameters used in PN Sequence Generator block	35
4.4	Parameters used in QPSK Modulator block	38
4.5	Parameters used in AWGN block	39
4.6	Parameters used in QPSK Demodulator block	40
4.7	Parameters used in Error Rate Calculation block	41
4.8	Parameters used in Display block	43
4.9	Parameters used in Convolutional Encoder block	47
4.10	Parameters used in Viterbi Decoder block	51
4.11	Parameters used in Error Rate Calculation block	53
4.12	Parameters used in Multipath Rayleigh Fading Channel block	58
4.13	Compatibility of Phase IV Parameters with Other Phases	62
5.1	Simulation Results of Phase I and Phase II	65

5.2	Simulation Results of AWGN and Multipath Rayleigh Fading with Doppler Shift = 55.56 Hz (speed, v = 60 kmph)	67
5.3	Simulation Results of AWGN and Multipath Rayleigh Fading with Doppler Shift = 83.33 Hz (speed, v = 90 kmph)	69
5.4	Simulation Results of AWGN and Multipath Rayleigh Fading with Doppler Shift = 111.11 Hz (speed, v = 120 kmph)	71

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
2.1	Frequency sharing in CDMA	13
2.2	Spreading technique	14
2.3	Relationship among the channel correlation functions and power density functions	19
3.1	Convolutional encoder (rate = 1/2, K = 3)	23
3.2	Example of convolutional encoder connection with different constraint length, K and generator polynomials	24
3.3	Encoder state diagram (rate = 1/2, K = 3)	26
3.4	Encoder trellis diagram (rate = 1/2, K = 3)	27
4.1	Simulation workflow	30
4.2	WCDMA System Block Diagram	31
4.3	Block Diagram for AWGN channel without Convolutional Coding	33
4.4	Block Diagram for AWGN channel with Convolutional Coding	48
4.5	Block Diagram for AWGN and Multipath Rayleigh Fading channel without Convolutional Coding	59
4.6	Block Diagram for AWGN and Multipath Rayleigh Fading channel with Convolutional Coding	63

5.1	BER of AWGN with and without convolutional coding	66
5.2	BER of AWGN and Multipath Rayleigh Fading with Doppler Shift = 55.56 Hz (speed,v = 60 kmph)	68
5.3	BER of AWGN and Multipath Rayleigh Fading with Doppler Shift = 83.33 Hz (speed,v = 90 kmph)	70
5.4	BER of AWGN and Multipath Rayleigh Fading with Doppler Shift = 111.11 Hz (speed,v = 120 kmph)	72
5.5	BER of AWGN and Multipath Rayleigh Fading without convolutional coding with different Doppler Shift values	73
5.6	BER of AWGN and Multipath Rayleigh Fading without convolutional coding with different Doppler Shift values	73

LIST OF ABBREVIATION

1G	First Generation
2G	Second Generation
3G	Third Generation
3GPP	Third Generation Partnership Project
AMPS	Advanced Mobile Phone Systems
ARIB	Association of Radio Industries and Business
AWGN	Additive White Gaussian Noise
BER	Bit Error Rate
CDMA	Code Division Multiple Access
ETSI	European Telecommunciations Standards Institute
FDD	Frequency Division Duplex
FM	Frequency Modulation
GSM	Global System Mobile
IMT2000	International Mobile Telecommunication 2000
ISI	Intersymbol Interference
ITU-R	International Telecommunications Union-Radio communications
kbps	kilo-bit-per-seconds
SMS	short messaging service
SNR	Signal-to-Noise-Ratio
TIA	Telecommunications Industry Association
UMTS	Universal Mobile Telecommunications System
WCDMA	Wideband Code Division Multiple Access

LIST OF APPENDIX

APPENDIX NO.	TITLE	PAGE NO.
A.1	The generic m file used to generate BER vs Eb/No graph for Phase I	81
A.2	The generic m file used to generate BER vs Eb/No graph for Phase II	82
A.3	The generic m file used to generate BER vs Eb/No graph for Phase III	83
A.3.1	For v = 60 kmph	83
A.3.2	For v = 90 kmph	83
A.3.3	For v = 120 kmph	84
A.4	The generic m file used to generate BER vs Eb/No graph for Phase IV	85
A.4.1	For v = 60 kmph	85
A.4.2	For v = 90 kmph	86
A.4.3	For v = 120 kmph	87
B.1	The generic m file used to plot of AWGN channel with and without convolutional coding	88
B.2	The generic m file used to plot of AWGN and Multipath Rayleigh Fading channel with and without convolutional coding	89

B.2.1	For v = 60 kmph	89
B.2.2	For v = 90 kmph	90
B.2.3	For v = 120 kmph	91
B.2.4	For different speed without convolutional coding	92
B.2.5	For different speed with convolutional coding	93

CHAPTER 1

INTRODUCTION

1.1 Project Background

The objective of digital communication is to propagate signal from the transmitter to the receiver. However, the communication channel is not free from the effects of channel impairments such as noise, interference and fading. These channel impairments caused signal distortion and signal to ratio (SNR) degradation.

One method that can be implemented to overcome this problem is by introducing channel coding. Channel encoding is applied by adding redundant bits to the transmitted data. The redundant bits increase raw data used in the link and therefore, increase the bandwidth requirement. So, if noise or fading occurred in the channel, some data may still be recovered at the receiver. While at the receiver, channel decoding is used to detect or correct errors that are introduced to the channel.

Wideband Code Division Multiple Access (WCDMA) is a standard established by IMT- 2000 in order to support higher data rates transmission for mobile system. This new standard is also employs channel coding in the communication link for better performance. Convolutional coding is one of the channel coding techniques which have been specified for WCDMA system.

1.2 Problem Statement

Multipath fading is a common phenomenon in mobile communication. It results from multipath propagation, reflection, refraction and diffraction. It caused communication environment changes quickly and thus introduces more complexities and uncertainties to the channel response. One known solution is by introducing channel coding in communication environment. Convolutional coding is used in WCDMA system due to its relatively good performance and with reasonably simple Viterbi decoding algorithm.

1.3 Project Objectives and Scope of Work

The aim of this project is to study the error performance of WCDMA system for convolutional coding in presence of Rayleigh multipath fading channel for single user environment. Thus three main objectives have been outlined, which are:

1. To investigate the effect of convolutional coding with different channel condition in WCDMA system
2. To simulate the system with different channel conditions which are Additive White Gaussian Noise (AWGN) and Rayleigh Multipath Fading with Doppler Shift.
3. To analyze BER for the simulated WCDMA system.

In order to achieve the objectives above, this project has been carried out totally based on simulation using Matlab software. Matlab is used to generate and calculate bit error rate (BER) and signal to noise ratio (SNR) for each predetermined channel condition.

1.4 Thesis Outline

This thesis is organized into six chapters. Chapter 1 provides an overview of the project which includes project background and objectives.

Chapter 2 gives in depth explanation on WCDMA system design that relates to the project scope, while Chapter 3 deals with the basic knowledge of channel coding of the system.

Chapter 4 covers the simulation methodology used in the project which based on Matlab software. Detailed explanation of the WCDMA model used in the

simulation is also presented which including the transmitter, receiver and channel design.

Chapter 5 presents the results and analysis of the simulation. The results of each WCDMA model are analyzed. Each subsection is ended by some discussion on the results.

Chapter 6 concludes the project with some suggestions on future development and conclusion on the work conducted throughout the project.

study between those coding schemes is essential to determine which coding scheme is more suitable for a system with different channel conditions.

5. It is also proposed that implementation of interleaver in the system in order to overcome the problem of irreducible error rate.

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