MODELLING RAYLEIGH FADING PROPAGATION AND EFFECT IN WIRELESS COMMUNICATION CHANNEL USING MATLAB

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This report is submitted in partial fulfillment of the requirements for the award of Bachelor of Electronic Engineering (Telecommunication Electronics) With Honours

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UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek	:	**Modelling Rayleigh Fading Propagation And Effect In Wireless Communication Channel Using MATLAB**
Sesi Pengajian	:	**2007 / 2008**

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DECLARATION

"I hereby declare that this report is result of my own works except for quotes as cited in the references."

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PENGESAHAN PENYELIA

"Saya akui bahawa saya telah membaca laporan ini dan pada pandangan saya laporan ini adalah memandai dari segi skop dan kualiti untuk tujuan penganugerahan Ijazah Sarjana Muda Kejuruteraan Elektronik (Elektronik Telekomunikasi) Dengan Kepujian."

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Tarikh : 9/5/08

DEDICATION

To my beloved family especially my mothers. Thank for supporting me and thank for God.

ACKNOWLEDGEMENT

Alhamdulillah, thanks to Allah the Almighty that I could finish this PSM 2 thesis. I want to express my sincere to the people that I had given support during this project implementation. First of all, I would like to thank to my supervisor Mr Redzuan bin Abdul Manap for his advise and assistance to me for accomplishing the project. Then, to my fmily especially my mum, Hjh Siti Rohani bt Md Isa and to all my friends for their suggestion and critism that always improved my progress in this project. Finally, I want to express my gratitude to all those involves in my project directly or indirectly.

ABSTRACT

In wireless communication system, the transmitted signal is distorted by various phenomena that are intstrinsic to the structure and contents of the wireless channel. Among these, multipath fading is dominant source of distortion in wireless communication. Fading refers to the fluctuations in amplitude, phase and multipath delays over very short travels distance or very short time durations One type of fading, called Rayleigh fading, happens when the transmitted signal go through several deflected path and there is no line of sight path. This fading can be modeled using Jakes' simulator, which is sum-of-sinusoid (SOS) simulator. The aim of this project is to implement the Jakes' simulator using MATLAB. The performance of this simulator is tested and analyzed.

ABSTRAK

Dalam sistem perhubungan tanpa wayar, isyarat yang dihantar dipengaruhi beberapa fenomena. Antarnya ialah, *mulitipath fading* yang paling banyak mempengaruhi isyarat tersebut. *Fading* merujuk kepada perubahan pada amplitud, fasa dan serakan dalam perjalanan. Terdapat satu jenis *fading* yang dikenali sebagai *Rayleigh fading*. Ia berlaku apabila isyarat yang dihantar akan melalui beberapa laluan yang terserak dan tidak terdapat laluan terus. *Fading* boleh dimodelkan menggunakan *Jakes' simulator*, iaitu sejenis *sum-of-sinusoid (SOS) simulator*. Matlamat utama projek ini ialah untuk mengaplikasikan *Jakes' simulator* menggunakan MATLAB. Dan seterusnya menganalisa simulator dan menguji simulator itu.

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LIST OF ACRONYMS

LOS	-	Line-of-sight
NLOS	-	No line of sight
(T/R)	-	Transmitter/receiver
B_D	-	Bandwidth
f_c	-	Sampling frequency
f_d	-	Doppler frequency
BER	-	Bit-error-ratio
PDF	-	Proxibity density function
MRC	-	Maximum ratio combining
SOS	-	Sum-of –Sinussoids
WSS	-	Wide-sense stationary
RVs	-	Random variables

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CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

Transmitted signal arrives at the receiver through various path of different length. Multiple version of the signal interferes with each other lead to the effect called fading. One of the common fading is known as Rayleigh fading. In this project, Initial work is required to generate the model of the transmitted signal. Later, Rayleigh fading propagation need to be modeled and subsequently its effect on the transmitted signal in wireless communication channel is analysed. All the simulation and modeling in this project is done using MATLAB.

1.2 PROBLEM STATEMENTS AND OBJECTIVES

There are many models/simulators that are used to represent the fading phenomenon in wireless communication system. However, only a few of these simulators uses the MATLAB software to model fading phenomenon in wireless communication.

The objective of this project is:

a) To enhance the knowledge of fading phenomena using Jakes simulator.
b) To model the Jakes simulator and analyses it in MATLAB.

1.3 SCOPES OF WORK

The scopes of works in this project are:

1) Theories and background knowledge acquisition of wireless communication channel, types of fading, Rayleigh fading and Jakes model.
2) Implementation of Jakes simulator model in MATLAB
3) Performance analysis of the simulator in modeling Rayleigh fading in wireless communication channel.

1.4 PROJECT METHODOLOGY

1) Literature review

   - Data acquisition or background study of multipath effect, types of fading such as Rayleigh and types of simulator.

2) Jakes simulator study

   - Background theory of the simulator including its parameters, condition and operation

3) Implementation of Jakes simulator in MATLAB

4) Testing the program code of the simulator

5) Performance analysis and results of the simulation

6) Thesis writing

7) Presentation

1.4.1 FLOW CHART

The figures show the flow chart to complete PSM:

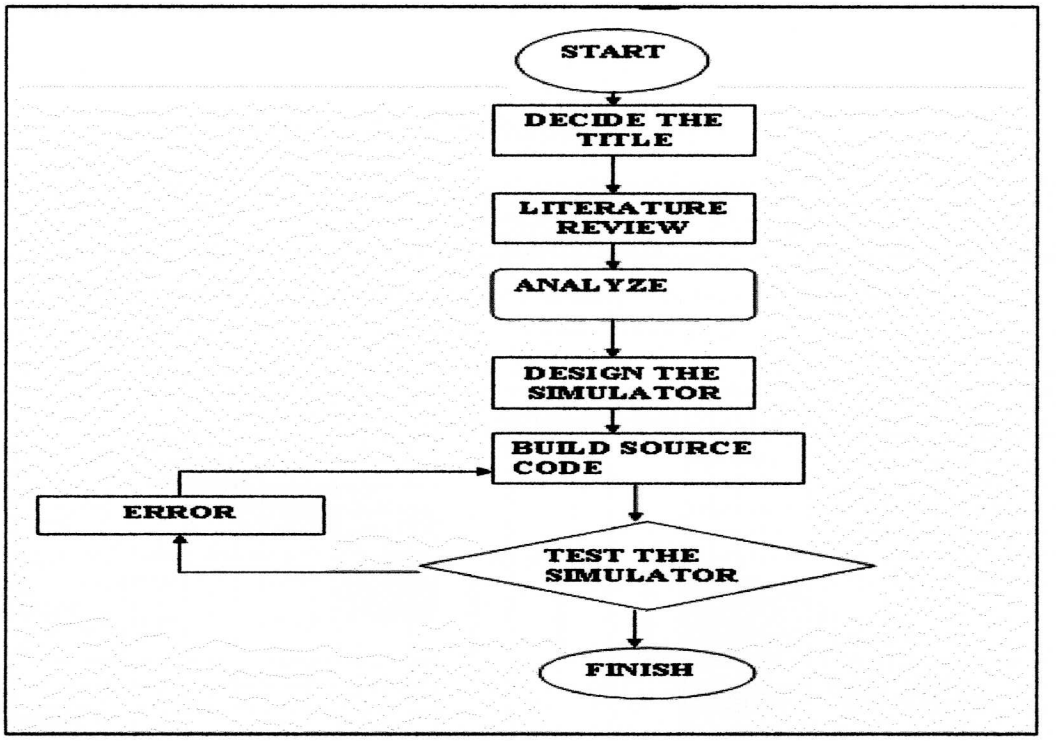

Figure 1.1: Flow Chart of the PSM

1.5 EXPECTED RESULT

At the end of this project, the expected results are:

1) Successfully gain knowledge about the effect of Rayleigh fading on the performance of data transmission in wireless communication channel.

2) Successfully implementation of Jakes Simulator in MATLAB.

1.6 PROJECT PLANNING

Table 1: Project Planning for PSM

PERANCANGAN PROJEK

Senarakan aktiviti- aktiviti utama bagi projek yang dicadangkan. Nyatakan jangka masa yang diperlukan bagi setiap aktiviti.

Aktiviti Projek	2007																						
	July			August				September				October				November				December			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Title Selection	PSM I briefing	■	■											Study leave		Final exam				Semester break			
Project Proposal			■	■																			
Literature review				■	■	■	■	■	■	■	■												
Jakes simulator study						■	■	■	■	■	■	■	■										
Seminar 1										■													
Submit report PSM 1												■											
Implemented Jakes simulator in MATLAB										■	■	■	■										
Testing the program code of the simulator																							
Troubleshoot																							
Thesis writing																							
Draft report submission																							
Seminar 2																							
Thesis submission																							

Aktiviti Projek	2008															
	January					February			March				April			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Title Selection						Mid Term Break										
Project Proposal																
Literature review																
Jakes simulator study																
Seminar 1																
Submit report PSM 1																
Implemented Jakes simulator in MATLAB	■	■	■	■	■											
Testing the program code of the simulator	■	■	■	■	■		■	■	■							
Troubleshoot								■	■	■	■					
Thesis writing	■	■	■	■	■		■	■	■	■	■	■				
Draft report submission											■	■	■	■		
Seminar 2																
Thesis submission																

1.7 THESIS LAYOUT

This thesis is organized as follows:

Chapter 1:Introduction

This project is introduced where there problem is identified and this the project objectives is outlined. Beside that, the scope of work of this project is describe.

Chapter 2 : Literature Review.

In this chapter, theories and background of wireless communication channel is discussed. All aspect of the wireless communication like multipath propogation, Doppler spread, types of fading and etc are in this chapter and for this chapter. The reference are from the books, internet, journals and etc.

Chapter 3: Jakes Simulator Model

The model is discussed here including the block diagram for Jakes Model and Improved Jakes Simulator and all the simulator output signal are in this chapter. Output signal are divided by 2. One of them is Inphase components and another is Quadrature components.

Chapter 4: Results

Experimental/Simulation results are presented here. The value of M and N is fix for simulation progress. The analysis of the Jakes and Improved Jakes model also discusses in this chapter

Chapter 5:Conclusion

All the chapter are summarize and also recommendation about modelling Rayeigh fading in this chapter has been discussed.

CHAPTER II

LITERARUTE REVIEW

2.1 Multipath Propagation

In wireless telecommunications, multipath is the propagation phenomenon that results in radio signals' reaching the receiving antenna by two or more paths. Causes of multipath include atmospheric ducting, ionospheric reflection and refraction, and reflection from terrestrial objects, such as mountains and buildings.

The effects of multipath include constructive and destructive interference, and phase shifting of the signal. This causes Rayleigh fading, named after Lord Rayleigh. The standard statistical model of this gives a distribution known as the Rayleigh distribution.Rayleigh fading with a strong line of sight content is said to have a Rician distribution, or to be Rician fading.[1]

In facsimile and television transmission, multipath causes jitter and ghosting, seen as a faded duplicate image to the right of the main image. Ghosts occur when transmissions bounce off a mountain or other large object, while also arriving at the antenna by a shorter, direct route, with the receiver picking up two signals separated by a delay.

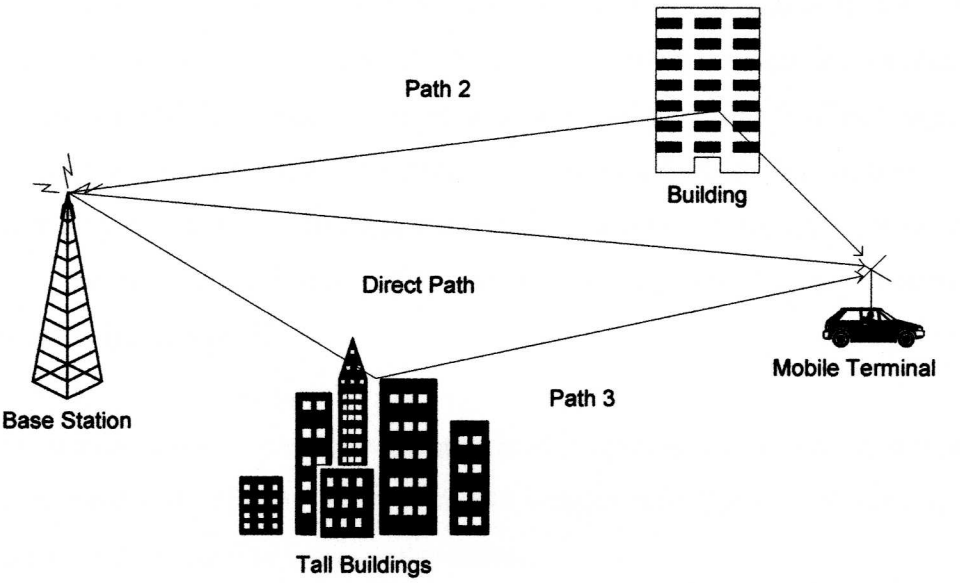

Figure 2.1: Typical Model of Land Mobile Radio [2]

Figure 2.1 is a typical model of a land mobile radio consists of an elevated base-station antenna (or multiple antennas) and a relatively short distance line-of-sight (LOS) propagation path, followed by many no line of sight (NLOS) reflected propagation paths and a mobile antenna or antennas mounted on the vehicle or more generally on the transmitter/receiver (T/R) or transceiver of the mobile or portable unit.