

**UNIVERSITI TEKNOLOGI MARA**

**THE PERFORMANCE STUDY OF  
BER BY USING DIFFERENT  
TECHNIQUES OF CHANNEL  
ESTIMATION FOR MIMO-OFDM**

**MOHD HAZWAN BIN MAT ALI**

Thesis submitted in fulfillment of the requirements  
for degree of

**Bachelor of Engineering (Hons.) Electronic  
(Communication)**

**Faculty of Electrical Engineering**

**JULY 2017**

## ACKNOWLEDGEMENTS

I am feeling grateful and thanks to Allah S.W.T gave me an opportunity, courage and strength to face all challenges for completing this project. First and foremost, I want to dedicate the acknowledgement to my supervisor, Mdm. Suzi Seroja Binti Samin for her guidelines and support to complete this project. I also would like to thanks to Dr. Darmawaty Ali and Miss Wan Norsyafizan Wan Muhamad for their evaluation on my project presentation. Last but not least, thanks to parents, family, friends, lectures and Faculty of Electrical Engineering in UiTM Shah Alam for their contribution in this project along the completing this project.

## ABSTRACT

The high transmission data rate, spectral efficiency and reliability are necessary in the future of mobile communications wireless systems. However, there are several problem on the inference that had been faced among the signals, complexity of transmission system and effected the spectral efficiency. The way that used to prevent these problem is by using Orthogonal frequency division multiplexing (OFDM) is another common technique in eliminating the inter symbol interference (ISI) which give the efficient high speed transmission for the best performance. To get a better performance of OFDM, the techniques that were applied to the systems are Discrete Fourier Transform (DFT) based channel estimation and Least Mean Square (LMS) channel estimation. They reduced the noise and help increasing the efficiency in the systems. To get the different performance, the comparison has been made by applying the Multiple Input Multiple Output (MEMO) OFDM with DFT channel estimation and LMS channel estimation. By applying the channel estimation with the multiple antenna system at transmitter and receiver, there will be a better performance of the OFDM system. The result of the performance will be presented with Bit Error Rate (BER) against Energy Bit per Noise Density ( $E_b/N_0$ ) that has been done using simulations software MATLAB. The result will shows the BER against  $E_b/N_0$  become lower.

## TABLE OF CONTENTS

<b>APPROVAL</b>	<b>ii</b>
<b>DECLARATION</b>	<b>iii</b>
<b>ACKNOWLEDGEMENTS</b>	<b>iv</b>
<b>ABSTRACT</b>	<b>v</b>
<b>LIST OF FIGURE</b>	<b>ix</b>
<b>LIST OF TABLE</b>	<b>x</b>
<b>LIST OF SYMBOLS AND ABBREVIATIONS</b>	<b>xi</b>
<b>CHAPTER 1: INTRODUCTION</b>	
1.1 BACKGROUND OF STUDY	1
1.2 PROBLEM STATEMENT	2
1.3 OBJECTIVES	3
1.4 SCOPE OF WORK	3
1.5 THESIS ORGANIZATION	3
<b>CHAPTER 2: LITERAUTURE REVIEW</b>	
2.1 INTRODUCTION	5
2.2 ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING (OFDM)	6
2.3 MULTIPLE-INPUT-MULTIPLE-OUTPUT (MJMO)	7
2.4 BIT ERROR RATE (BER)	9
2.5 ENERGY PER BIT TO NOISE POWER SPECTRAL DENSITY RATIO ( $E_b/N_o$ )	9
2.6 SIGNAL TO NOISE RATIO (SNR)	10
2.7 QUADRATURE AMPLITUDE MODULATION (QAM)	10
2.8 MODULATION	12
2.9 DISCRETE FOURIER TRANSFORM (DFT) BASED CHANNEL ESTIMATION	13
2.10 LEAST MEAN SQUARE (LMS) CHANNEL ESTIMATION	15
2.11 MINIMUM MEAN SQUARE ERROR (MMSE)	

2.11 ADDITIVE WHITE GAUSSION NOISE (AWGN)	16
2.12 MATLAB SOFTWARE	16
	17
<b>CHAPTER 3: METHODOLOGY</b>	
3.1 INTRODUCTION	19
3.2 FINAL YEAR PROJECT 1 (FYP1)	19
3.2.1 PROJECT TITLE	19
3.2.2 PROJECT PROPOSAL	20
3.3 FINAL YEAR PROJECT 2 (FYP2)	20
3.3.1 PROJECT DEVELOPMENT	20
3.3.2 PROJECT DOCUMENTATION	21
3.4 WORKFLOW OF THE PROJECT	22
3.5 OFDM BASEBAND SYSTEM	24
3.6 FLOWCHART OF THE PROJECT	25
<b>CHAPTER 4: RESULT AND DISCUSSION</b>	
4.1 INTRODUCTION	27
4.2 RESULT SIMULATION	28
4.2.1 MIMO-OFDM Performance with Different Channel Estimation Techniques by using 2 by 2 Antenna Configuration	28
4.2.1.1 The Performance Comparison of BER vs Eb/No of MIMO-OFDM System with Different Channel Techniques by Using Four by Four Antenna.	31
4.2.2 MIMO-OFDM Performance with Different Channel Estimation Techniques by using 4 by 4 Antenna Configuration	32
4.2.2.1 The Performance Comparison of BER vs Eb/No of MIMO-OFDM System with Different Channel Techniques By Using Four by Four Antenna.	35
4.3 DISCUSSION	
	36