

# ADAPTIVE DS/CDMA RECEIVER FOR MULTIUSER DETECTION

This thesis is presented in partial fulfillment for the award of the Bachelor in Electrical  
Engineering (Hons.)

UNIVERSITI TEKNOLOGI MARA



NOOR HALILA BINTI MANSOR  
Faculty of Electrical Engineering  
Universiti Teknologi MARA  
40450 Shah Alam, Selangor

MARCH 2004

## ACKNOWLEDGEMENT

In the name ALLAH S.W.T, the most Gracious, Ever Merciful, the Beneficent, the Almighty One. It is deepest sense of gratitude to of the almighty ALLAH who gives me strength and ability to complete this project.

First of all, I would like to express my special thanks to my Industrial Project supervisor, Puan Norasimah Mohd Khadri for her teaching, support, advice and guidance. Her valuable guidance is much appreciated. A special thanks to Associate Professor Dr. Hj. Mohd Asri Hj Mansor, Puan Putri Aidawati Ahmad and Encik Mohd Murtadha Othman for their precious information and knowledge of Matjab programming. I would also like to express my deepest appreciation to Encik Roslam from ERICSON for his helpful comments and information about CDMA.

I would like to express my sincere gratitude and heartfelt thanks to my beloved parent, Encik Mansor bin Maaruf and Puan Jamilah binti Hj Mohd Din for their guidance and love in nurturing me to be who am I today.

Finally, thanks for all my colleagues, friends and lecturers or staffs of Faculty of Electrical Engineering who are directly or indirectly for their support, invaluable help and advice in the completion of this thesis. THANK YOU.

Noor Halila Binti Mansor  
Faculty of Electrical Engineering  
Universiti Teknologi MARA  
Shah Alam

## ABSTRACT

An adaptive receiver is considered for use in combating the near-far problem in Direct-Sequence Code-Division Multiple-Access (DS/CDMA) communication network. The focus of the paper is on the multiuser interference rejecting capability of the receiver. This technique was implemented by using Matrix Laboratory (MATLAB) 6.5. The receiver uses a chip matched filter followed by an adaptive equalizer to perform despreading operation. The adaptive structure allows the receiver to adjust the weights and improve the system combating interference and noise capability. So, it can combat the near-far problem in DS/CDMA. From the simulation results, the error probability of a Code Division Multiple Access (CDMA) network using this receiver structure is obtained and compared with a system using conventional receivers. The receiver is shown to be immune to the near-far problem in the sense that the performance without any power control is nearly identical to the performance with perfect power control.

# TABLE OF CONTENTS

CHAPTER	PAGE
DECLARATION	i
ACKNOWLEDGEMENT	ii
ABSTRACT	iii
TABLE OF CONTENTS	iv
LIST OF FIGURES	vii
LIST OF TABLES	viii
LIST OF ABBREVIATIONS	ix
<b>1. INTRODUCTION</b>	
1.1 Introduction	1
1.2 Background Study	1
1.3 Scope of Project	2
1.4 Report Organisation	3
<b>2. MULTIPLE ACCESS TECHNIQUES</b>	
2.1 Definition and Types of Multiple Access Techniques	4
2.2 Frequency Division Multiple Access Techniques (FDMA)	5
2.3 Time Division Multiple Access Techniques (TDMA)	5
2.4 Code Division Multiple Access Techniques (CDMA)	6
2.4.1 Characteristics of CDMA	7
2.4.2 Advantage of CDMA over FDMA and TDMA	8
2.4.3 Comparison between CDMA over FDMA and TDMA	8
2.4.4 A Cellular CDMA System	9

2.5	Direct-Sequence Code Division Multiple Access	11
2.5.1	Basic Direct Sequence Technique	13

## ADAPTIVE RECEIVERS FOR CDMA SYSTEMS

3.1	Adaptive Receivers for CDMA System	14
3.2	Matched Filters	14
3.3	P-N Sequences	15
3.3.1	Maximal Length Sequences	15
3.4	The Conventional Receiver	16
3.4.1	Disadvantage With The Conventional	16
3.5	A Multiuser Detection Problem	17
3.5.1	Different Types of Multiuser Detectors	17
3.6	The Need for Adaptive Receivers	18
3.6.1	Why is the Conventional Receiver Not Optimal?	18
3.6.2	The Near-Far Problem	19
3.6.2.1	Power Control	20
3.6.2.2	Power Control Affect Near-Far Problem	20
3.6.3	Multiuser Receivers	21
3.7	Why Use Adaptive Minimum Mean Squared Error Receivers?	23

## SOFTWARE DEVELOPMENT – MATRIX

### LABORATORY

4.1	Introduction	24
4.2	Software Development Tool	24
4.2.1	MATLAB (Matrix Algebra)	24
4.3	Software Design	25
4.4	Programming in MATLAB	26
4.4.1	Control Flow	28
4.4.2	Plotting	28