

**DESIGN OF MINSKOWSKI FRACTAL MICROSTRIP  
PATCH ANTENNA FOR SUPER  
WI-FI APPLICATION**

**Thesis is presented in partial fulfillment for the award of the  
Bachelor of Engineering (Hons.) Electronic (Communication)  
UNIVERSITI TEKNOLOGI MARA (UiTM)**



**NURFADZILAH BINTI JOHAR  
FACULTY OF ELECTRICAL ENGINEERING  
UNIVERSITI TEKNOLOGI MARA  
40450 SHAH ALAM,  
SELANGOR, MALAYSIA**

**JULY 2013**

## **ACKNOWLEDGEMENT**

First, all praises to Allah the Al-Mighty for the strengths and His blessing for me in continuing this learning process and completing this thesis. I have taken great efforts in this project. However, it would not have been possible without the kind support and help from many individuals and organizations.

I would like to extend my sincere thanks to all of them. I am highly indebted to Madam Suhaila bt Subahir as my supervisor for her guidance and constant supervision as well as for providing necessary information regarding the project and also for her support in completing the project for the past two semesters.

I would like to express my gratitude towards member of UiTM staffs for their kind co-operation and encouragement in supervisor, fabrication and measurement helps. My thanks and appreciations also go to my colleagues in developing the project and people who have willingly helped me out with their abilities.

Last but not least, sincere thanks go to my beloved parents and also to my families for their love, prayers and encouragement and for always supporting me till now. Special thanks also to those who indirectly contributed in this research.

Thank you very much.

## ABSTRACT

In this paper, the design of Minkowski Fractal microstrip patch antenna for Super Wi-Fi application is presented. Super Wi-Fi frequency is between 54MHz until 806MHz. The objectives of this project are to reduce the size of antenna while maintaining the performances of designed antenna. Frequency, return loss, bandwidth, voltage standing wave ratio (VSWR), radiation pattern, directivity and gain characteristics of this antenna are presented and discussed. The conventional MPA has been designed based on calculations made that operate at the frequency of 800MHz and fed by a  $50\Omega$  microstrip line. The Minkowski Fractal technique is being used to reduce size of the conventional MPA antenna. The antenna is designed and simulated by using the Computer Simulation Technology (CST) Microwave Studio software release version 2011. The Minkowski Fractal MPA is fabricated on RT Duroid 6002 substrate having dielectric constant,  $\epsilon_r$  is 2.94mm and the thickness of substrate,  $h$  is 1.524mm. The experimental measurement of the fabricated Minkowski Fractal MPA was carried out using Vector Network Analyzer (VNA). The comparison between Minkowski Fractal MPA and conventional MPA results are analyzed. The size of Minkowski Fractal MPA is reduced around 60.3% compactness compared to the conventional MPA. It can be conclude that, increasing the number of iterations of the Minkowski Fractal MPA will decrease the antennas gain, input impedance, bandwidth and VSWR.

## TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	TITLE	i
	APPROVAL	ii
	DECLARATION	iii
	DEDICATION	iv
	ACKNOWLEDGEMENT	v
	ABSTRACT	vi
	TABLE OF CONTENTS	vii
	LIST OF FIGURES	x
	LIST OF TABLES	xiii
	LIST OF SYMBOLS AND ABBREVIATIONS	xiv
1	INTRODUCTION	1
	1.1 BACKGROUND	1
	1.2 PROBLEM STATEMENT	3
	1.3 OBJECTIVE	3
	1.4 SCOPE OF WORK	4
	1.5 OUTLINE OF THESIS	4
2	LITERATURE REVIEW	6
	2.1 INTRODUCTION	6
	2.2 SUPER Wi-Fi	6
	2.3 MINSKOWSKI FRACTAL STRUCTURES	7
	2.4 PAST WORK REVIEW	9

2.5	FEEDING TECHNIQUES	17
2.5.1	Microstrip Feed Line	17
2.5.2	Coaxial Feed Line	18
2.5.3	Aperture-Coupled Feed	19
2.5.4	Proximity-Coupled Feed	20
2.6	TRANSMISSION LINE MODEL	20
2.7	ANTENNA PARAMETERS	21
2.7.1	Return Loss	21
2.7.2	Voltage Standing Wave Ratio (VSWR)	22
2.7.3	Bandwidth (BW)	22
2.7.4	Radiation Pattern	23
2.7.4.1	Beamwidth	24
2.7.4.2	Gain	24
2.7.4.3	Directivity	25

### 3

#### METHODOLOGY

3.1	INTRODUCTION	26
3.2	FLOW CHART	26
3.3	MATHEMATICAL EQUATION AND SIMULATION PROCESS	29
3.3.1	Basic Radiating Patch	29
3.3.2	Conventional MPA	30
3.3.3	Minkowski Fractal MPA	32
3.4	FABRICATION PROCESS	36
3.5	MEASUREMENT	37
3.5.1	Measurement Equipment and Process	37
3.5.1.1	Calibration Kit	37
3.5.1.2	Vector Network Analyzer (VNA)	38
3.5.1.23	Spectrum Analyzer (AT5011)	38