

MICROSTRIP SIERPINSKI CARPET ANTENNA DESIGN

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To my beloved parents:

Thank you for giving me the chance to be what I can be.

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ABSTRACT

Low cost of fabrication and low profile features of microstrip antennas, attract many researchers to investigate the performance of this antenna in various ways. Fractal antenna is a new member in the family of antennas. They have peculiar properties that make them suitable for applications where wideband and multiband are important parameters of the overall performance. Fractal technology allowed us to design miniature antennas and integrate multiple telecommunication services such as cellular (GSM 900 and GSM 1800), wirelessLAN, GPS and hiperLAN2 into a single device. Microstrip sierpinski carpet antenna and sierpinski carpet monopole antenna are designed in this project. The main objective of this project is to design a multiband antenna. The design involved simulations, fabrications and measurements. Mathcad 2001 is used to obtain the size of the basic square patch antenna and simulation was done using Micropatch v.2 and Microwave Office. The fabrication and testing was done at Wireless Communication Centre (WCC). Wideband and multiband operation was observed in sierpinski carpet monopole antenna.

ABSTRAK

Ciri-ciri antena microjalur yang berprofil rendah dan kos fabrikasi yang murah telah membuka laluan kepada para penyelidik untuk mengkaji prestasi antena ini dalam pelbagai cara. Antena pecahan ini masih dikategorikan baru dalam antenna. Antena pecahan ini mempunyai ciri-ciri khusus yang membolehkan ia digunakan dalam aplikasi yang mana jalur lebar dan jalur banyak merupakan parameter yang penting bagi menentukan prestasi keseluruhan. Teknologi pecahan ini membenarkan kita merekabentuk antena yang bersaiz kecil dan memuatkan pelbagai servis telekomunikasi seperti GSM (GSM 900 dan GSM 1800), wirelessLAN, GPS dan hiperLAN2 didalam satu peranti sahaja. Antena tampal pecahan mikrojalur dan antena hamparan tegak direka dalam projek ini. Objektif utama projek ini adalah untuk merekabentuk antena yang mempunyai banyak jalur frekuensi. Proses yang terlibat dalam merekabentuk antena ini ialah simulasi, fabrikasi dan pengukuran. Program Mathcad 2001 digunakan bagi mendapatkan saiz antena segiempat tampal dan simulasi dilakukan menggunakan Micropatch v.2 dan Microwave Office. Fabrikasi dan pengukuran dilakukan di makmal Pusat Perhubungan Tanpa Wayar (WCC). Antena hamparan tegak dapat beroperasi dalam jalur lebar dan banyak frekuensi.

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LIST OF SYMBOLS

BW	Bandwidth
f	Frequency
L	Length of the Microstrip Patch Antenna
W	Width of the Microstrip Patch Antenna
h	Substrate thickness
$\tan \delta$	Loss tangent of dielectric material
V	voltage
G	Gain
ϵ_r	Relative Permittivity
ϵ_{eff}	Effective Relative Permittivity
ΔL	Fringe factor
c	Velocity of electromagnetic waves in free space
VSWR	Voltage standing Wave Ratio
CW	Clock wise
CCW	Counter clock wise

CHAPTER I

INTRODUCTION

1.1 Project Background

Modern telecommunication systems require antennas with wider bandwidths and smaller dimensions than conventionally possible. This has initiated antenna research in various directions, one of which is by using fractal shaped antenna elements. In recent years several fractal geometries have been introduced for antenna applications with varying degrees of success in improving antenna characteristics. Some of these geometries have been particularly useful in reducing the size of the antenna, while other designs aim at incorporating multi-band characteristics. Yet no significant progress has been made in corroborating fractal properties of these geometries with characteristics of antennas.

Several antenna configurations based on fractal geometries have been reported in recent years. These are low profile antennas with moderate gain and can be made operative at multiple frequency bands and hence are multi-functional. In this work the multi-band (multifunctional) aspect of antenna designs are explored further with special emphasis on identifying fractal properties that impact antenna multi-band characteristics. To lay foundations for the understanding of the behavior of such

antennas, the nature of fractal geometries is explained first, before presenting the status of literature on antennas using such geometries.

Fractal geometry allows us to design a miniature antenna and integrate multiple telecommunication services into single device. One of the most relevant trends for wireless devices is miniaturization. Miniaturization become important for the next generation of antennas for wireless applications which have to integrate multiple services such as cellular (GSM 900 and GSM 1800), wireless LAN 2.4 GHz, GPS 1.575 GHz, radio and hiperLAN2 5.25GHz into one device such as handsets, laptops and PDAs. In this situation, we need the smallest antenna to make use of the available wireless service and for coverage of the different frequency bands is made possible with multiple-band antenna design.

1.2 Objective

Objective of this project is to design and fabricate a multi band antenna using sierpinski carpet fractal antenna and microstrip fractal antenna. Parameters that influence antenna's performance in term of matching and bandwidth are studied to achieve this objective. Design and fabrication processes are based on simulation using Microwave Office.

1.3 Scope of Work

Scope of this project:-

- i. Design and fabricate a sierpinski carpet fractal antenna and a microstrip fractal antenna.
- ii. Investigate the performance of the sierpinski carpet fractal antenna and microstrip fractal antenna.

1.4 Dissertation Overview

In this dissertation, several topics are covered and they are organized into six chapters. This first chapter, the introduction to the project, gives an explanation of the objective, scope of work and project background.

Chapter II begin with the description of antenna characteristics. This is followed by discussion of relevant theory and literature review on the designed antenna structures. Matching techniques and method of analysis are also presented.

Chapter III presents the antenna design procedure and the fabrication of the designed antennas. This chapter discusses the design of basic microstrip square patch antenna and microstrip fractal patch antenna.

Chapter IV presents brief description of software used in designing and simulating the antenna structures. Some examples of the simulation results are included.

Chapter V presents some results and analysis that obtained from simulation and measurement.

Chapter VI presents the conclusions for this thesis. Some ideas for future works of this project are suggested.

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