UNIVERSITI TEKNIKAL MALAYSIA MELAKA

OPTIMIZATION PROCESS OF T-SHAPED MICROSTRIP ANTENNA PERFORMANCE FOR BROADBAND

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Electrical Engineering Technology (Telecommunication) with Honours

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Telecommunication) with Honours. The member of the supervisory is as follow:

……

(Project Supervisor)

ABSTRAK

Secara umumnya, antena adalah alat yang telah digunakan untuk menghantar dan menerima isyarat frekuensi. Tampalan jalur mikro antena adalah paling digemari untuk struktur antena dalam usaha yang minima dan konfigurasi dikurangkan untuk sistem tanpa wayar serta aplikasi RF. Hari ini, pelaksanaan antena jalur mikro yang dihasilkan dalam pelbagai kegunaan untuk kawasan telekomunikasi. Malangnya, penghasilan antena jalur mikro dalam jalur frekuensi tertentu seperti jalur lebar jarang dihasilkan. Oleh itu, projek ini bercadang untuk membangunkan antena jalur mikro yang berbentuk T khusus untuk penggunaan jalur lebar. Projek ini juga adalah memberi tumpuan kepada penghasilan dua (2) jenis antena jalur mikro yang merupakan tampalan berbentuk T. Tampalan antena jalur mikro direka menggunakan perisian Advance System Design (ADS). Dalam projek ini, antena jalur mikro telah dianalisis oleh empat (4) parameter. Parameter ini adalah Dimensi, Sudut Polarisasi, Frekuensi dan Jarak untuk mendapatkan keluaran kuasa yang terbaik sebagai tindakbalas. Dari empat parameter tersebut, sebahagian analisis telah dijalankan bagi mengkaji kesan parameter dengan menggunakan 2^4 kaedah reka bentuk faktorial. Analisis yang melalui perisian Design of Expert (DOE) akan digunakan untuk mengenal pasti bahawa penyelesaian optimum bagi jalur mikro antena berbentuk T adalah 2.5 cm dimensi, 180˚ sudut polarisasi, frekuensi 2.7 GHz dan 15 cm jarak. Tetapan ini optimum dipilih untuk mempengaruhi jalur mikro antena berbentuk T untuk beroperasi dengan keluaran kuasa yang terbaik.

ABSTRACT

Generally, antenna is a device that had been used for transmitting and receiving frequency signal. Micro strip patch antenna is a standout amongst the most favoured antenna structures for minimal effort and minimized configuration for wireless system and RF application. Present day, the implementations of micro strip antennas are produced for variety usage for telecommunication area. Unfortunately, producing micro strip antenna in a particular frequency band which for broadband is seldom developed. Hence, this project is proposing to develop a T-shaped micro strip antenna specifically for broadband usage. This project is focus on produce two (2) types of micro strip antennas which is T-shaped patch. The patch of micro strip antennas were designed using Advance System Design (ADS) Software. In this project, the micro strip antennas were be analyzed by four (4) parameters. These parameters are Dimension, Polarization Angle, Frequency and Distance to obtain the best output power as the response. From that four parameters, the analysis part was conducted on studying the effect of the parameters by using 2^4 factorial design method. The analysis through Design of Expert (DOE) Software will be used to identified that the optimal solution for the T-shaped microstrip antenna are 2.5 cm dimension, 180˚ polarization angle, 2.7 GHz frequency and 15 cm distance. These optimal setting are selected for affecting the T-shaped microstrip antenna to operate with the best output power.

DEDICATION

This humble effort especially dedicated to my family, lecturers and friends for their support, guidance and encouragement upon completing this projects and report. Thank you.

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In the name of Allah S.W.T, the Most Gracious who has given me the strength and ability to complete this projects. Praise to Him who seek help and guidance and under His benevolence we exist and without His help, this project could not have been accomplished.

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A special gratitude also dedicated to my family who always gave me supports, advices and help me throughout my study. I really appreciated all of the help and encouragement that were given to me along the period of doing this project. It was their kindness that gave me opportunity to successfully complete this project

Last but not least also dedicated to my classmates, friends, academic staffs, technical staffs and every person who is participated in helping me during the process of completing this project. The guidance and support they gave to me to overcome the obstacles encountered during completing this project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

ADS	-	Advance Design System
ANOVA	-	Analysis of Variance
DOE	-	Design of Expert
D	-	Directivity
dB	-	Decibel
F	-	F Test (ANOVA)
G	-	Gain
°	-	Degree
η	-	Eta (Efficiency)
Γ	-	Gamma (Gain)
>	-	More than
φ	-	Phi (Gain)
θ	-	Theta

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

Antenna is a device had been used in the process of sending or receiving signals in the form of wave frequency. Usually, this antenna system is commonly in radio frequency or RF and process delivery and receipt of signals will involve two or more stations to ensure that desire signal (frequency) reach at the address of the site. For example, a song from the radio stations can be heard by the listener. This is because the song was transmitted from radio station via satellite and satellite will transmitted the song to the listener. Hence, the song from the radio station has become the transmitter antenna to the receiver (satellite). Meanwhile, the satellite will become transmitter antenna and the signal will be transmit directly to the listener.

Microstrip antenna was initially presented in the 1950s. However, this idea needed to wait for around 20 years to be acknowledged after the advancement of the printed circuit board (PCB) technology in the 1970s. From that point, microstrip antennas are the most common sorts of antennas with extensive variety of utilizations because of their apparent advantages of light weight, low profile, low cost, planar configuration, simple of conformal, predominant convey ability, reasonable for array with the ease of fabrication and integration with microwave monolithic integrate circuits (MMICs).

Therefore, the focus of this project is to produce a T-shaped micro strip antenna for broadband usage. In this project, Design of Experiment (DOE) Software will be used to evaluate the performance of T-shaped micro strip antenna. As a result, the best combination of properties for the T-shaped micro strip antenna that reach maximum and optimum results in transmitting and receiving signal for broadband usage are achieved.

1.2 PROBLEM STATEMENT

Generally, antenna is a device that had been used for transmitting and receiving frequency signal. Micro strip patch antenna is a standout amongst the most favoured antenna structures for minimal effort and minimized configuration for wireless system and RF application.

Present day, the implementations of micro strip antennas are produced for variety usage for telecommunication area. Unfortunately, producing micro strip antenna in a particular frequency band which for broadband is seldom developed. Hence, this project is proposing to develop a T-shaped micro strip antenna specifically for broadband usage. This project likewise could contribute to be among of the accomplishment in the antenna technology towards the improvement of antenna innovation and the performance of this micro strip antenna will be maximized by using statistical method. Conversely at the end of this project, there will be the most appropriate with improvement of the micro strip antenna that has reached at an ideal and optimum level for broadband application.

1.3 OBJECTIVES

In this research, the main objectives of this project are:

i. To study and develop T-shaped micro strip antenna by using Advance Design System (ADS) Software for broadband applications.
ii. To identify a significant effect of T-shape micro strip antenna properties for broadband applications.
iii. To determine the optimal T-shaped micro strip antenna properties for improvement of T-shaped micro strip antenna performance.

1.4 SCOPES

The scope of this research will be focus primarily on the optimization of T-shaped micro strip antenna performance for broadband applications. This antenna will print on the negative strip board and the T-shaped antenna will be design by using ADS Momentum. There are four properties will be emphasized during this research was conducted which are distance, frequency, polarization angle and dimension. Each of those properties has two different level values. All data collection will be analyses by using Factorial Design. .

This research was predominantly limited by the small scale of the experiments conducted. This problem occurred as the connection cable between the experiment apparatus restricts for the transmitter and receiver antenna to be placed further. Besides that, the designing procedure of the microstrip antenna also could be one of the factors that contribute towards the imperfect results. By designing the microstrip antenna specifically according to a certain criteria such as type and dimension of the microstrip antenna, the application would encourage for a better designing steps hence could lead for obtaining a more appropriate and accurate results. By considering other outputs or reactions in the research studied, a better depth of data collected and information may have been obtained. In addition, other variables and properties to be varied such as type of substrates and type of driven element used for the T-shaped microstrip antenna would likewise be advantageous and motivating to be studied.

CHAPTER 2
LITERATURE REVIEW

2.1 MICRO STRIP ANTENNA

Antenna is a transducer which transmits or receives electromagnetic waves. Micro strip antennas have a few points of interest over traditional microwave antenna and in this way are utilized as a part of practical applications. Micro strip antenna in its easiest configuration is appeared in Figure 2.1. It comprises of a transmitting patch on one side of dielectric substrate (Єr≤10), with a ground plane on other side [1].

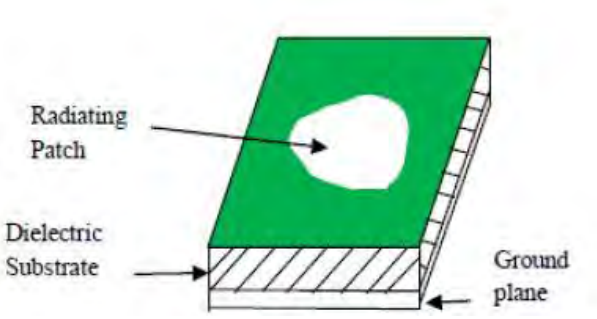
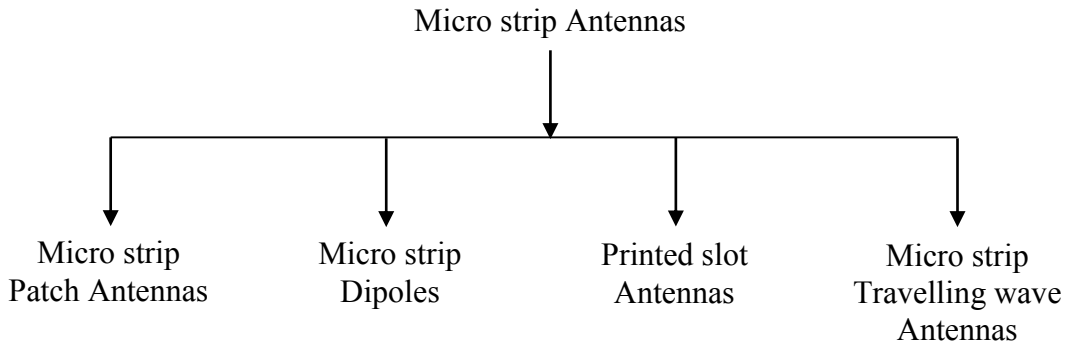


Figure 2.1: Micro strip antenna configuration.

Microstrip antennas are characterized by a larger number of physical parameters than are conventional microwave antennas. They can be intended to have numerous geometrical shapes and dimensions [2]. All microstrip antennas can be partitioned into four fundamental categories



The characteristic of micro strip patch antennas, micro strip slot antennas and printed dipole antennas are compared in table 2.1 [3].

Table 2.1: Table of characteristic of micro strip patch antennas, micro strip slot antennas and printed dipole antennas.

Characteristics	**Micro strip Patch Antenna**	**Micro strip Antenna**	**Printed Dipole Antenna**
Profile	Slim	Slim	Slim
Fabrication	Very simple	Simple	Simple
Polarization	Linear and circular	Linear and circular	Linear
Shape flexibility	Any shape	Mostly rectangular and circular shapes	Rectangular and triangular
Spurious radiation	Exists	Exists	Exists
Bandwidth	2-50%	5-30%	-30%

Micro strip antenna has a few preferences over conventional microwave antenna with one comparability of frequency range from 100 MHz to 100 GHz same in both sort. The various advantage and disadvantage are given in table 2.2 [4].

Table 2.2: Advantages and disadvantages of micro strip antenna.

Advantages	Disadvantages
Low weight	Low efficiency
Low profile	Low gain
Thin profile	Large ohm loss in the feed structure
Need no cavity backup	Low power handling capacity
Linear and circular polarization	Excitation of surface waves
Capable of dual and triple frequency operation	Polarization purity is difficult to achieve
Feed lines and matching network can be fabricated simultaneously	Complex feed structures require high performance arrays.

2.2 MICRO STRIP PATCH ANTENNA

A micro strip patch antenna (MPA) comprises of a conducting patch of any planar or non-planar geometry on one side of a dielectric substrate with a ground plane on other side.

It is a well-known printed resonant antenna for narrow-band microwave wireless connections that require semi-hemispherical scope. Because of its planar arrangement and simplicity of integration with micro strip technology, the micro strip patch antenna has been intensely concentrated on and is frequently utilized as components for an array. Many of micro strip patch antenna have been contemplated to date. An exhaustive list of the geometries alongside their remarkable elements is accessible [5].

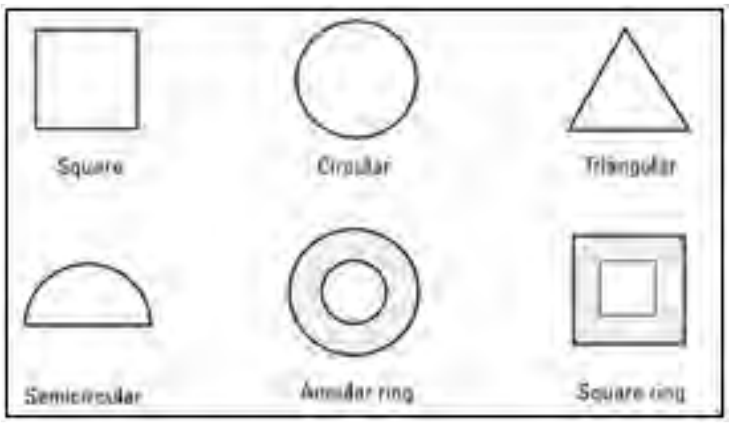
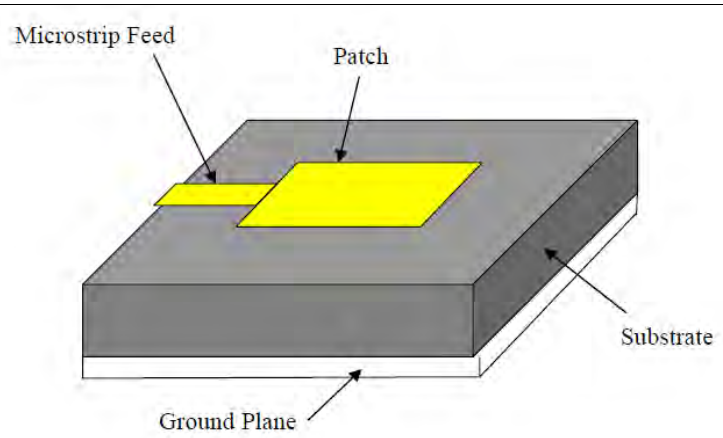


Figure 2.2: Different shapes of micro strip patches.

2.3 FEEDING TECHNIQUES

There are numerous configurations that can be utilized to sustain micro strip antennas. The four most prominent feed models are micro strip line, coaxial probe, aperture coupling and proximity coupling are given in Table 2.3**.**

Table 2.3: Types of feed techniques.

No.	Type of Feed Techniques	Figure of Feed Techniques
1.	Micro strip line feed	
2.	Coaxial probe feed