

**COMPARISON OF PERFORMANCES OF VARIOUS TYPE OF MATERIALS
ON RECTANGULAR STACKED PATCH ANTENNA WITH CPW-FED TRIPLE
TRIANGLE SLOT**

FINAL YEAR PROJECT

FATIMAH BINTI BAHARIN

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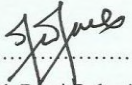
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AZMAN B AWANG TEH

Pensyarah
(COP DAN TANDATANGAN PENYELIA)
Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer (FKEKK),
Universiti Teknikal Malaysia Melaka (UTeM),
Karung Berkunci 1200,
Ayer Keroh, 75450 Melaka

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Signature : 

Supervisor's Name : En Azman Bin Awang Teh

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Dituju Khas Buat Umi, Ayah Dan Keluarga. Tidak Lupa Buat Bakal Suami Yang Jauh
Dan Sahabat Yang Banyak Memberi Dorongan Dan Nasihat.

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Abstract

This project discussed about the comparison of performances of various type of materials on rectangular stacked patch antenna with CPW-fed triple triangle slot for WiMAX application. The main thing of this project is to develop the rectangular patch antenna with CPW-fed triple triangle slot with and without stacked patch (air and glass as a gap) and the antenna is be able to operate in 3.5GHz. Besides that, the performance of parameter that has been studied were return loss, bandwidth, gain and directivity of a rectangular patch antenna with a CPW-fed triple triangle slot with and without stacked patch (air and glass as a gap). Nowadays, with its unique two dimensional structure and the best material properties, graphene has attract researcher attention. This project used copper, aluminium, silver, gold and graphene as a patch material in order to determine the capability of graphene as a best material between these material in this type of antenna. Next, the design was develop and simulated by using CST Studio Suite software. From the overall result, the best design was rectangular stacked patch antenna with CPW-fed triple triangle slot by using air as a gap and a graphene as a patch material. This is because the value of antenna performances such as return loss, bandwidth, gain and directivity is -15.362, 3.9028GHz, 3.321Db and 3.824dBi is the highest among others material. After that, all the result obtained from the simulation was tabulated and analyzed. From this project, proved that graphene gives an improvement in the performance of antenna due to its high conductivity.

Abstrak

Projek ini membincangkan tentang perbezaan prestasi pelbagai bahan untuk segi empat bertindan tampal antenna dengan CPW-suapan gandaan tiga segitiga untuk aplikasi WiMAX. Perkara utama berkaitan projek ini adalah untuk menghasilkan segi empat tampal antenna dengan CPW-suapan gandaan tiga segitiga dengan atau tanpa tampal bertindan (udara dan gelas sebagai jurang) dan antenna mampu berfungsi pada 3.5GHz. Selain itu, prestasi parameter telah dikaji dimana kehilangan balikan, lebar jalur, gandaan dan keterarahan untuk segi empat tampal antenna dengan CPW-suapan gandaan tiga segitiga dengan atau tanpa tampal bertindan (udara dan gelas sebagai jurang). Hari ini, dengan keunikan dua dimensi struktur dan sifat bahan terbaik graphene telah menarik minat penyelidik. Projek ini menggunakan tembaga, aluminium, perak, emas dan graphene sebagai bahan tampal untuk mengenalpasti kebolehan graphene sebagai bahan terbaik diantara bahan yang lain untuk antenna jenis ini. Seterusnya, reka bentuk ini dihasilkan dan di simulasi menggunakan CST Studio Suite software. Daripada hasil keseluruhan, reka bentuk yang terbaik adalah segi empat bertindan tampal antenna dengan CPW-suapan gandaan tiga segitiga dengan menggunakan udara sebagai jurang dan graphene sebagai bahan tampal. Ini kerana nilai prestasi antenna iaitu kehilangan balikan, lebar jalur, gandaan dan keterarahan adalah -15.362, 3.9028GHz, 3.321Db and 3.824dBi adalah tertinggi diantara bahan yang lain. Selepas itu, semua hasil diperoleh dari simulasi telah dijadualkan dan dianalisis. Daripada projek ini, dibuktikan bahawa graphene memberi peningkatan prestasi kepada antenna berdasarkan konduktivitinya yang tinggi.

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Chapter 1

Introduction

1.1 Introduction

The two-way exchange of opinions, information and news either by writing, speech or gestures including body language and facial reactions is the definition of communications. It can be the act of transmitting, a providing or swapping of knowledge, signals, or messages as by writing, talk or gestures. Besides that, communications also is a system for sending or receiving information and messages, as by radio, telephone and others.

Antenna is the component which transforms wire propagated waves into space propagated waves. It is a very important component in communication, broadcasting and radar system. The antenna receives electromagnetic waves and passes them onto a receiver or transmits electromagnetic waves which have been produced by a transmitter. At the

end of transmission system, an antenna converts electrical energy in transmission line into electromagnetic waves that are emitted into space. While, at the receiver, an antenna convert back the electromagnetic waves receives into electrical energy.

It is generally utilized with a radio transmitter or radio collector. In transmission, a radio transmitter supplies an electric current swaying at radio recurrence to the antenna terminals, and the antenna transmits the vitality from the present as electromagnetic waves (radio waves). In gathering, it is intercepts some of the power of an electromagnetic wave in order to produce a tiny voltage at its terminals, that is applied to a receiver to be amplified.

Antenna is a vital part of all supplies that uses radio. They are utilized as a part of frameworks, for example, radio television, show TV, two-way radio, interchanges beneficiaries, radar, mobile phones, and satellite correspondences, and additionally different gadgets, for example, carport entryway openers, remote receivers, Bluetooth-empowered gadgets, remote machine systems, child screens, and RFID labels on stock.

Normally an antenna consists of an arrangement of metallic conductors (components), electrically associated (frequently through a transmission line) to the collector or transmitter. An oscillating present of electrons constrained through the radio wire by a transmitter will make a wavering attractive field around the antennas components, while the charge of the electrons likewise makes an oscillating electric field along the components. These time-fluctuating fields transmit far from the radio wire into space as a moving transverse electromagnetic field wave. Then again, amid gathering, the wavering electric and attractive fields of an approaching radio wave apply drive on the electrons in the antennas components.

Antennas can be intended to transmit and get radio waves in all level bearings just as (omnidirectional antenna), especially in a specific bearing (directional or high increase radio wires). In the last case, an antenna might likewise incorporate extra components or surfaces with no electrical association with the transmitter or beneficiary, for example, parasitic components, illustrative reflectors or horns, which serve to coordinate the radio waves into a pillar or other wanted radiation pattern.

1.2 Problem Statement

Nowadays, the ability of an antenna to transmit and receive data in a very fast rate is an important characteristic for any application such as WiMAX application. The WiMAX forum has a certain profiles based on the IEEE 802.16 standard, it is operates in 2.5GHz band (2.5GHz – 2.69GHz), 3.5GHz (3.3GHz – 3.8GHz) and 5.5GHz (5.25GHz – 5.85GHz).

For a microstrip patch antenna it have a few limitation, such as produce a narrow bandwidth, microstrip antennas with a high dielectric constant when it is fabricate and associated with a tolerance problems. Nowadays, microstrip antenna is increasingly useful and become very widespread within the mobile phone market

Besides that, the ability to enhance the parameter is one of the target requirements. So, this project is to study the effect of a various type of material such as copper, aluminium, silver, gold and graphene as the patch material and as increased the effectiveness of a rectangular patch antenna with a CPW-fed triple triangle slot.

Other than that, special properties of graphene conductivity from microwave to THz frequency are the foundation of many promising application proposed.

1.3 Project Objective

The main aim of the project is investigating and designing a rectangular stacked patch antenna with a CPW-fed triple triangle slot in CST STUDIO SUITE Software for WiMAX application.

Next, to study the performances of parameter such as return loss, bandwidth, gain and directivity on a rectangular stacked patch antenna with a CPW-fed triple triangle slot.

In addition, the comparison of performance of parameters for a material between copper, aluminium, silver, gold and graphene as a patch material have been made.

Furthermore, the rectangular patch antenna with a CPW-fed triple triangle slot with and without stacked patch is being compared by the effect of performance of parameters mentioned above. At the end of the project, a rectangular stacked patch antenna with a CPW-fed triple triangle slot with a optimize frequency will be developed.

1.4 Scope of Work

To design and develop the rectangular stacked patch antenna with a CPW-fed triple triangle slot in Computer Simulation Tool (CST) software is the aim of this project. Firstly, start with the literature review and research for more understanding on the concept and theory about this project. Then, by using CST STUDIO SUITE Software the simulation was performed and reorganized to make sure that the result will meet the specification required.

This antenna can be used for WiMAX application with a resonant frequency is 3.5GHz. This project use a copper, aluminium, silver and gold as a patch material to determine the effectiveness of the material compare with graphene. In addition, this project is focused on how the effectiveness and capability of this type of antenna by using a rectangular patch antenna with a CPW-fed triple triangle slot with and without stack patch.

Besides that, tabulate the data and graph based on the simulation and result in Computer Simulation Tool (CST) software to ensure the enhancement of using the patch material. The fabrication of the antenna is not involved in this project due to the high cost of graphene and the limitation of materials and machines in UTeM.

1.5 Brief explanations on methodology

This project determined by the objectives of the project. From the literature review section, information was gained to study and learn about the antenna fundamentals. After that, the project continued by performed the design of rectangular stacked patch antenna with a CPW-fed triple triangle slot. Next, after process of designing, this project used copper, aluminium, silver, gold and graphene as patch materials for the antenna design. Then, the simulation will be carried out by using CST software to find out the performances of parameter such as return loss, gain, directivity and bandwidth of the antennas, hence the simulation result will be compared. When obtain all simulation result for the design of antennas, the analysis and estimation of the characteristic of the antennas will be carried out. A detail explanation for methodology parts will be explained in Chapter 3.

1.6 Organization of Thesis

This thesis is divided into 5 chapters. The outline of each chapter stated in the paragraph below:

Chapter 1: Highlighted aims and objective of the thesis. An overview of the thesis is given at the end of the chapter.

Chapter 2: In the literature review, a basic of introduction of antenna, antenna concepts, feeding methods and the introduction of graphene has been described.

Chapter 3: The methodology to design rectangular stacked patch antenna with a CPW-fed triple triangle slot is described. In this part, a method and technique in order to achieve the aim of this project was mentioned.

Chapter 4: Focused on the result and discussion of this project. Simulated result is obtained for the antenna design using copper, aluminium, silver, gold and graphene as the patch material is discussed at the end of the chapter.

Chapter 5: Contains the conclusion and recommendation that give an idea of the prospect.

Chapter 2

Literature Review

This chapter will explained on the fundamental concept and theory of the reconfigurable project design with any information to improve the design project of antenna. The overall parameters will be discussed as well as each of its contribution to an antenna performance adding with the techniques used in the preparation and designation of reconfigurable antenna.

2.1 Antenna Definition

The IEEE Standard Definitions of Terms of Antennas (IEEE Standard 145-1983) defines the antenna or aerial as “a means for radiating or receiving radio waves.” [1] The Webster’s Dictionary define the antenna as “a usually metallic device (as a rod or wire)

for radiating or receiving radio waves.” In other words, the antenna is the transitional structure between free-space and a guiding device [2].

2.2 Antenna Concepts

An antenna gives the wireless system three fundamental properties: gain, direction and polarization. Gain is a measure of increase in power. Gain is the amount of increase in energy that an antenna adds to a radio frequency (RF) signal. Direction is the shape of the transmission pattern. As the gain of a directional antenna increases, the angle of radiation usually decreases. This provides a greater coverage distance, but with a reduced coverage angle. The coverage area or radiation pattern is measured in degrees. These angles are measured in degrees and are called beamwidths.

An antenna is a passive device which does not offer any added power to the signal. Instead, an antenna simply redirects the energy it receives from the transmitter. The redirection of this energy has the effect of providing more energy in one direction, and less energy in all other directions.

2.3 Basic Characteristics Microstrip Patch Antenna

Microstrip antennas received considerable attention starting in the 1970s. Microstrip antennas, as shown in Figure 2.1, consist of a very thin metallic strip (patch) placed a small fraction of a wavelength above a ground plane. The microstrip patch is designed so its pattern maximum is normal to the patch (broadside radiator). This is accomplished by properly choosing the mode (field configuration) of excitation beneath