PATTERN RECONFIGURABLE ANTENNA

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BORANG PENGESAHAN STATUS LAPORAN

PROJEK SARJANA MUDA II

Tajuk Projek : PATTERN RECONFIGURABLE ANTENNA

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This project and research work is dedicated to any beloved parents for their devoted caring throughout my life, my loving brother and sister, also my friends for their encouragement and love.

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ABSTRACT

The recent wireless communication systems tend to be high-capacious, multifunctional and cover more frequency bands. Therefore, the quantity of the antenna is becoming larger and larger. This will lead to large communication system equipment, increased costs, and electromagnetic compatibility problems. This thesis presents the design of a pattern reconfigurable antenna which can operable at 2.4GHz for wireless communication system using electrical switching technique with integration of RF PIN diodes. For this project, a rectangular microstrip patch antenna was first designed and fabricated as a reference. Then a microstrip patch antenna with a partial ground plane base equipped with two pin diode is designed to get pattern reconfigurability. Two PIN diode switches are mounted over the slots in the ground plane optimize to yield the maximum number of radiation pattern and to enhance the resonance frequency, return loss, gain and efficiencies. This antenna is an attractive candidate for WLAN applications. While standard antennas radiate the energy in a fixed direction, pattern reconfigurable antenna allows a single radiation structure to behave as several antennas with different radiation properties. Pattern reconfigurability enables wireless communication systems to avoid noisy environments, maneuver away from electronic jamming, and save energy by redirecting signals toward intended users only. Pattern configurable antennas are frequently used to increase channel capacity and broaden the coverage area of wireless system.

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ABSTRAK

Sistem komunikasi tanpa wayar hari cenderung untuk menjadi capacious tinggi, pelbagai fungsi dan merangkumi lebih banyak band frekuensi. Oleh itu, kuantiti antena menjadi lebih besar dan lebih besar. Ini akan membawa kepada peralatan sistem komunikasi yang besar, kos meningkat, dan masalah keserasian elektromagnet. Tesis ini akan membentangkan rekabentuk antena reconfigurable corak yang boleh beroperasi pada 2.4GHz sistem komunikasi tanpa wayar yang menggunakan teknik pensuisan elektrik dengan integrasi diodes RF PIN. Bagi projek ini, sebuah segi empat tepat microstrip patch antena pertama direka dan direka sebagai rujukan. Kemudian antena patch microstrip dengan kapal terbang sebahagian tanah asas dilengkapi dengan dua pin Diod direka untuk mendapatkan corak reconfigurability. Dua PIN Diod, suis dipasang ke slot dalam satah bawah mengoptimumkan hasil jumlah maksima corak sinaran dan meningkatkan kekerapan resonans, kehilangan kembali, keuntungan dan kecekapan. Antena ini adalah untuk calon yang menarik untuk aplikasi WLAN. Manakala standard antena memancar tenaga arah tetap, antena reconfigurable corak membolehkan sinaran satu struktur untuk berkelakuan sebagai beberapa antena dengan sifat-sifat sinaran yang berbeza. Corak reconfigurability membolehkan sistem komunikasi tanpa wayar untuk mengelakkan persekitaran bising, bergerak dari jamming elektronik dan menjimatkan tenaga dengan melencongkan isyarat ke arah pengguna sahaja. Corak dikonfigurasikan antena sering digunakan untuk meningkatkan kapasiti saluran dan meluaskan kawasan liputan sistem tanpa wayar.

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CHAPTER 1

INTRODUCTION

1.1 Introduction to the Project

Electrical transmission of speech communication, music, pictures and other information by using the electrical signal. Speech and music sent directly from their sources to listeners across the close proximity through sound or acoustic waves. A photo of the same sent directly with optical or light waves over a short distance.

At longer distances, communication wire and radio communication used to send signals. It is a unusual circuit component, known as the ' antenna ' that has prepared radio communications may in practice. Creating an antenna burly enough electromagnetic field at huge distances and, mutual, it is extremely susceptible to external electromagnetic field intimidated it. However, coupling between the receiver and transmitter antenna is consequently miniature that the signals should be amplified in both the sending and receiving stations. It is impossible to try radio communications without an antenna.

Wireless communications system recently tends to be high, multi-functional and include more frequency band. Therefore, the quantity of the antenna gets larger and

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larger. This will lead to large equipment, communication systems, increasing cost and the problem of electromagnetic compatibility. Remodeling antenna, which offers a wide range of functions within the radiation pattern, frequency, or polarization, can realize the function of various dynamic antennas as it can adjust behavior to measure different situations and context operations. Therefore, it is effectively reducing adverse effects on the system of wireless communication brought about by the number of antennas.

Nowadays seen from most studies of the reconfigurable antenna by numerous institutions, reconfigurable antenna according to its function is divided into frequency reconfigurable antenna, polarization reconfigurable antenna, pattern reconfigurable antenna and hybrid reconfigurable antenna. The implementation methods contain using switches, changing material electromagnetic properties, loading variable reactance, using mechanical methods, using the parasitic units, using switchable feeding networks to improve their performances and so on [1].

The radiation pattern is one of the main characteristics of the antenna. Thus, the antenna pattern reconstruction cannot not be important instructions on remodeling antenna research. Antenna pattern reconstruction can be used to avoid noise sources, increase profit and safety systems, save energy with direct signals only in the desired direction. The pattern or the frequency of reconfigurability can be accomplished in several ways, such as moving to pass through the switch, using loading change to change current behavior at the antenna, or adding parasitic elements change to alter the elements of performance driven. Reconfigure patterns have been achieved mainly by using parasitic elements of variable length. Switching mechanism is used to change the existing password and giving patterns of behavior that reconstituted [2].

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1.2 Problem Statement

High capacity is very crucial in wireless as it is required for future application. It is because; the data transferred by users are becoming larger nowadays. For example, in the early years the data transferred consists of only text or voice only. As time goes by, the user is demanding higher channel capacity as they wish to send voice with picture or text with video or text, picture, and video at the same time. These data are required more capacity to be transferred. One of the main challenges in wireless communication is to gain high capacity in order to fulfill future application necessities. It is important in increasing the data transferred simultaneously. The enhancement insist for capacity in a wireless system has provoked large study intended at achieving advanced invention to the bandwidth provided.

Besides that, the current communication devices are portable and multiplications supported such as Bluetooth, Wi-Fi, GPS, and so much more. These applications are used different operating frequencies in order to avoid interferences between them. The conventional way to support this demand is by placing two or more antennas with different resonant frequency in that device. Obviously, this method is not effective because combining two or more antennas proving difficult because they will probably pair with each other causing degradation signals are received or sent. Placing two antennas in a device also bring in the space issue since it is usually designed to be a portable device and by placing multiple antennas in the device required more spaces. Moreover, this will lead to large communication system equipment, increased costs, and electromagnetic compatibility problems.

Some packages may use two or three antennas for diversity reception on small devices to increase the probability of receiving a usable signal, but usually only one of the antennas is used for transmission. The transmission from the portable device to a

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base station or other access point is the weakest part of the bidectional communication link because of the power, size, and cost restrictions imposed by portability. Moreover, the portable device is often used in unpredictable and /or harsh electromagnetic conditions, resulting in antenna performance that is certainly less than optimal. Reconfigurability antennas in such a situation can provide many advantages. For example, the capability to adjust the operating frequency antennas can be used to change the operating band, filter out annoying signals, or tune the antenna to take account of the novel surroundings. The radiation pattern of the antenna can be altered; it can be brought to the access point and employ fewer power for shipping, resulting in important savings in battery power.

Reconfigurable antennas, which offer diverse functions in radiation pattern, frequency, or polarization, can realize the function of the multiple antennas since it can dynamically adapt its behavior to different measurements situations and operational contexts. Therefore, it effectively reduces the adverse effects on the wireless communication system brought by the antenna number.

Reconfigurable antennas and devices represent a key technology for improving the performance of wireless communication systems. Accordingly, several design strategies for achieving reconfigurabilty in terms of one or more antenna parameters (i.e., operating frequency, polarization, etc.) Among these, antennas with a reconfigurable radiation pattern are of great interest due to their positive impact on network capacity and reliability by reducing interference problems and maximizing signal-to-noise ratio.

A remodeling pattern of electromagnetic radiation is radiator pattern changing with the switch. Typically, the frequency of such antenna operations is reserved unvarying. But in a few cases it is considered to contain dissimilar radiation patterns at

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dissimilar frequencies. Pattern reconfigurability allows wireless communication system in order to avoid a noisy environment, moving from electronic jamming, and save energy with the direct signal to the direction of the intended users. The antenna pattern is often used to raise the configured capacity channels and expanded the coverage of a wireless system.

1.3 Objective

The main purpose of this project is to design, simulate and fabricate pattern reconfigurable antenna for wireless communication system using electrical switching technique with integration of RF PIN diodes.

1.4 Project Scope

The project scope is focused on microstrip patch antenna designs which provide pattern reconfigurability. Slotted ground plane and switching techniques are added to control surface current in order to achieve pattern reconfigurabily .

1.5 Methodology

In order to achieve the objective, a number of activities have indentified, as outline below:

i. Investigate characteristics of microstrip patch antenna by means of simulation and numerical analysis.

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ii. Simulate the pattern reconfigurable antenna design model using antenna simulation software before the actual prototype built.

iii. Integrate RF Pin diode into the proposed antenna to evaluate the reconfigurable characteristics performance.

iv. Develop a new design prototype of pattern reconfigurable antenna.

v. Antenna performance evaluation and optimization.

CHAPTER 2

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LITERATURE REVIEW

2.1 Introduction

In recent years, wireless communication systems have shown tremendous growth. It will enable the accommodation of higher data rates owing to the advent of various services such as cellular, satellite communications and wireless local area networks. Since several applications operate either at different frequency bands or different radiation characteristics (such as pattern or polarization), the system requires multiple characteristic for several services. In addition, in urban areas, multipath fading phenomena may occur after multiple reflections or scatterings. As a large number of users are included within the limited frequency bandwidth, the probability of interference is increased. A reconfigurable antenna can solve these problems due to its diversity functions. In addition, it saves installation space and cost [3]. Reconfigurable antenna is able to change the antenna frequency, bandwidth, operational radiation pattern and polarization has become a very active field of research in the past decade. This is mainly due to their ability to provide dynamic reconciliation of changes in the channels of communication or system requirements [4].

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2.2 Antenna

The fields of wireless communication at present have given more emphasis to the field of antenna design In the early years when the available radio frequencies, an antenna with a design that is easy to use as a tool for transmitting electrical or radio waves in the air into all directions. This is an innovative way of communication to replace the wired technology wireless technology was first introduced by Galileo Marconi when he successfully start the first wireless telegraph in 1895. After that, the development of wireless technology make rapid. Antenna development plays an important role in wireless technology as the number of growing by leaps and bounds from the user in broadcasting, telecommunications, navigation, radar, sensor, and perhaps for the future cognitive radio wireless communications for example [5].

2.3 Basic Antenna Properties

The basic features that are used to explain the performance of the antenna including a fixed Voltage Impedance, Wave Ratio (VSWR), broadband, radiation pattern, 3 dB beam width, profitability and ultimately polarization.

2.3.1 Impedance

Antenna input impedance identically must match the characteristics of the transmission lines for maximum energy transfer archives between coaxial transmission line and antenna. If the antenna input impedance not equal to the characteristic impedance, transmission line will generate waves as shown at the antenna terminal and travel back towards energy sources. This reflects the energy cause a reduction in the

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efficiency of the system as a whole. The losses in efficiency will occur if the antenna is being used to send or receive energy.

2.3.2 Return Loss

In telecommunications, return loss refers to the ratio of power/power transmission delivered to the transmission lines. The value of the loss mitigation amplitude for the Return described in comparison to energy is reversed to send energy. Excellent antennas require a small value losses back less than point-10dB for best performance. Lost back to Pointe-10 dB is means that only 10% of the amounts of energy that can be seen while 90% of the amount of power delivered.

2.3.3 Bandwidth

Bandwidth is the frequency range antenna will be delivered efficiently where the antenna meets the criteria specified a set of performance specification. When the power antenna (3dB) ½, walk up and down this frequency has been reached and the antenna will no longer do. Antenna operates in a wide frequency range and still maintains satisfactory performance must have compensation circuit switched into the system to maintain the impedance matching. The relationship between the VSWR and bandwidth shown in Figure 2.13. Antenna bandwidth can be calculated as the equation 2.1. [6]

$$BW\ \% = \frac{fu-fl}{\sqrt{(fu \times fl)}} \times 100 \qquad (2.1)$$

Where fu = upper frequency bandwidth

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