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Research Article

Design Of Frequency Reconfigurable Microstrip Antenna

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ABSTRACT
Due to the rapid evolution in electronics and wireless communication, the demand for the portable electronic devices operating at different frequency bands for multiple applications has been increased. Frequency reconfigurable antennas play an important role in wireless communication. In our proposed method we designed a micros trip patch antenna using HFSS software in order to increase return losses. The substrate used in this proposed design is FR4 with dielectric constant 4.4 and thickness 1. 6mm. The measured tuning of the designedantenna ranges from 2.5 to 5GHz. The value of VSWR is in the range of1-2 in this range of frequency. The return losses obtained in our designed antenna is 23Db

Keywords: wireless, portable, antenna

Introduction

The word antenna is derived from Latin word which is called a transmitting/receiving device. Antennas are the key components in wireless communication system. An antenna is a type of transducer which converts electrical signal to electromagnetic signals. Patch antennas are extremely used today. They can used for satellite communications and various military applications such as GPS, mobile phone, missile systems, etc., due to the lightweight, simple structure and easy implementation. The increasing demand for modern mobile, satellite and wireless communication systems have driven many researchers to work on improving performance and enhancing applications of patch antennas. The re-configurable antenna has become a distinct area in the modern wireless applications because it empowers a single antenna to be used at various systems. Re-configurability of an antenna means to achieve modification in antenna's operating frequency, polarization, or radiation characteristics dynamically. The characteristic modification of an antenna can be obtained by redistribution of current in antenna. There are many techniques involved in which the antenna current can be redistributed, either by altering the geometry of antenna or by changing the electrical properties of antenna. For this RF switches, varactors, or tunable materials can be used. These concepts of re-configurability can significantly decrease the complexity of hardware by reducing the number of components. There are different techniques to achieve reconfigurable aspect of the antenna structure, for example, By varying the physical structure of an antenna, shifting the feeding point, implement antenna arrays, etc. It is essential to note that while changing one parameter in the antenna characteristics then it can affect the other parameters. Therefore, during the design of antenna all the antenna characteristics should be analyzed simultaneously in order to achieve the required re-configurability.

Types of Antenna:-Wire antenna

Wire antennas are used virtually everywhere on automobiles, buildings, ships, aircrafts etc.. They may be of the form straight wire, rectangle, square loop or any other configuration. Short Dipole Antenna, Dipole Antenna, Loop Antenna and Monopole Antenna are the examples of wire antennas. Microstrip antenna these are low profile, comfortable to planar and non-planar surfaces, simple and inexpensive to fabricate. Hence these are used in aircrafts, satellites, mis siles, cars, and mobile phones. Rectangular Microstrip Patch Antenna and Quarter Wave Patch Antenna are the examples of Microstrip antennas. Log periodic antenna A log-periodic antenna (LP), also known as a log- periodic array or log- periodic aerial, is a multi-element, directional antenna designed to operate over a wide band of frequencies. Bow Tie Antenna and Log-Periodic Dipole Antenna are the examples of Log Periodic Antenna Aperture Antennas The aperture is defined as the area, oriented perpendicular to the direction of an incoming electromagnetic wave, which would intercept the same amount of power from that wave as is produced by the antenna receiving it. Slot Antenna and Horn Antenna are the examples of Aperture Antennas. Reflector Antennas An antenna reflector is a device that reflects electromagnetic waves. Antenna reflectors can exist as a standalone device for redirecting radio frequency (RF) energy, or can be integrated as part of an antenna assembly. Flat-plate Reflector Antenna, Corner Reflector Antenna and Parabolic Reflector Antenna are the examples of Reflector antennas Lens Antennas A lens antenna is a microwave antenna that uses a shaped piece of microwave-transparent material to bend and focus the radio waves by refraction, as an optical lens does for light. Typically it consists of a small feed antenna such as a patch antenna or horn antenna which radiates radio waves, with a piece of dielectric or composite material in front which functions as a converging lens to collimate the radio waves into a beam. Conversely, in a receiving antenna the lens focuses the incoming radio waves onto the feed antenna, which converts them to electric currents which are delivered to a radio receiver. They can also be fed by an array of feed antennas, called a focal plane array (FPA), to create more complicated radiation patterns. Travelling wave Antenna A lens antenna is a microwave antenna that uses a shaped piece of microwave-transparent material to bend and focus the radio waves by refraction, as an optical lens does for light. Typically it consists of a small feed antenna such as a patch antenna or horn antenna which radiates radio waves, with a piece of dielectric or composite material in front which functions as a converging lens to collimate the radio waves into a beam. Conversely, in a receiving antenna the lens focuses the incoming radio waves onto the feed antenna, which converts them to electric currents

Existing Design

In this design, a circular patch antenna is designed using GENYSIS software. At the beginning, the radius dimension of a circular antenna was calculated manually by extending the standard cavity model formula and the length of the 50 Ω line feed was obtained from LIBRA software by inserting the characteristics of thesubstrate and metal conductor.

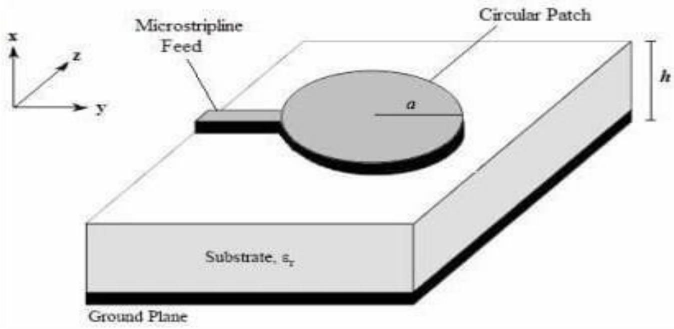


Fig 2.1: circular patch Antenna

The dimensions of the antenna in this project were 25.41 mm and 1.173 mm for length and width of feed line respectively. While the antenna radius that obtained from the calculation was 2.31 cm. Simulation of the design was carried out by using GENESYS software. The optimization process was applied until the satisfactory results were obtained. The flow of work then continues with the fabrication process. This process begins with the layout from the GENESYS. After that, the etching process was carried out according to the dimensions from the simulation. Finally, the antenna was measured using a Vector Network Analyzer to compare the simulation and the measurement results. This circular antenna was designed based on the cavity model to obtain the best output in term of return loss and VSWR.

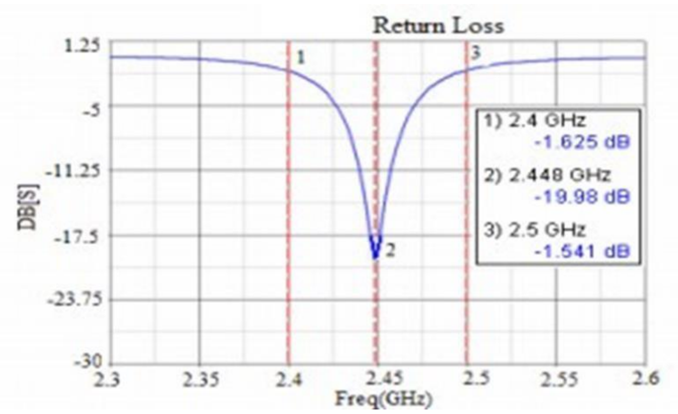


Fig 2.2: Return losses of existing method

As shown figure 2.2 represent the return losses of the existing system and figure 2.3 represent the VSWR of the existing system.

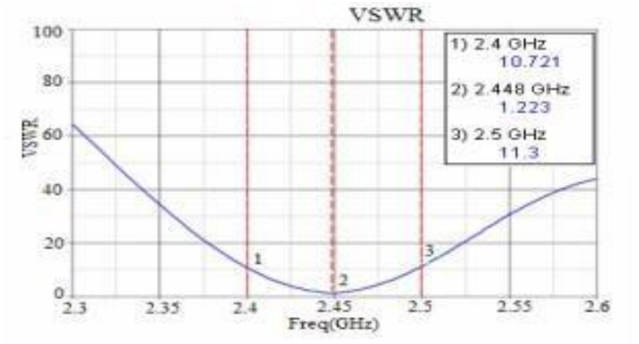


Fig 2.3: VSWR of the existing system

Proposed Design

Micro strip antennas are used in communication systems due to simplicity in structure, conformability, low manufacturing cost, and very versatile in terms of resonant frequency, polarization, pattern and impedance at the particular patch shape and model. The performance of the antenna is affected by the patch geometry, substrate properties and feed techniques. At the beginning dimensions of substrate, ground, and patch are calculated. In our proposed design two rectangular patches are added to both sides of existing method. The antenna is designed used FR4 substrate which is having dielectric constant 4.45 and thickness (h) of 1.6mm and a resonant frequency of 4.5MHz.

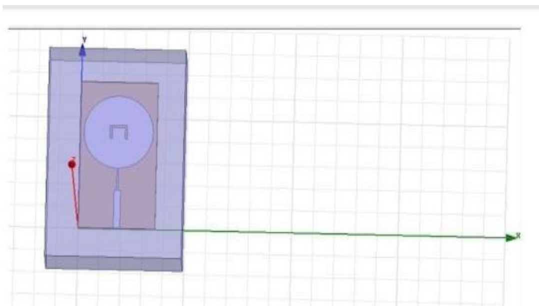


Fig 3.1: proposed Design

The dimensions of patch are 13.75 length and 18.24mm width and the dimensions of ground are 29mm length and 29mm width. The dimensions of both ground and substrate are same. Designing and stimulation of antenna is carried out by using HFSS (High Frequency Simulated Software) and the feed line used in the design process is micro strip feed line. Figure 3.1 represent proposed design.

Necessity of Re-configurability

Let us consider the two general applications of re-configurability, one is single-element scenarios and other one is array scenarios, in single-element scenarios an antenna used in portable wireless devices, such as cellular telephonic device, a personal digital assistant, a laptop or computer or any electronic device. Single antennas typically used in these devices are mono pole or micro strip antenna based and may or may not have multiple-frequency capabilities. Some packages may use two or three antennas for good reception on small devices to increase the probability of receiving a usable signal, but usually only one antenna will used for transmission. The signal transmission from the portable device to the base station or other access point is the weakest part of the bidirectional communication link because of the power, size, and cost restrictions imposed due to portability. Moreover, the portable device is often used in unpredictable and harsh electromagnetic conditions, which results in the performance of antenna that is certainly less than optimal condition. Antenna re-configurability in such a situation could be able to provide numerous advantages. For the instance, the ability to tunethe operating frequency of antenna could be utilized to change operating bands, filtering out interfered signals, or to tune the antenna to account for a new environment. If the radiation pattern of antenna is changed, then it could be redirected towards the accesspoint and use lesser power for the transmission ofsignal, which results in a significant savings inthe battery power. The antennas are mostly used in array configuration, feed structures with power dividers/combiners and phase shifter s. For the instance, current planar phased array of the radar technology is typically limited to both scan angle and frequency bandwidth as a result of the limitations of the individual array elements and the restrictions of the antenna element spacing. These restrictions come from mutual coupling effect on one hand, and the appearance on grating lobe on the other hand. Many of these established applications assume that the antenna elementpattern is fixed, and all the elements of the antenna are identical, and the elements that lie on a periodic grid. The additional reconfigurability to antenna arrays can provide additional degrees of freedom that may result in wider instantaneous frequency bandwidths, more extensive scan volumes, and radiation patterns that can provide control over the side lobe distributions. There are several antenna structures that are suitable for implementation of re configurable antennas, among them micro strip patch antennas are very attractive structures for various types of re configurable antennas, all such antennas areusually equipped with switches that are controlled by DC bias signals. By toggling the switch between on and off states, the antenna can be reconfigured to obtain better result. The following section describes the design procedure of micro strip patch antenna types presented and different feed types used in this dissertation. the advantages of proposed design, Return losses increases, Information transferred is more comparedto existing design.

Results

Below figures represent outputs of the proposed design

Radiation Pattern

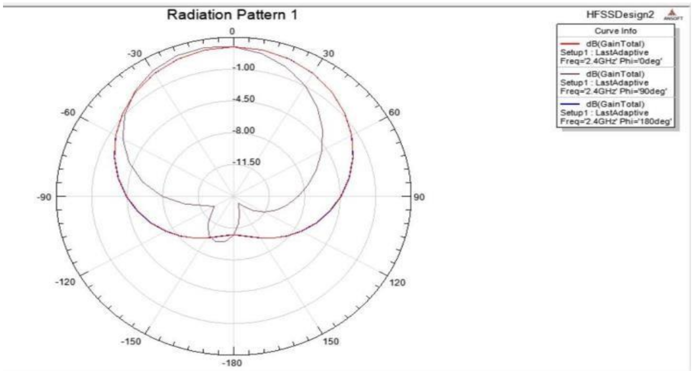
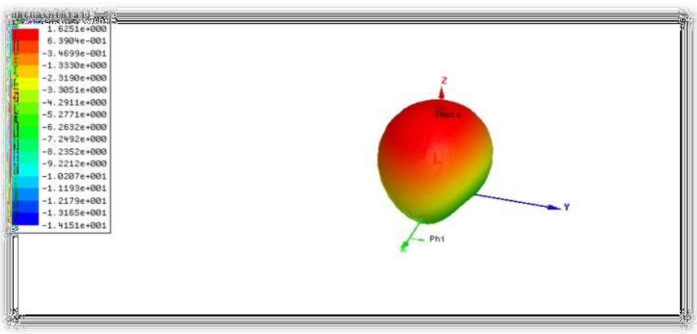


Fig 5.1: Radiation pattern of proposed design



Return Losses

The return losses obtained after simulating the proposed method is 23dB and the output of thereturn losses is represented using figure 5.3

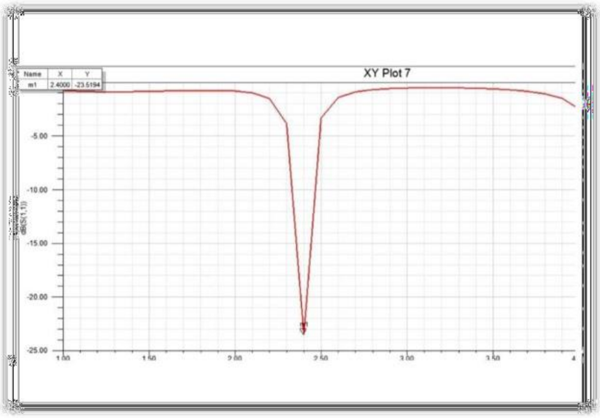


Fig 5.3: Return losses of proposed design

VSWR

VSWR obtained after simulating proposed design is 1.2 and it is represented using belowfigure 5.4

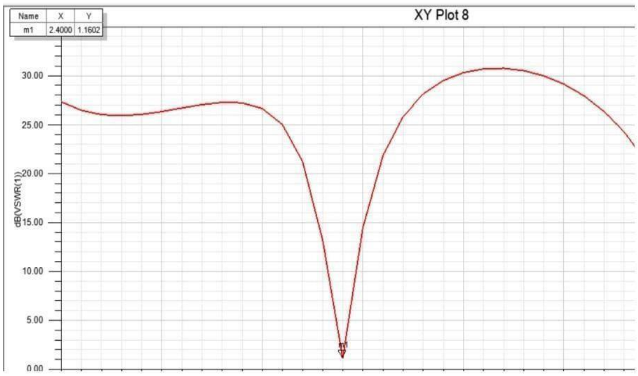


Fig 5.4: VSWR of proposed design

Conclusion

U-Shaped micro strip patch antenna that is fed by micro strip lines is designed by adding patches on either side to the existing method using HFSS software. From the simulation results we observe that the return losses obtained is -23dB and VSWR is in the range [1, 2] which resembles thatit is a reliable antenna. Since return losses is increased the amount power reflected back will be reduced which increase the maximuminformation transfer.

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