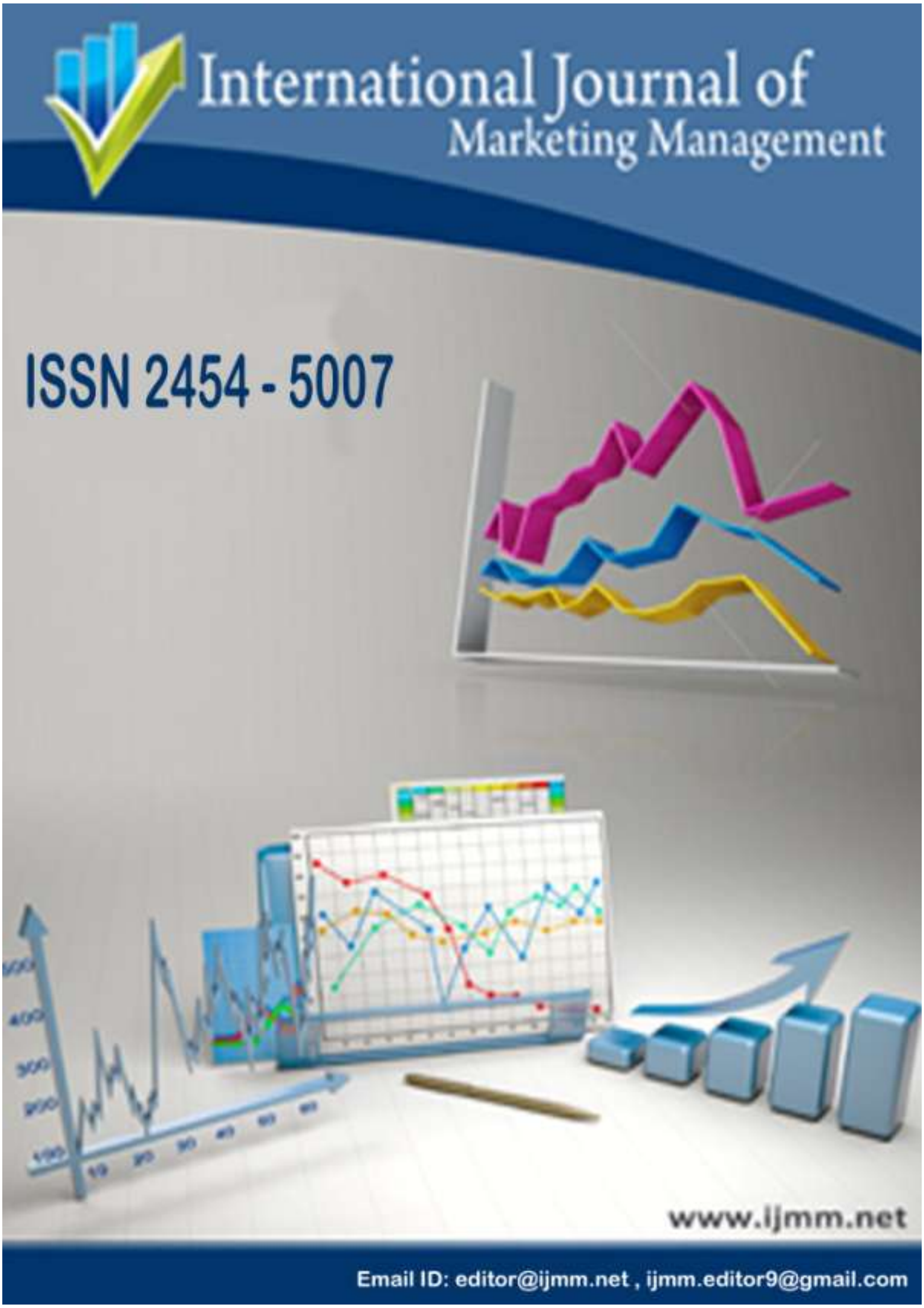
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Design and Optimization of Micro strip Patch Antenna for Satellite Applications

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ABSTRACT
1.Microstrip Patch Antenna for Ultra Wide Band 3.1 to 10.6 GHz is the subject of this thesis. Microstrip patch antenna fundamentals are the focus of this dissertation. The antenna's properties were studied parametrically to determine how their different geometrical and other factors affected them. The patch and ground plane size and separation, as well as the substrate material's dielectric constant, are among the antenna's geometrical characteristics. In order to get the best outcomes and performance, the parametric research also examines several strategies for optimising various antenna characteristics. This is a simulated experiment. CST microwave Studio simulation software is used to create the antenna design and simulation. The full UWB spectrum is covered by four antennas of varying forms and sizes. The first antenna design had two overlapping half-circular patches. Antenna performance is enhanced by cutting a small rectangular slot through the patch. The antenna's return loss curve indicates a bandwidth of 3 GHz to 12 GHz, with a low S11 of -45 dB at 3.5 GHz. elliptical patch antenna with modified ground plane, which spans 2.46 Ghz to 13.62 Ghz, has a minimal return loss at resonance frequency 10GHz of -50dB. The second design.

2. INTRODUCTION

It is becoming commonplace for people to use a wireless network. The wireless system is used by almost all of the electrical and electronic devices in use today. It is crucial to have an antenna in order to use the wireless system. Antenna is an electrical device that converts the electrical power supplied at the input into electromagnetic waves that are sent into the space.electrical power is generated by converting radio waves into electrical power at a receiving end. Remote control television, cellular phones, satellite communications and spacecraft are all examples of devices that require antennas. Wireless phones and computer networks are also common. An ever-increasing number of wireless gadgets are being launched, resulting in an increase in the need for smaller antennas. Additionally, the usage of antennas in aeroplanes and spacecraft has raised the requirement for a low-profile, dependable communication device. Low-profile and small weight are the hallmarks of a microstrip antenna. With the use of printed circuit technologies such as a dielectric substrate attached to a metallic layer in a certain shape, this antenna may be readily created. A continuous metallic layer is placed on the opposite side of the substrate to serve as a ground plane. It is possible to utilise any continuous form as a radiating patch, not only the fundamental shapes. Some microstrip antennas utilise dielectric spacers instead of dielectric

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substrates, which results in a broader bandwidth but at the expense of a reduced level of ruggedness. It is easy to place microstrip antennas on any flat or non-planar surface because of its low profile and mechanical strength. Microstrip antennas are /2 in diameter. Because of the antenna's size, microstrip antennas are often used above the microwave frequency range. Microstrip patches are impractical at frequencies below microwave due to the large dimensions needed. Microstrip antennas are now widely employed in commercial industries because of their low cost and ease of fabrication thanks to modern printed circuit technology. As microstrip antenna technology advances and new research is conducted, it is projected that in the not too distant future some time most of the conventional antenna will be replaced by microstrip antenna.

1.2 Objective of the Work

Rectangular, square, round, and triangular are all frequent forms for microstrip patches. A well-established design formula exists for each of these concepts, which have been thoroughly researched. There are several different kinds of antennas that are explored in antenna design. New microstrip patch antenna shapes have been developed that can cover the whole Ultra Wide Band. electromagnetic interference (EMI) is a key challenge for UWB systems since there are many other wireless narrowband applications licenced to various frequencies band in the UWB band. Because of this, the UWB antenna must be designed such that it can reflect interference from other radio frequencies. UWB antennas should contain band notches to reject existing frequency bands in the ultra-wide band in order to address this interference issue. Three distinct UWB designs with various band notches are shown here. The purpose of this thesis is to investigate the relationship between antenna performance and different microstrip patch antenna characteristics. This is a simulated experiment. The antenna was designed and simulated using CST Microwave Studio software, a professional 3-D full-wave electromagnetic modelling tool. The antenna parameters are then adjusted to examine the impact of antenna parameter variation on antenna performance.

3. APPLICATIONS

Due to its many benefits, the microstrip antenna was proven to be quite helpful in many different applications after a number of restrictions. A common kind of defence system antenna is the microstrip antenna, which may be found on anything from missiles to satellites. Microstrip antennas are now widely employed in commercial industries because of their low cost and ease of fabrication thanks to modern printed circuit technology. Microstrip antennas are predicted to replace most conventional antennas within a short period of time due to continuing research and development in this field. Microstrip antennas are widely used in a variety of fields, including: • Antennas utilised in mobile applications should be low weight and tiny in size. All of these may be met with a microstrip antenna. Smartphones, cellular phones, UHF pagers and radar applications in vehicles such as aircraft and ships are the most common types of mobile applications. Radar is used for a wide range of purposes, including maritime radar, surveillance radar, and remote sensing radar. It's important to have a circular polarisation antenna for satellite communications. Using dual feed networks and other approaches, it is possible to quickly create an antenna with required polarisation using a microstrip antenna. Satellite broadcasting makes use of parabolic antennas, which are common in satellite communication. Instead of a parabolic reflector, a flat array of microstrip antennas may be employed.

System of Global Positioning

Satellite-based GPS systems were first employed solely for military reasons, but they have now found a wide range of commercial applications. Keeping track of a vehicle's precise location and position has become a need for automobiles, ships, and aircraft. GPS uses 24 satellites that orbit the Earth every 12 hours at a height of 20,200 kilometres. The signal sent by the GPS satellite is received by thousands of receivers on the planet by means of two frequencies in the L- band. A circularly polarised reception antenna is required. In the L-band, an omnidirectional microstrip antenna with a broad beam and low gain is easy to construct. Satellite Direct Broadcasting:-

Television services are provided in several countries through direct transmission. An antenna with a gain of at least 33 dB should be used on the user's side of the ground. Typical parabolic reflector antennas are large, need a lot of area, and are susceptible to snow and rain. An array of circularly polarised microstrip antennas may be used to receive direct broadcasting.. Snow and rain are less of an issue, and they're also easier to install and less expensive. For the Pedestrian:- Antenna

Because of the limited area available, an antenna designed for pedestrian use should be as compact as feasible. Antennas with a compact footprint, minimal weight, and a thin profile include Pocket-sized devices are often equipped with this technology. For that, a microstrip antenna is the greatest option out there. Short circuiting the patch or employing high dielectric constant material may be utilised to reduce the antenna's size. However, it has the disadvantage that a smaller antenna results in a decrease in performance.

When it comes to radar:-

Antennas with the proper gain and beamwidth are required for radar applications such as Manpack radar, Marine radar, and Secondary surveillance radar. It is possible to employ an array of microstrip antennas to get the appropriate gain and beamwidth. The Synthetic Aperture radar approach is utilised for specific applications, such as measuring ocean wave speed and direction and identifying ground soil grades. This method has two patch antenna arrays separated by a suitable distance.

3. MICROSTRIP PATCH ANTENNA THEORY

Antenna made using microstrip wire

A microstrip antenna consists of two thin metallic layers (to), one as a radiating patch and the other as a groundplane, sandwiched between them. On the dielectric substrate, the conductor patch is employed as a radiating element. Away from the main materialA conductive layer serves as the ground plane. The most common metals to be utilised as a layer are copper and gold. For the most part, the geometry of a radiation patch is determined by the existing theoretical models, and it is straightforward to anticipate its performance based on this information. Some fundamental forms are square, rectangular, dipole, triangular, elliptical, and round. Because of their simplicity in analysis and manufacture, the most common forms are circular, rectangular, and dipole. The substrate may be made of a range of dielectric materials with dielectric constants ranging from 2.2sr to 12[8].

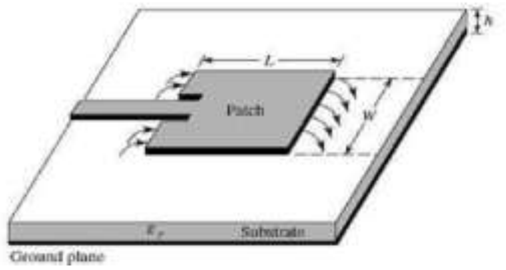

Figure 1. Microstrip Patch Antenna.

An antenna made out of microstrip material has a very limited frequency range. Microstrip antennas, on the other hand, may be effective in government security systems that need a very narrow bandwidth. The height of the substrate has a direct relationship to the bandwidth of the microstrip antenna. Two primary methods exist for increasing bandwidth: one is based on circuit theory, the other is structural.

Antenna characteristics are determined by the TX line and antenna combination in addition to the antenna element itself. A microstrip antenna's input impedance is often complicated, while the TX line's characteristic impedance is real (usually 50 ohm). As a consequence, the transmission line's impedance will be mismatched, resulting in a voltage standing wave pattern and a narrow bandwidth. Between the antenna and the transmission line, impedance matching networks may be used as a solution to this issue. A variety of impedance matching methods exist at one's disposal, and circuit theory is concerned with them. Mechanism of ionising radiation

When a microstrip line is left open ended on one end and fed on the other, some of the power is radiated in space from both ends as electromagnetic waves because of the discontinuity. At half-wavelength or a multiple of half-wavelength

distances apart, Denlinger found that the highest quantity of power sent into space is maximal [6]. Denlinger came to the conclusion that radiations were emitted from the open end as a result of the discontinuity's surrounding fields. Consider a rectangular antenna with a half-wavelength-long radiating patch supplied by a microstrip feed line in order to understand how microstrip antennas radiate. An open-ended microstrip line may be seen as a rectangular antenna.

The opposite end receives the energy. There should be no current at the corners of the patch since it is just half a wavelength long and is left open-ended on the other side. The voltage and current will be out of phase by a factor of ninety. Patch [9] has a maximum positive voltage and a maximum negative voltage.

RESULTS OF THE SIMULATION:

The design makes advantage of a somewhat circular ground plane. An antenna with a defective ground plane may have its bandwidth increased this way. The main axis and minor axis radius of the elliptical notch in the ground plane are x=1.6 and y=3.1 correspondingly. S11 and frequency are shown on a graph below for the best-optimized settings.

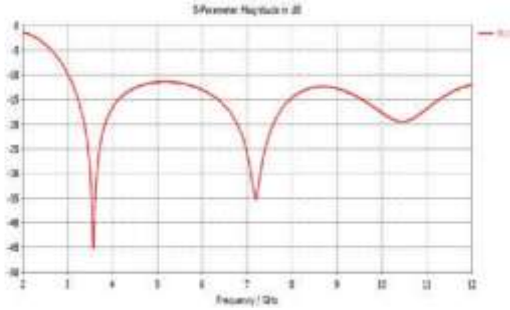

Figure 2. Frequency vs s11 curve for optimized values

The effect of modifying the radius of patch effect on s11 parameter is observed. Figure below shows different s11 vs frequency curve for different values of radius r. It is observed that when we increase the radius the s11 vs frequency curve shifts towards lower frequency while on decreasing it shifts toward right. Therefore we can conclude that the two resonance frequencies we are getting are inversely proportional to the radius of the circular patch. It is also observed that for optimum value of radius r=9 the s11 is more deep.

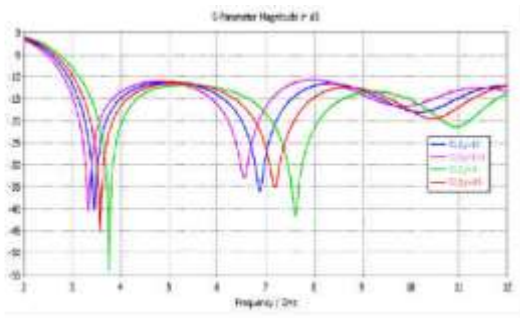

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Figure 3. frequency vs s11 curve for different values of radius r.

CONCLUSION AND FUTURE WORK

This dissertation explores seven distinct types of microstrip patch antennas, each with a unique form. In order to work in UWB with different band notches for different applications such as (WiMAX) operating at 3.3-3.7 GHz, (WLAN) for IEEE 802.11a at 5.15-5.825 GHz, and (Downlink X-band satellite communication systems at 7.25- 7.75 GHz), four of them are designed for use in UWB applications without any band notches. Super-Extended C Band / INSAT 4.45-4.8GHz (Indian National Satellite systems). If you want to obtain the required frequency band-notched, the simplest and most usual approach is to cut a narrow slot into an antenna's radiating patch. This will influence how current flows through the patch, and various shapes are employed to form the slots. In order to simulate the suggested antenna construction, we used Microwave Studio in Computer Simulation Technology Simulator (CST), a professional 3-D full-wave electromagnetic simulator. There are shown simulated results that indicate the utility of the suggested UWB antenna construction. According to the simulation findings of the suggested band notch antenna, the proposed antenna has excellent triple band notch characteristics for different frequency bands and shows good return loss and radiation patterns in the desired UWB.

More research is needed to find ways to make UWB antennas smaller so that they may be used in more real-world settings. Metamaterial has the potential to decrease the size of a product significantly. PSO and the Genetic Algorithm are two examples of optimization approaches that may be utilised to get the best possible outcomes.

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