VARIOUS TECHNIQUES OF WIRELESS COMMUNICATION IN ANTENNA: A SURVEY

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Abstract

Antenna is a device which is used to communicate in the wireless communication network. It is also used to transmit data or information in the wireless channel or AIR medium. There are different types of antenna categorized in multiple types according to the need of the user to be used in various applications. In the presented paper categories of antennas along with its types are discussed in details with their respective applications. The applications of the Antenna, performance and the efficiency are also discussed in this paper. The desired antenna can be selected for the fast and efficient transmission of data in the wireless communication network with the help of this article.

Keywords: *Communication, Antenna, Characteristic, Wire Antenna, Travelling Wave Antennas, Reflectors Antennas, Log-Periodic Antennas, Aperture Antennas.*

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1. INTRODUCTION

For converting the conducted waves and electromagnetic waves in wireless medium there is a component used known as Antenna [1]. Antenna is the zoological word which means the long, thin feelers of the insects used to sense in the environment. It is the most common component which is used in any electronic framework. It acts as a transmitter between the recipient and the free space in AIR medium. Antenna can convert the electromagnetic signal into electrical signal. Transfer of data or communication in the wireless medium is done by the Antenna. The very important property of the antenna is its radiation capacity which is also use to measure the efficiency of the Antenna. If the radiation of the electromagnetic signal is high of the antenna than its efficiency is also high.

Communication in the wireless medium can be done in the form of audio, video or graphical form using antenna [2]. The need for the communication in the wireless communication network has developed the idea of enhancement of the properties of Antenna. New design and development of the antenna has been done for the better communication on various applications in the wireless network. The communication can be over a mobile system, Radio or satellite. The signal broadcasting is done by the Antenna to makes the connectivity with the compatible devices for communication. Antennas are designed depending on the system and environment need some of the antenna are built according to the direction of radiation needed like in one direction radiation producing antennas or point to point communication required by the system. In the presented paper various antennas are discussed along with the properties of them.

Communication in the free space or Air medium without using any wired component is known as wireless communication where the data is transfer from one point to another. For this wireless communication the component is used known as antenna is the backbone of communication in air medium. To provide security and ease to the communication or data transfer various kinds of antenna are used which operates in different applications. The properties of the antenna can be changed according to the need of the applications like polarization, frequency and radiation pattern. But there are some antenna which can be change their properties or function dynamically are called reconfigurable antenna.

Antenna consists of a conductor and the inductor which is derived version of the parallel circuit [3]. The modern antennas are very similar in look with the ancient antennas model. But now they are optimized as need by the applications at great expense. In the test antenna this is not much required as they are intended to measure the strength of the field while installation is done.

2. CHARACTERISTIC OF ANTENNA

Antennas are capable of converting one wave form to another. Energy conversion is of not much important regarding direction as it provides ease to understand. The various characteristic of pure antenna used for transmitting and receipting of signals are as follows[4][5][6].

2.1 Radiation Density

It can be defined as the product of electric field and magnetic field strength. It is also known as power density. Isotropic radiator is the simplest imaginable antenna which is not practically exists but generates wave in spherical wave

front at dimensionless point in space that are radiating uniformly in all direction. It is given by

$$S=E*H$$

Where S is the radiation density, E is the electric field strength and H is the magnetic field strength.

2.2 Radiation Pattern

The radiation pattern of the antenna is described by its behavior in three dimensional spaces. There are two patterns in with the radiation of the antenna is transmitted, first is the horizontal pattern and second is the vertical pattern by monopole or dipole antenna.

2.3 Directivity

It can be defined as the ration of the radiation intensity obtained from the main direction to the radiation intensity generated by the free loss isotropic radiator. It is given by

$$D=\frac{\textit{Radiation intensity of main direction}}{\textit{Radiation intensity from the free zero isotropic radiator}}$$

2.4 Gain

It can be defined as the maximum radiation intensity or power produced in the main direction to the radiation intensity produced in free loss direction by isotropic radiator. It is given by

$$G=\frac{\textit{Radiation produced by antenna}}{\textit{Radiation produced by undesired or reference radiator}}$$

2.5 Input Impedence

It is one of the most important characteristic of an antenna. It is present at the antenna feed point which can be split up into radiation resistance and loss resistance

2.6 Antenna Factor

It is also being called as the conversion factor or transducer factor of the antenna. It can be define as the ratio of the electric field strength to the measured output voltage at the feed point of antenna. It is given by

$$K=\frac{\textit{Electric field strength}}{\textit{Output voltage}}$$

2.7 Bandwidth

The bandwidth of the antenna is defined as the range in which various usable frequencies exebhits and improves the performance of the antenna.

2.8 Aperture

Aperture is the conical component of the antenna which is responsible for transmitting and receiving of the electromagnetic signal in wireless communication network.

2.9 Polarization

It can be defined as the maximum radiation produced by the antenna in a particular direction. This can be given by the polar diagram and they are of following three types.

Linear polarization in which the direction of the electromagnetic signal produce is changes its magnitude only.

Circular Polarization in which the magnitude of the electromagnetic signal produced is constant but the direction is changed in respect to the direction of propagation.

Elliptical Polarization is that in which both the direction and magnitude of the electromagnetic signal is changed and it can be given by the elliptical equation.

3. CATEGORIES AND TYPES OF ANTENNA

The antennas are categorized mainly in six types depending upon the design, implementation , properties, frequencies range and operational mechanism and even some other antennas are also exists but not categorized. They are as follows [7][8][9]:

- Wire antenna
- Travelling Wave antennas
- Reflectors antennas
- Micro-strip antennas
- Log-Periodic antennas
- Aperture antennas

3.2 Dipole Antenna

It is a wire antenna which has a very thin radius. It is very similar to the short dipole antenna but it does not need to be short in operation frequency range or wavelength. In the dipole antenna the impedance become high and the length become much closed to the wavelength. The direction of the radiation is totally depending on the wavelength of the antenna as if the full wavelength dipole antenna has more direction rather that the half wave dipole antenna or shortwave dipole antennas. It is an omnidirectional antenna.

3.2 Half Wave Dipole Antenna

It is one of the special cases of dipole antenna in which the output generated is half wave length and that is why it is known as half wave dipole antenna. It is also a wired antenna. In this type of antenna the frequency ranges from 1.877 GHz to 2.1199GHz. It is constructed using two conductors which have a gap between them along the centre fed in the wire section. There is also a resistance attached in the centre of the two conductors. 2.15dB is the directivity of the half wave dipole antenna.

3.3 Broad Band Dipole Antenna

It is a wired antenna in which the size of the radius is increased. These types of antenna are also known as wideband antennas in which antenna can be made broadband by increasing the radius size of the antenna. This antenna work on the basis that if the size of the antenna

increased than the bandwidth increases respectively. But as the size increase the resonant frequency decreases that is why this antenna is has more limitations than others.

3.4 Folded Dipole Antennas

This is also a wired antenna which covered less area. It has a simple infrastructure and simple design which provide low cost to the system. The manufacturing of this antenna and installation is very easy. There are two folded wire used in the design of this antenna in which ends of the folded wire are kept open. The impendence of the antenna depends on the geometry parameters rather than the thickness of the strip. This type of antenna comprises the wide loop and the radiation are generated same as in the dipole antenna.

3.5 Bi-Conical Dipole Antennas

In the bi-conical dipole antennas the data transmission capacity has no restriction on the infinite constant impedance line. It has also a wired antenna which has a open circuit stub same as in the resonant dipole. It is a simple and short antenna which means short in wavelength of the frequencies.

3.6 Helical Antennas

It was introduced in the year 1964 by Jhon Kraus. It is a travelling wave length antenna which is also sometimes called as Helix antennas. The most common helical antenna has the shape of corkscrew which transmits the signal along the axis of the antenna. The phase is variable in this antenna and the current flows along it. These antennas are in practice for many years as it is easy to use. This kind of antennas is mostly used in satellite transmission of data as the properties of this antenna are exceptional. The microwaves from VHF are getting by the use of helical antennas.

3.7 Spiral Antennas

This is a travelling wave length Antenna which belongs to the frequencies independent class. These antennas have a very large size bandwidth and the frequencies ranges from 30:1. These antennas are mostly circular polarized and can be efficiently produce 30GHz frequency range if the lower range is 1GHz and also in between frequencies can be utilized. It has a peak radiation pattern which means radiation direction is perpendicular to the plane surface. These antennas are very much used in defence industry for the application sensing. The frequencies bandwidth ranges from 1-18GHz in spiral antennas. These antennas are also used in GPS systems.

3.8 Yagi-Uda Antennas

This antenna was first invented in the year 1926 by Shintaro Uda in Japan. These are the very smart and brilliant antennas which are also called as yagi only. These are travelling wave length antennas. The architecture of this antenna is very simple and the gain provided by this antenna is very high that is more than 10dB. This antenna consist one of the dipole or folded dipole component. These antennas are used in VHF and UF radars. The efficiency and the performance of this antenna totally depend on the reflector and the kind of dipole component used in it.

3.9 Corner Reflector Antenna

This is the reflector antenna which is mostly used to increase the directivity of the radiation. The radiation of the antennas can be increased by introducing the reflector that can be a conductive sheet which can be place behind it. These antennas are simple in design so very cost efficient and effectively working properly. These antennas bring up the radiation in one direction by placing the dipole element or two plain reflector conductive panels. This antenna will generate the greater bandwidth.

3.10 Parabolic Reflector Antennas

These antennas are most commonly known as reflector antennas or satellite dish antennas. These antennas provide a high gain ranges from 30db to 40db without cross polarization. The parabolic antennas are typically of two types: cylinder antenna and other is parabolic antenna. In this antenna the pattern of the radiation depends upon the feed component.

3.11 Log Periodic Antennas

These antennas are designed for the greater and wide bandwidth in the year 1960 by Isbell. The bandwidth depends on the structure of the antenna. This antenna is very useful in the applications which needs wide band. The log periodic antennas frequencies range from 30 to 300MHz. The VHF bandwidth is greater than 10:1 ratio in this antenna and that is why it is categorized as the independent antennas. The very first log periodic antenna structure was developed by Raymond Duhamel.

3.12 Micro Strip Patch Antennas

The micro strip patch antennas are commonly used in the wireless application like WLAN, Bluetooth, WI-Fi etc. It consists of a patch and a ground plan. These is a dielectric medium between the conducting patch and plane known as substrate which has the particular value of dielectric constant. The dimension of the ground and substrate is bigger as compare to the patch.It has a small and compact size which provides flexibility to the wireless communication system. It is easy to install and capable to be operated in multi band at multiple notches. These are widely used in military services. Planner Inverted-F Antenna is the most commonly used patch micro strip antenna. It is capable of producing large bandwidth and high gain. The frequencies range from DCS-1800 and PCS-1900 bands in PIFA. The Diamond Shape Patch micro strip antenna can be used to generate different polarization with the help of multiple notches.

3.13 Horn Antennas

The horn antenna was introduced in the year 1897 by the Jagadis Chandra Bose. He proposed the pyramidal antenna

which was a horn antenna. This antenna has a very simple architecture and it is built to provide excite to the wavelength and bandwidth. Reflector antenna component or the conductive shield is used as the principle in this antenna. It is the reason it could be used as a reflector antenna. This antenna has a directional radiation pattern which provides high gain. The gain in horn antenna increases with the increase in frequencies.

3.14 Slot Antennas

These are the very popular aperture antennas because they can be cut out or molded at whatever surface they are grounded on. The frequencies bandwidth ranges from 300 MHz to 4GHz in slot antenna. The polarization of slot antenna is linear and it is typically unidirectional radiation producer. The performance of this slot antenna is depending upon the shape, slot size and cavity behind it.

4. RELATED WORK

In this proposed work the researcher has built the simple micro strip patch antenna designed in CST microwave Studio at 2.4 GHz frequency bandwidth. This proposed work on antenna is built using conducting patch and a plane where di electric medium is used in between them. The micro strip patch antennas are the most commonly used in WLAN, Bluetooth etc for wireless communication in AIR medium. The gain produce by the proposed work is 8.27 dB and VSWR of 1.18. [10].

In the presented proposed work the two formulas for calculating the gain of the antenna are used and combined together to compute the gain of the rectangular folded array antenna. The very first formula is based on the gain method in the field intensity and second formula is derived from the existing gain comparison method. The reference antenna used in this work is isotropic antenna. The simulated result shows that the 0.52% and 0.3% normalized root mean square errors are found in first and second formulas respectively. Both the methods can be used to compute the gain of the antennas [11].

In the real world Orthogonal Design Method (ODM) is frequently used but not in the designing and development of antenna. The performance of the antenna tends to be more objective rather that the geometrical factors which is divided into some levels. ODM gather the small antenna and built up the prospective antenna. When the satellite antenna is designed, firstly the rough architecture of the antenna is built. The ODM method is then applied to locally optimize the antenna with HFSS which is commercial simulation software. The simulated result shows that the roughly evolved antennas optimization is successful by ODM [12].

In the year 1960, the modeling of the biological evolution on computer system began along with the genetic algorithms which were introduced to the antenna development community. There are many other biological processes which are introduced for the enhancement of the antenna development. This proposed work by the author generalizes the use of genetic algorithms, particle swarm optimization and ant colony optimization in antenna building. There is also many examples of array optimization of antenna are presented [13].

There are various evolutionary methods are applied to the electromagnetic design problem with promising results in recent years. The efficiency of the evolutionary algorithms are very low that is the optimization time is low which is not allowing the application to grow in industrial applications. For this reason the new method is introduced which is called SADEA (Surrogate model assisted differential evolution for antenna synthesis). In this method the Gaussian Process is introduced to provide better performance to the candidate design. In this paper the surrogate model is proposed which is a evolutionary aware search which will provide global search even when the traditional high-quality surrogate model is not present. The proposed work is tested and obtains comparable result which provided 3 to7 times speed enhancement for optimization the antenna design [14].

915 MHz band application like Bluetooth and ZigBee uses the rectangular micro strip patch antenna which is presented in this paper. ZigBee application is widely used as it provides the very fast transmission of data in the wireless communication network. These types of application require short transmission distance with respect to the low power dissipation. Multi strip patch antennas are the printed antennas which are in high demand now a day in computer science field. The proposed antennas is build using FR-4 epoxy substrate and the 1.6mm of thickness with the radius of 4.4 The frequency ranges in this work is from 902 MHz to 928 MHz with one directional radiation pattern. It has a compact size of 60*30mm. It provides simple design pattern and narrow bandwidth. The simulate results shows that the proposed antenna is good in performance [15].

5. CONCLUSION

Antenna are the basic need of the wireless communication network which is growing tremendously in recent years so there is a need to study the mechanism of it and provided some enhancement for the better performance of it. There are many antennas are discussed in this paper with the help of which anyone can choose the antenna for the desired application. The properties of antenna are also discussed like the size of the antenna which provides simple infrastructure, frequencies ranges and easy installation which provides desirable antenna to be used for functional application in wireless communication network.

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