International Journal of MC Square Scientific Research Vol.9, No.1,2017

Design and Optimization of Monopole Antenna for High Data rate Applications

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Abstract

In general an antenna is act as a transceiver for transmitting and receiving signals with high frequency. It is very important in real time and portable high data rate applications. The parameters decide the characterize of the antenna, the perfectness of antennae are the source resistance of the excitation source that feeds the antennae, characteristic impedance of the transmission line that feeds the antennae, the geometry of the antennae itself, the Voltage Standing Wave Ratio, the Reflection Coefficient, the Directivity, Horizontal Gain, Vertical Gain, Total Gain, radiation pattern, the magnitude of the electric field, efficiency, the current distribution and voltage distribution in the geometry of the antenna. The main parameters to be optimized for wideband portable application are the Gain, Directivity and Efficiency. Monopole antenna transmits the signal in a particular direction only. This work addresses the problem of Gain and Directivity by cascading multiple geometrical structures as well as changing the metal by which the geometrical structure is manufactured. By cascading simple structures it is possible to obtain the same directivity and gain provided by complex structures. The work identifies the second problem of efficiency by using stub or electrical networks as resonators. The stubs are designed by using impedances and admittances information provided by Smith chart at a particular frequency. The tool used for simulation is 4nec2 which stands for Numerical Electromagnetic Code. The frequency of operation used for analysis 300MHz. The wavelength in this frequency of operation is 1m.

Keywords: Antenna Design, Reflection Co-efficient, SWR, Directivity, Gain

1. Introduction

An Antenna is also named as transceiver because it is capable of Transmitting and Receiving signals with high radio frequency. In general antenna is a device which converts

Issn No:0975-0932

electrical signals into radio waves and vice versa. In transmit a high frequency alternating current to the antenna terminal. In receiver side, obstruct some of the energy of an electromagnetic wave, to produce a very small voltage as its terminal that is applied to the receiver going to be amplified. Antenna design was made by some characteristic suitable for the transmission these are the transmission and reception of radio waves in all directions not only for particular direction. The performance and characteristic of the antenna is defined by many parameters like gain, bandwidth, beam width, Voltage Standing wave ratio, radiation pattern etc. Radiation pattern is defined as, in which direction the transmission is higher and lower for communication. Major lobe, minor lobe and side lobe are the transmission range in the radiation pattern. In recent time's reflector is used back side of the antenna for reducing the reflection. The reflector re-transmits the signal to the target direction. Dipole antenna is a prototyping antenna; it consists of two conductors arranged around an axis. Ultra wide band technology is also known as radio RF technology; short duration pulse is used to transmit data in binary form over a wide spectrum of frequencies. It broadcast the information over a wide bandwidth above 400MHz. Circular disc monopole and vertical disc monopole antenna are different antenna based on ultra wide bandwidth antenna design. UWB has ultra wide frequency bandwidth; it can achieve extremely high capacity as high as thousands of Mbps. It works at low power transmission levels, and also provides high secure and high reliable communication. UWB system is purely based on impulse radio features like low complexity. Impedance matching, radiation pattern, stability, data rates, cost, weight, size of the antenna are the challenges facing the wide band antenna design.

2. Related Works

Jing song hong et al. [1] described the two Ultra Wide Band Compact directive balance antipodal Vivaldi antennas. UWB Antenna is one of the emerging antennas used for microwave imaging systems. UWB antenna achieved the good impedance matching compared to other type of antennas. Antipodal Vivaldi antenna grantee the wide band requirements using FR4 substrate. Antenna Size reduction is one of the difficult processes for using low frequency applications, so UWB antennas are sizable. To reduce the coupling between antennas, Directivity and gain is improved when reducing the coupling between antennas.

K Shambavi et al. [2] presented the multi strip monopole antenna for ultra wideband high frequency applications. The multi strip and single strip monopole antenna having various frequency and wavelength for achieve a higher wideband width. Ultra wideband antenna is not affected by multipath fading. A rectangular slot is introduced in the antenna to get a better bandwidth and gain. Radiation pattern for monopole antenna is Omni directional and bidirectional in elevation plane.

Surjati et al. [3] was described the Perfect magnetic wall condition (PWB) using Ultra wideband (UWB) antenna. Interference is eliminated by using step impedance resonator at 6GHz. Swarm optimization algorithm is used to optimize the UWB antenna design. Embedded

Issn No:0975-0932

resonance slots in ground plane technique does not control any bandwidth and ripple. Double pole band-rejected UWB antenna based two resonators are used to avoid the characteristics of flat skirt. UWB design based algorithm is possible to adjust the band-stop and band-pass frequency in UWB applications.

Dual band antenna based bandwidth enhancement technique was proposed by Jithu et al. [4]. The main aim of the design is capable of operating large frequency range based wide band characteristics and ultra wide band characteristics. Dual band antenna is operating in GSM and ISM band for mobile applications. T shaped ground planes, shorting strips, feeding structures, and elliptical antennas used to overcome the narrow bandwidth. Low profile planar antennas is validated on monopole antennas and its does not need any additional elements.

3. Dipole and Monopole Antenna

Dipole antenna is the simplest and mostly used antenna for wide range of applications. The common structure of the dipole antenna is just a straight rod with end to end same axis. Mostly used dipole antenna is half wave dipole antenna; the wave length of the antenna is ¼. The most commonly used antenna is monopole antenna. It is the antennae with simple geometrical structure that can be used for mobile and portable applications. The so many existing antennas have poor directivity, radiation pattern and gain. The directivity can be improved by changing the geometry and size of the antennae, or otherwise increasing the quantity of current flowing to the antenna. The quantity of current flowing through the antenna is not changeable and so keeping the power fed to the antenna constant if we vary the geometry the directivity is also changed significantly. The structure of the monopole antenna is shown in figure1

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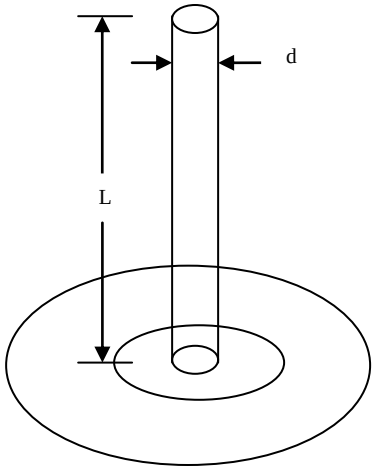

Figure. 1Basic Structure of Monopole Antenna

Issn No:0975-0932

4. Proposed Monopole Antenna Design

A monopole antenna is a type of radio frequency based antenna, it consist of a straight rod shaped conductor it can be anything like wire, mounted on a ground plane. The monopole antenna having two sides, one edge of the antenna is connected to the bottom end of the antenna, and the another side is connected to the earth ground plane. Earth is used as the ground plane of the antenna. The monopole antenna is a resonant antenna, the functions of rod as open resonator for radio waves, changing the standing waves of voltage and current along its length. The antenna length is determined by the wavelength and radiation pattern of the radio waves. Like a dipole antenna, the monopole antenna has unidirectional and omnidirectional radiation pattern. It radiates the radio signal in all azimuthally directions perpendicular to the antenna, but the radiated signal varying with elevation angle. At very high frequency (VHF) and ultra high frequency (UHF) antenna needed a smaller size ground plane. So artificial ground plane are used to mount the antenna above the ground plane.

5. Simulation Results

Our proposed new monopole antenna design have higher radiation pattern and gain when compared to the existing antenna types. Minor lobe and side lobe of the radiation pattern is less when compared to existing monopole antenna. Electric field of the proposed monopole antenna is improved.

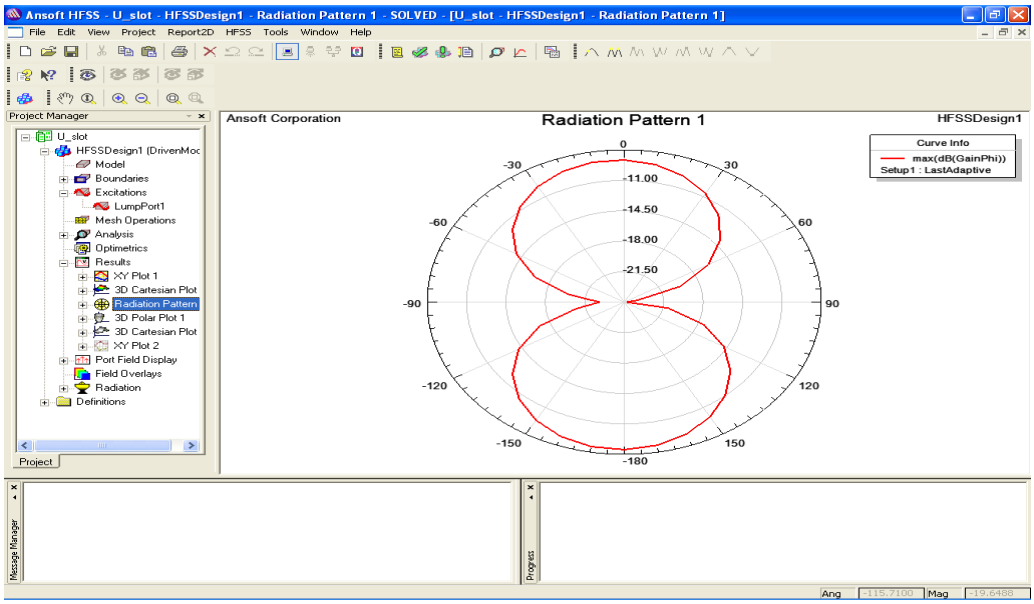

Figure. 2 Proposed Antenna Radiation Pattern

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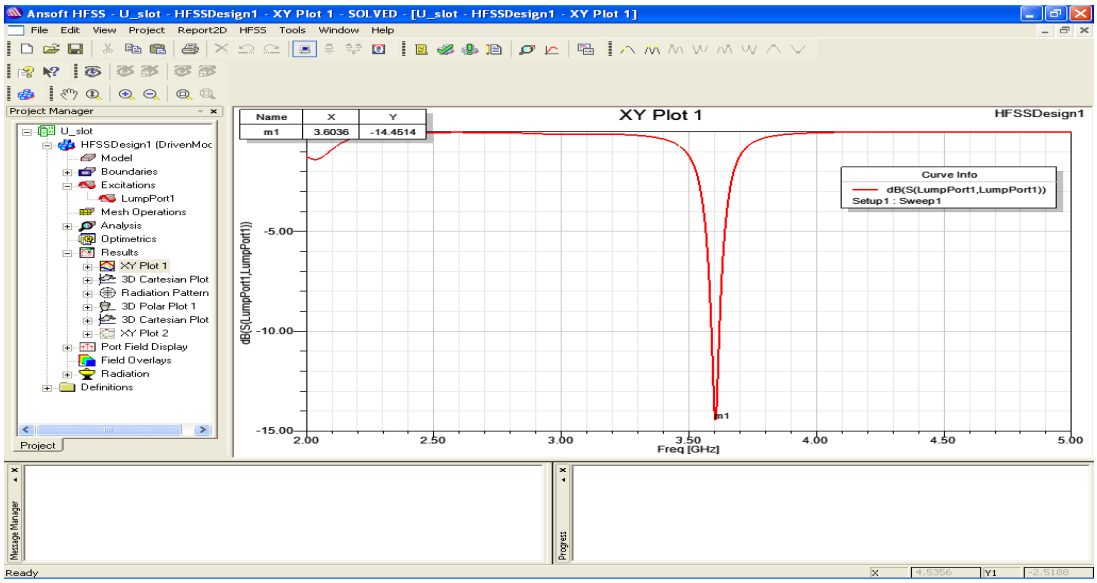

Figure. 3 Return Losses

The above shows the return losses of the monopole antenna. Compared to existing antenna the losses should be reduced and the gain is increased.

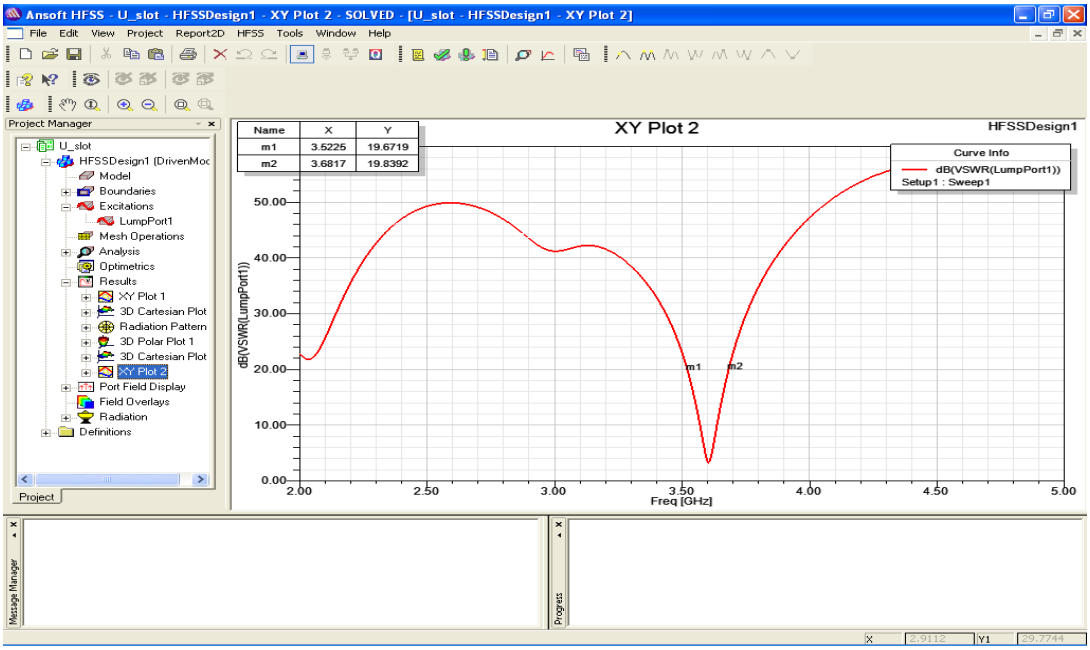

Figure. 4 Voltage Standing Wave Ratio

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6. Conclusion

In this paper concentrate on the antenna parameters like radiation pattern, gain, reflection coefficient and voltage standing wave ratio. The proposed monopole antenna was designed to increase the above parameters. The performance achievements were done by reducing the size and change the metal of the monopole antenna. HFSS is used as simulation tool for taking the characteristic results of the monopole antenna.

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Issn No:0975-0932