A SURVEY ON HIGH SLEEVE ANTENNA GAIN

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Abstract – In this paper a survey on sleeve antenna is done to enhance the gain. The sleeve antenna is specially design dipole antenna which is polarised perpendicularly. The sleeve antenna is used in different field of application such as for indoor communication, outdoor communication, and in medical field. But the existing system has maximum gain of 5dBi only. So array of sleeve antenna is been suggested to raise the gain. The array antenna is the collection of two or more antenna which increases the gain. Thus sleeve array antenna is designed such that it gets maximum gain.

Keywords: *Sleeve array antenna, gain, radiation pattern, sleeve antenna*

1. INTRODUCTION

The rapid development of recent wireless communication systems, wideband antennas with omnidirectional radiation patterns, simple structure and easy fabrication are used. Considering various types of antennas, monopole antenna is an smart choice to meet most of the constraint, such as a staircase-shaped patch with a modified advanced composite fed structure, a folded monopole antenna with an inverted “S”-type structure, a spider-shaped monopole antenna consisting of a bulb-like metal body, a dielectric sleeve, and eight arc metal pipes, a CPW single-layer printed antenna with a rectangular monopole radiator imprinted with a half-elliptical slot, etc.

Sleeve antenna is specially design antenna used for transmission and reception. It is vertically polarized omnidirectional antenna. The sleeve antenna can work practically in any radio frequency, mostly in high-frequency band applications such as Citizen band radio base station or maritime ship-to-ship, ship-to-shore radio antennas. Nowadays sleeve antenna is designed in medical field and indoor communications. These are used as both monopole and dipole which have been traditionally less efficient which need to be enhanced.

Sleeve antennas are used in field of surgical removal of liver tumors. They can develop to effective treatment of heptictumors. Two dimensional axisymmetric finite element methods is used for tumor detection. The antenna works on 60watt input power at frequency of 2.45 GHz. However the gain of antenna is -10dB. Even though the antenna good reflection coefficient the lower gain really affect the performance.

A new simulated interstitial applicator for microwave ablation denoted as multi section floating sleeve antenna. It is an asymmetrical floating type sleeve antenna featuring a split tip on the tip, proficient of producing larger lesions, having much improved reflection coefficient and much more localized power distribution compared to Floating sleeve antenna. Performance of the antenna has been evaluated numerically, taking into account the temperature distribution, antenna impedance matching, size and shape of the thermal at the operating frequency 2.45GHz and power of 60 Watt for 66 sec through the finite element method. The corresponding increase in temperature has been evaluated by the bioheat equation. After computing the temperature profiles using finite element method, the lesion size, shape, and antenna efficiency are used to assess antenna performance.

Since most of the hepatocellular carcinoma tumors are spherical in shape, the major goal is to optimize the antenna to yield the spherical lesion with larger radius. The frequency, at which the reflection coefficient is least, is referred as booming frequency and should be approximately same as the operating frequency of the microwave generator used.

Wideband sleeve antenna when used in wireless communication application. They are added with four symmetrical ridges. They worked in the frequency range of between 1 GHz to 7 GHz. It is having excellent wideband bandwidth. The applications include WLAN, WiMax and Direct communication solution etc. But having low gain of 1.49dB.A novel wideband antenna design with sleeve antenna structure and symmetrical ridges. Without altering the overall configuration and physical dimensions, four symmetrical ridges are added between the sleeve and the main radiator, which improves the impedance bandwidth of the antenna significantly.

This antenna structure consists of four parts main radiator, a sleeve, four symmetrical ridges, and a ground plane. The sleeve and ridges are connected together; the variation of radius not only affects the impedance match of the lower band, but also modifies the interaction between the ridges and main radiator. By retaining four symmetrical ridges between the sleeve and the main radiator, the antenna obtains an impedance bandwidth enhancement without changing any physical dimensions

The sleeve antenna is modified as helical shape to reduce the size and to good impedance matching performance. A coaxial short hub is inserted inside the sleeve so as to make it as helical one. It works at a frequency of 1.5GHz with high return loss of -20dB and having maximum gain of 2.32dB. The advantage of the antenna is that could reduce the average leakage current and mainly used in breast cancer detection system. Researches on human tumor diagnosis using electromagnetic waves are actively in progress state. In that, microwave imaging is used to detection of breast cancer because the electrical properties of malignant tumor tissue are different than normal breast tissue. Microwave tomography has been widely studied as a breast cancer detection method. In the method, circular arrayed transrceiving monopole antennas are commonly used because the monopole antenna has a simple structure and omnidirectional radiation pattern. For a portable breast cancer detection system however, the monopole antenna requires a proper ground plane to obtain stable characteristics. This ground plane can increase the size of the portable system that requires compactness. Otherwise, the dipole antenna does not need a ground plane and it also has simple structure and omnidirectional pattern. However, the dipole antenna that has quarter-wavelength folded balun can increase the size of the portable system. Hence, a good candidate for compactness of the portable system is a miniaturized sleeve dipole antenna.

The rising demand of wireless services requires the characterization of new standards able to provide an increased degree of flexibility for the end-user and a higher speed of data transmission. The sleeve antenna works here on radio frequency. They are used in wireless connectivity. They are generally smaller in size and operate in 3.15GHz to 4.3GHz. They are mainly used in portable WiMax devices having gain between 2-5.85dB. IEEE 802.16 Worldwide Interoperability for Microwave Access normally called WiMax. WiMax is a telecommunications technology that be responsible for wireless transmission of data using different modes, from point to-multipoint links to portable and fully mobile internet access. IEEE 802.16 accepted three frequency bands namely lower band (2.5 - 2.69 GHz), medium band (3.4 - 3.6 GHz) and upper band (5.72 – 5.86 GHz) for WiMAX communication system. A CPW fed sleeve monopole antenna for WiMAX application has been presented in the system.

Enhancing the performance of dual sleeve monopole antenna for indoor base station application and size reduction are the major achievement in this case. It is operated on low operating frequencies. It is applied for WiBro, Wlan, and universal mobile telecommunication system (UMTS) etc. It is having gain of 2.15dB. To obtain wider bandwidth, the loaded patch technique was further employed on the circular patch with conical-pattern radiation to increase its impedance bandwidth. A top-loaded coaxial probe is used to stimulate these modes through capacitive coupling. Impedance bandwidths of these antennas are not enough to satisfy the requirements of the present multiband wireless communication systems. Wideband folded feed L-slot folded patch antenna is attained, but the radiation pattern is relatively poor due to the asymmetry of the antenna structure. The antenna mainly includes an upper shorted circular patch, four shorting probes, a cone, a circular ground plane, and a dual-sleeve structure including a circular sleeve and a parasitic sleeve. By connecting four shorting probes from the upper circular patch to the ground, which is placed equally on each side of the planar monopole, the size reduction is achieved.The capacitive coupling and inductive loading are introduced by top-loading a circular patch and by using shorting probes, respectively. The diameter of the circular patch is about 0.32 times the free-space wavelengths, and the antenna height is about 0.07 times the free-space wavelengths of the low operating frequency. Furthermore, the dual-sleeve structure is successfully engaged to advance the impedance bandwidths through achieving another two resonant points. Due to these routines, the antenna has wide and potential applications for wireless communication.

Antenna is fed with CPW transmission line. This antenna has improved broadband impedance characteristics. They work in the operating frequency of 2.43GHz-8.16GHz and achieves gain of 1.1dB-4.2dB. A planar sleeve monopole antenna fed by a CPW transmission line is used. Here the antenna is predominantly simple in manufacturing due to its single metal layer and no via hole required in short-circuiting the sleeves to the ground plane. Additionally, this antenna can achieve very broadband impedance behaviour. Its bandwidth far outdoors the attainable bandwidths using conventional sleeve monopole antennas. This antenna consists of a monopole with two sleeves and is printed on an FR4 microwave substrate with thickness 1.6mm and relative permittivity 4.4. A 50-O CPW feed line, having a signal strip of width and a gap of width G, is used to excite the antenna. The monopole antenna is centrally placed close to the signal strip of the CPW feed line. For a conventional monopole antenna, the fundamental resonant mode is at about 2.5GHz, and the gained impedance bandwidth determined from the 10 dB return loss. The impedance bandwidth of antenna can significantly be improved by choosing suitable sleeve length and spacing. In addition, the accomplished results have confirmed that using CPW feeding configuration is an effective way to improve the broadband impedance features of the sleeve monopole antenna. The rest of the paper is organized as follows. Section II Sleeve antenna design and structure.Section III Result and discussion.Section IV Conclusion.

2. SLEEVE ARRAY ANTENNA STRUCTURE AND DESIGN

The structure of proposed sleeve array antenna is shown in figure1. Sleeve array antenna is designed to increase the gain of ordinary sleeve antenna. The conventional sleeve antenna is having less gain so array antenna is designed to enhance to conventional antenna.

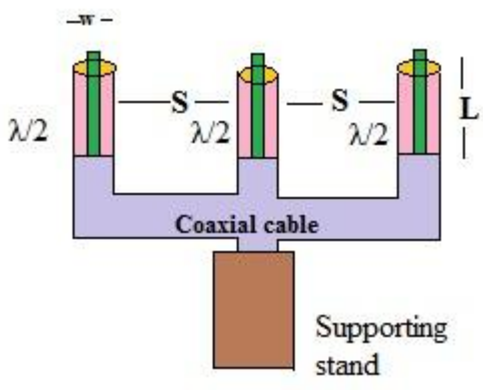

Fig – 1: Sleeve array antenna

S= distance between two sleeves
L= length of each sleeve antenna
W= width of the sleeve antenna
By varying the parameters the performance of antenna can be varied

2.1. DESIGN PARAMETERS FOR SLEEVE ARRAY ANTENNA

The permittivity of a material is an electromagnetic property that determines how the material interacts with an electromagnetic field which is independent of the measurement technique.

$\varepsilon = D/E$ ……….. (2.1)

ε=permittivity of the substance in Farads per meter

E= electric field strength

D=Electric flux density

Thus the relative permittivity is given by

$\varepsilon r = \varepsilon s/\varepsilon o$ ……… (2.2)

ε_r=relative permittivity

ε_s=permittivity of the substance in farad per meter

ε_0= permittivity of a vacuum in Farads per meter

εo= 8.854x10^-12 F/m

FR4 is the common dielectric used in the circuit board as the insulator between the ground planes and signal traces.

Dielectric constant =ε/εo ………….. (2.3)

Directivity is ratio of radiation power in a given direction to the ratio of radiation power averaged overall direction.

$$D(\theta,\phi) = \frac{P_{rad}}{P_{rad}^{avg}} = \frac{4\pi}{\Lambda_{solid}}|F(\theta,\phi)|^2 \quad (2.4)$$

P_{rad} = radiation power intensity

P_{rad}^{avg} = average of radiation power intensity

$$F(\theta,\phi)=g(\theta,\phi)f(\theta,\phi) \quad . (2.5)$$

$f(\theta,\phi)$= Pattern factor

$g(\theta,\phi)$ = Element factor

Where, $\Lambda_{solid} = \iint_{\Lambda}|F(\theta,\phi)|^2 d\Lambda$ (2.6)

Thus the maximum efficiency is considered as

$$D = \frac{P_{rad}^{max}}{P_{rad}^{avg}} = \frac{I_{rad}^{max}}{I_{rad}^{avg}} = \frac{4\pi I_{rad}^{max}}{P_{rad}} = \frac{4\pi I_{rad}^{max}}{I_{rad}^{max}\Lambda_{solid}} = \frac{4\pi}{\Lambda_{solid}} \quad (2.7)$$

I_{rad}^{max} = maximum radiation intensity

I_{rad}^{avg} = average radiation intensity

Gainis ratio measure of input & output power of antenna

$$G(\theta,\phi) = \eta D(\theta,\phi) = \frac{P_{rad}}{P_{input}} = 4\pi\frac{I_{rad}(\theta,\emptyset)}{P_{input}} = \eta\frac{P_{rad}}{P_{rad}^{avg}} \quad (2.8)$$

Where, $\eta = P_{rad}^{avg}/P_{input}$

$I_{rad}(\theta,\emptyset)$ = radiation intensity

3. RESULT AND DISCUSSION

After a detailed study about different sleeve antennas we could understand that a normal sleeve antenna will only have a maximum gain of less than 5dbi however it enhanced. But antenna is used in different kinds of applications so it requires higher gain, so sleeve array antenna is suggested to use inorder to have higher gain and better radiation pattern.

Figure 2 shows the gain comparison between ordinary sleeve antenna and sleeve array antenna. Graph compares the gain of sleeve antenna and sleeve array antenna at an interval of frequency range. It is understood that the maximum gain of sleeve antenna is 5dB and maximum gain of sleeve array antenna is 12dB. Thus the sleeve antenna can be replaced by sleeve array antenna by making it into compact size.

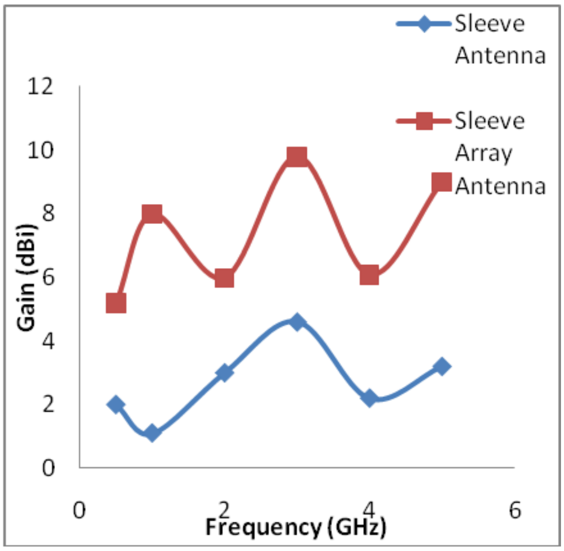

Fig – 2: Comparing sleeve antenna with sleeve array antenna

The radiation pattern of array antenna has a maximum radius on desirable patterns with higher gain with narrower beam width in vertical plane

Figure 3 shows the radiation pattern of sleeve array antenna

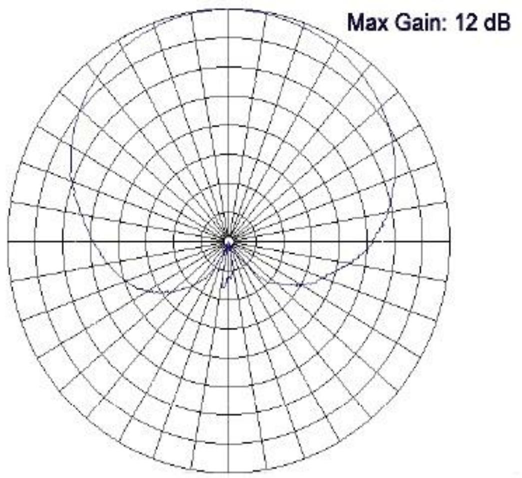

Fig – 3: Radiation pattern of sleeve array antenna

The above radiation pattern shows that sleeve array antenna can give maximum of 12dB gain and it is vertically polarized.

4. CONCLUSION

After having a survey about gain of sleeve antennas it is understood that gain of the antenna should be enhanced for better performance of the antenna. So using sleeve array antenna is been suggested to raise the gain minimum of 5dBi.The ordinary sleeve antenna will have maximum gain of 5dBi while desired sleeve array antenna will have maximum of 12dBi. Sleevearray antenna having the advantages of maximizing the signal to interference plus noise ratio (SINR), cancel out interference from a particular set of direction, provide density reception and decide the direction of arrival of incoming signals.So it can be used in all fields of application.

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