ISSN:2348-2079

Volume-8 Issue-2

International Journal of Intellectual Advancements and Research in Engineering Computations

Dual-polarized embroidered textile armband antenna array with directional radiation for on and off-body applications

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ABSTRACT

In the modern day communication, antenna's plays a vital role to transfer and receive information from one place to another place. In this project, a dual-polarized embroidered textile antenna array with directional radiation pattern is proposed for both on and off-body wearable application, to obtain high gain in unique direction. The existing work was an omni-directional radiation antenna array and which consists of more than two antennas to transfer and receive the information, cause the reduction in the gain. In the proposed system, the antenna array designed around the cylinder with the radius lesser than 23mm, at an operating frequency of 5.8GHz. The size of the planned microstrip antenna is 18.5mm (L), 2mm (B), 19mm (H) and the cylinder dimensions are 240mm (H), 40mm (Dia). The performance of the proposed antenna is analysed by using bandwidth, directivity and reflection coefficient using HFSS software.

Index Terms: Antennas, Dual-polarized, Textile antenna, Embroidery, Directional, Wearable application

INTRODUCTION

An antenna is an array of conductors or elements electrically connected to the transmitter or receiver. It is the interface between radio waves propagating through space and electric current moving in meta conductors, used with a transmitter or receiver. Antenna are designed to transmit and receive radio waves in all horizontal directions and vertical directions equally (omnidirectional antenna) or preferentially in a particular direction (directional or high gain antenna). An antenna has parasitic elements, parabolic reflectors or horns, which serve to direct the radio waves into a beam or other desired radiation pattern in wearable communications systems, are playing an important role in firefighting and military applications. The antennas are typically required to be high efficient, low absorption by human tissue and flexible.in real time operation, the design of wearable antennas is an extremely challenging task, which is quite different from those of conventional antennas. The wearable antennas can be divided into two types, namely on-body and off-body wearable antennas.

In this paper, a dual polarized embroidered textile antenna which can operate in both on-body and off-body modes simultaneously, is proposed based on the properties of directional patch antenna arrays the design of a structure is to excite a directional antenna array, wrapped around the cylinder. This antenna array generates the directional radiation pattern. The microstrip patch antenna elements are composed around the cylinder, which serve to minimize radiation into the human body. Based on other fabrication techniques, the embroidered textiles are low cost, low loss and easily integrated into garments, the embroidered textile antennas are considered a better choice for wearable applications. It is mainly used in military applications.in omni-directional antenna information is shared in omni

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directions which is easily noticed by hackers and information get lost. So that Directional antenna information is used which sends information in particular directions which cannot be accessed by hackers which keeps the information securely.

This paper is organized within the following sections II. Literature survey review, III. Existing method, IV. proposed method , V. Result, VI. Conclusion and future scope

LITERATURE SURVEY REVIEW

Yu-hang yang, Bao-hua sun and Jing-li guo proposed Low-cost, single-layer, dual circularly polarized (CP) series-fed antenna the proposed antenna with more compact structure and lower ohmic, dielectric losses caused by the feeding network compared with parallel-fed antennas. Kashif nisar paracha, Sharul kamal abdul rahim , Ping jack soh proposed Low Profile Dual-band Dual Polarized Antenna for Indoor/Outdoor Wearable Application, . To isolate the antenna against the influence of the human body, a multiband artificial magnetic conductor (AMC) plane is added on the reverse side of the dual-band radiator. Kenan turbic, Luis m. Correia and Marko proposed Mobility Model for Wearable Antennas on Dynamic Users for mobility model provides similar received power as the skeleton-based model with MoCap data, the maximum difference in the considered scenario being below 1 dB. Neil J. Grabham, Yi Li, Lindsay R. Clare proposed Fabrication Techniques for Manufacturing Flexible Coils on Textiles for Inductive Power Transfer for Flexible coils have been fabricated using standard processes widely used in the textile industry, such as screen printing and embroidery.in this project, the circularly dual-patch antenna.in the previous projects the types of antennas used are circular typed ones with limited realistic output, since most of the antennas are not directional the antenna used is having more realistic output. Mostly many projects antennas are circular but for movable applications it is not possible for that directional antennas are replaced. Usage of embroidery textile substrate, the radiation does not penetrate the human body. Compared to existing circular polarized antenna proposed directional antenna has more gain.

EXISTING METHOD

The existing work was an omni-directional radiation antenna array and which consists of more than two antennas to transfer and receive the information, because the reduction in the gain. Omni-directional antenna information is shared in omni directions which is easily noticed by hackers and information get lost. Microstrip Line feeding method is very simple to design and fabricate. But this technique suffers from some limitations. If substrate thickness is increased in the design then the surface waves and the spurious radiation also increases. Because of that the undesired cross polarization radiation arises.

PROPOSED METHOD

Software description

ANSYS HFSS (High-Frequency Structure Simulator) is a 3D Electromagnetic (EM) simulation software for simulating and designing high-frequency electronic products such as antenna, RF, antenna arrays or microwave components, high-speed interconnects, connectors, filters, IC packages and printed circuit boards. HFSS provides a powerful and complete multi-physics analysis of electronic products, ensuring their thermal and structural reliability. HFSS employs versatile solvers and an intuitive Graphical User Interface (GUI) to give unparalleled performance plus deep insight into all 3D EM problems. Through integration with ANSYS structural, thermal and fluid dynamics tools. The HFSS 19.0 release is a major step forward for three-dimensional full- wave electromagnetic field simulation with new innovations for engineering simulation and design. The software includes key updates in mesh generation, solver technologies, and enhancements to the user interface and modeler.

Microstrip patch antenna finds several applications in wireless communication. For example, satellite communication requires circularly polarised radiation patterns, which can be realised using either square or circular patch microstrip antenna. In global positioning satellite (GPS) systems, circularly polarised microstrip antennae are used. In this project, a dual-polarized embroidered textile antenna array with directional radiation pattern is proposed for both on and off-body wearable application, to obtain high gain in unique direction.

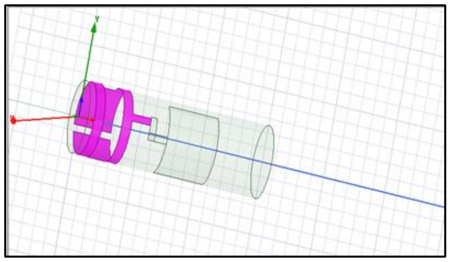

Figure 1 Microstrip patch for 5.8 GHz

The antenna of 5.8 GHz had been designed with the respective dimensions of 18.5x2x19mm with the help of the dielectric constant and height of the substrate as shown in figure 1. FR4 epoxy substrate has been used for the manufacturing because the dielectric constant is too low than other materials. In the proposed system, the antenna array designed around the cylinder with the radius lesser than 23mm, at an operating frequency of 5.8GHz.

RESULT

VSWR stands for Voltage Standing Wave Ratio, and is also referred to as Standing Wave Ratio (SWR).

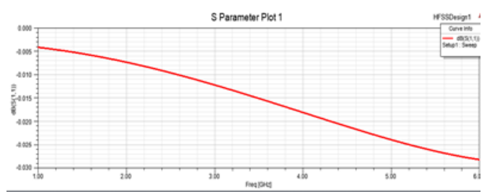

Figure 2 VSWR plot

The parameter VSWR is a measure that numerically describes how well the antenna is impedance matched to the radio or transmission line it is connected. As shown in Figure 2, the VSWR plot is obtained with result of raising of 11.08 dB and it continues up to the fall at 5.8 GHz.

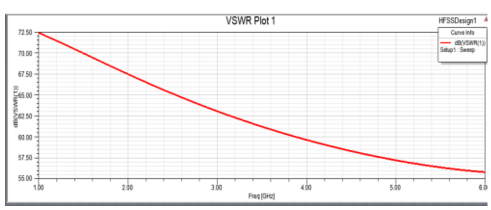

Figure 3 S Parameter Plot

In practice, the most commonly quoted parameter in regards to antennas is S11. S11 represents how much power is reflected from the antenna, and hence is known as the reflection coefficient (sometimes written as gamma: or return loss). If S11=0 dB, then all the power is reflected from the antenna and nothing is radiated. As shown in Figure 3, it is obtained that the S Parameter plot with result of raising of 11.08dB and it continues up to the fall at 5.8 GHz.

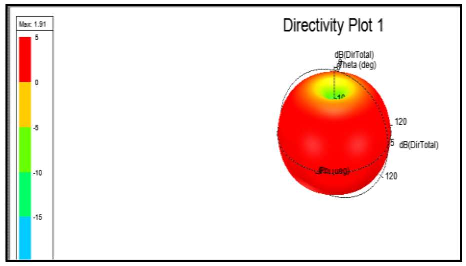

Figure 4 Directivity Plot

Antenna directivity is the ratio of maximum radiation intensity (power per unit surface) radiated by the antenna in the maximum direction divided by the intensity radiated by a hypothetical isotropic antenna radiating the same total power as that antenna. As shown in Figure 4, the obtained maximum directivity is about 1.91. This value is same as that of S parameter value. There are different colours indicate different ranges. The red in the directivity plot indicates the maximum directivity of the antenna. The dark blue region indicates the minimum directivity of the antenna.

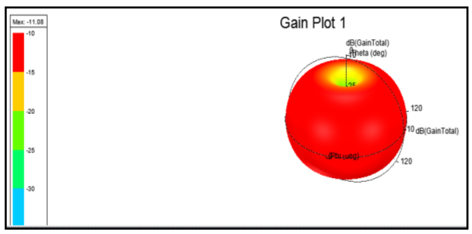

Figure 5 Gain Plot

Gain as a parameter measures the directionality of a given antenna. An antenna with a low gain emits radiation in all directions equally, whereas a high-gain antenna will preferentially radiate in particular directions. As shown in Figure 5, the obtained maximum gain is about 11.08The red in the directivity plot indicates the maximum gain of the antenna. The dark blue region indicates the minimum gain of the antenna. It was known that gain is directly proportional to the directivity, when the efficiency is 100 percent. As shown in Figure 5, when the frequency increases the slot moves from inductive region to the capacitive region.

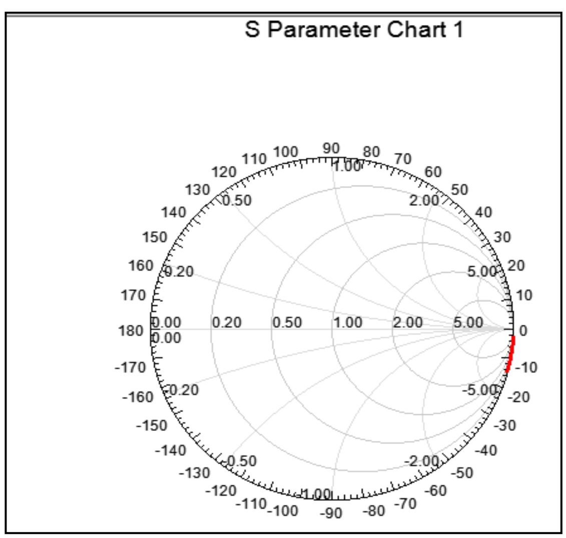

Figure 6 S-paramater impedance plot

In s parameter, the maximum gain is 11.08 and the maximum directivity is 1.91 the impedance line drawn in figure 6 shows the above mentioned value. This shows that the output of gain and directivity related to impedance plot is correct.

In dual patch directional radiation antenna, the gain obtained is 11.08 dB and with reference to base paper, the obtained gain of dual patch omni-directional antenna is 7dB. This result analysis shows, the omni-directional directivity and gain is less than the directional directivity and the gain. Due to a fixed frequency, the s-parameter and the z-parameter falls in the graph. This shows that the graph reveals that the directional dual patch is better than omni-directional antenna.

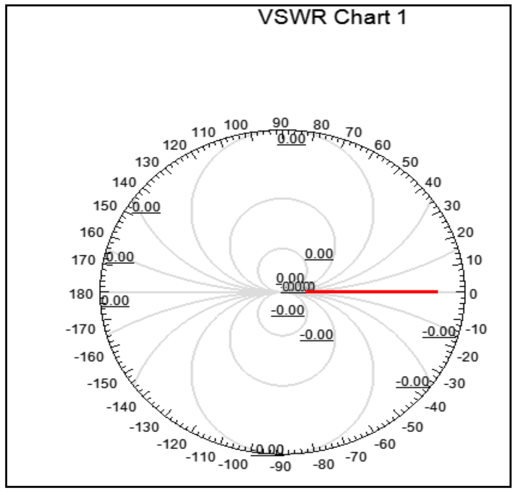

Figure 7 VSWR Impedance plot

The parameter VSWR is a measure that numerically describes the antenna is impedance matched to the transmission line or radio.it is connected. The reflection coefficient is called as s11 or return loss. The minimum VSWR is 1.0. In this case, no power is reflected from the antenna, which is ideal. The VSWR Impedance plot is shown in figure 7.

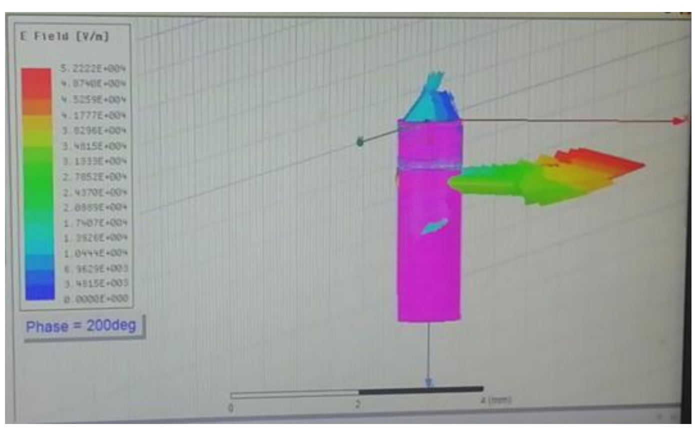

Figure 8 Animated image of radiation direction

This shows that the dual patch directional antenna array emits the radiation on both opposite sides.

CONCLUSION AND FUTURE SCOPE

The dual patch directional antenna array gain and directivity is maximum. The maximum gain of existing dual patch omnidirectional antenna array is 7 dB and the maximum gain of proposed dual patch directional antenna array is 11.08 dB. The directional antenna array is used for military applications. The information is secured through transmission or reception by fixing transmission and receiving antenna in different places of the body. In omni-directional, the information communicate in all directions, but in directional the information communicate in single side communication for securing data. In this project, the directional dual patch antenna is better than omni-directional patch antenna.

It plays an important role as omni-directional antennas doesn't get increased its size it is a fixed one whereas directional antennas gets increased its size of substrate the gain doesn't gets affected this gets an advantage over omni-directional antennas which used in future times.

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