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ANALYSIS OF MICROSTRIP PATCH ANTENNAS FOR THYROID GLAND CANCER CELLS DETECTION

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Abstract – A Microstrip antenna in its simplest configuration consists of a radiating patch on one side of a dielectric substrate, which has a ground plane on the other side. The patch conductors usually made of copper or gold can be virtually assumed to be of any shape. However, conventional shapes are normally used to simplify analysis and performance prediction. The radiating elements and the feed lines are usually photo etched on the dielectric substrate. The radiating patch may be square, rectangular, circular, ring, elliptical or any other configuration. Square, rectangular and circular shapes are the most common because of ease of analysis and fabrication. The antenna parameters like Return Loss, VSWR, Radiation pattern are verify and stimulated on CST Microwave Studio.

Key Words: Directivity, Gain, Return loss, Bandwidth.

1. INTRODUCTION

The novel features of the fabricated fully textile antenna is that conductive threads woven in the warp as well as weft are used to produce the conductive patch and the ground plane. This makes the antenna completely wearable. Four-layer weaving is used to produce three layers of different material for the textile antenna (conductor–dielectric–conductor).The substrate woven from simple cotton threads makes the textile antenna more flexible and wearable[1].Co-Planar Waveguide (CPW) is a type of feeding technique where there is no via holes or shorting pins involved. CPW has characteristics such as: low radiation loss, larger bandwidth, improved impedance matching, and more importantly, both radiating element and ground plane are printed on the same side of the substrate [2].Wearable textile antennas, combined with the rapid progress of the fabrication technologies of conductive fibrous materials in recent years. As the human body has a very high relative permittivity, the presence of a human body close to an antenna reduces antenna efficiency and lowers the resonance frequency [3]. The microwave methods of measuring the dielectric properties of the material can be divided into the following two main categories non resonant method and resonance method. The complex permittivity of the material can be calculated at a single frequency by simply measuring the shift in frequency and the value of Q-factor. These techniques may require more complex sample preparation [4]. It is important to maintain good antenna gain over most of the body to help avoid problems with excellent gain over some regions [5]. The firefighter's inner and outer garment is being equipped with a variety of sensors. Foam is commonly used in protective clothing as additional protection for vulnerable body parts, such as shoulders, knees, and elbows. Since foam is flexible and the antenna does not contain protruding parts, it will not disturb the movements of the wearer [6].

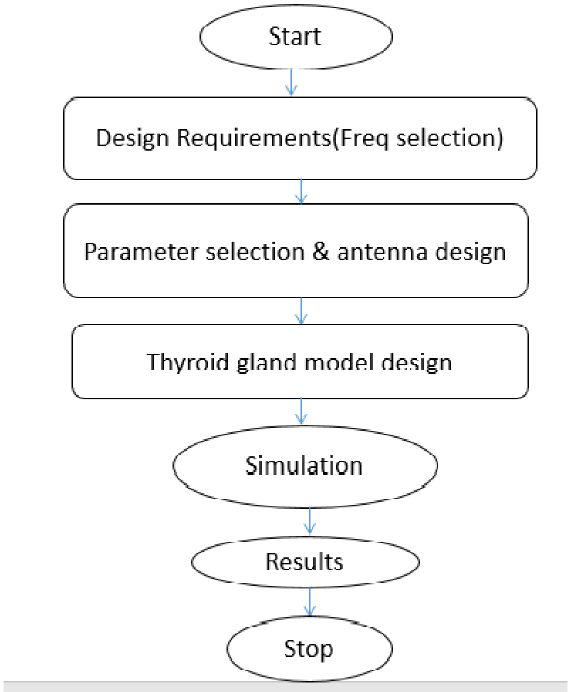


Fig-1: Data flow diagram

2. METHODOLOGIES

a) Multilayered Weave antenna

This paper proposes a unique, first of its kind fabrication technique for the making of textile antennas. A novel method that provides scope for automation in textile antenna production is presented here. A completely integrated textile antenna fabrication method that eliminates the tasks of positioning and fastening of the various components of a patch antenna is discussed. The technique employs multilayer weaving for the production of a wearable antenna on a cotton substrate. Silver yarn is used for the conductive regions of the textile antenna. Two layers of woven cotton serve to isolate the radiating patch from the ground plane of the antenna. The designed antenna was chosen to operate at the frequency of 2.45 GHz for Wireless Local Area Network. The built prototype resonated at 2.43 GHz with a |S11|of 18.62 dB. The integrated textile antenna exhibited a gain of 1.06 dBi at 2.43 GHz.

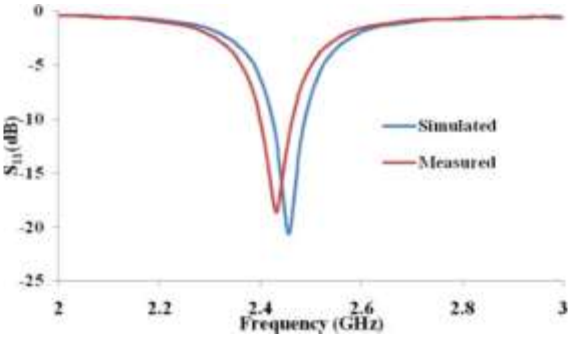


Fig-2: shows the S_{11} characteristics

From the above figure, the resonant frequency of the designed antenna is at 2.43 GHz with a |S11| of 18.62 dB.

b) Inkjet-Printed antenna

The paper describes a method of inkjet-printing a Co-Planar Waveguide (CPW)-fed flexible antenna for the development of a wearable microwave imaging (MWI) device for cancer detection and monitoring. The single side of a monopole antenna is represented as a fractal pattern with customized slots. The antenna is inkjet-printed using a low-cost additive fabrication method on a flexible substrate such as Kapton using Dimatix materials printer. Simulation using CST Microwave Studio and measurement carried out on an inkjet printed antenna with a VNA confirm that the designed antenna bandwidth ranges from 2.5GHz to 6.5GHz making it suitable for Microwave imaging applications.

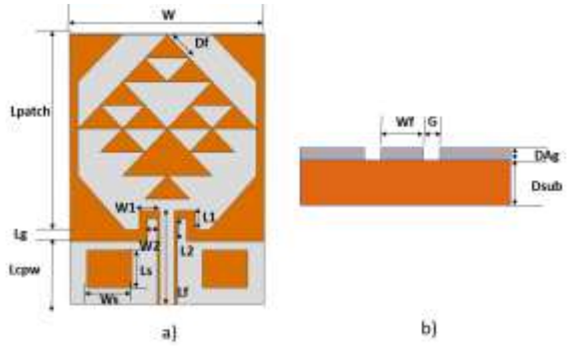


Fig-3: CPW antenna design a) Front b) Side

This antenna comprises a hexagon shaped embedding with fractal slot based radiation elements fed by an optimized CPW as shown in fig 3.

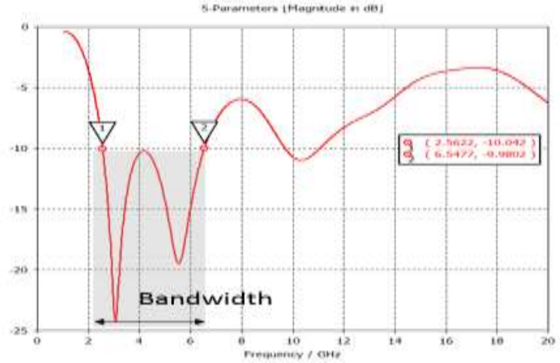
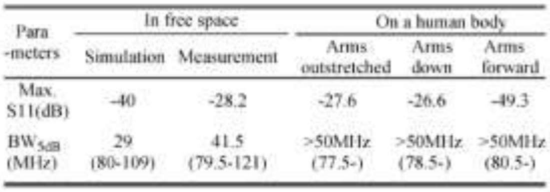


Fig-4: Simulated antenna return loss.

The figure shows that the simulated return loss (S11) of the proposed antenna. The operating bandwidth covers a range from 2.5GHz to 6.5GHz where the S11 is less than -10dB. This provides a 4 GHz bandwidth.

c) Embroidered wearable antenna

A wearable textile antenna with multiple resonance frequencies is proposed for the reception of FM signals using conductive embroidery of metal composite embroidery yarn (MCEY) on a polyester woven substrate. This embroidered FM antenna comprises five individual folded dipoles connected in parallel so that the bandwidth can be broadened *via* multiple resonances. The MCEY embroidered multiresonant folded dipole (MRFD) antenna is attached to a jacket, stretched from the left forearm, over the shoulder, and to the right forearm. The proposed antenna provides a wide operating band of 80.5 MHz to over 130 MHz at 5 dB return loss regardless of the arm movements, satisfying the FM broadcast band (87.5–108 MHz). The gain of this body-worn antenna is in the range of 7.08 to 15.79 dB in the FM broadcast band regardless of the arm movements.



Para-meters	In free space		On a human body		
	Simulation	Measurement	Arms outstretched	Arms down	Arms forward
Max. S11(dB)	-40	-28.2	-27.6	-26.6	-49.3
BW_{5dB} (MHz)	29 (80-109)	41.5 (79.5-121)	>50MHz (77.5-)	>50MHz (78.5-)	>50MHz (80.5-)

Table-1: Characterization of Embroidered antenna

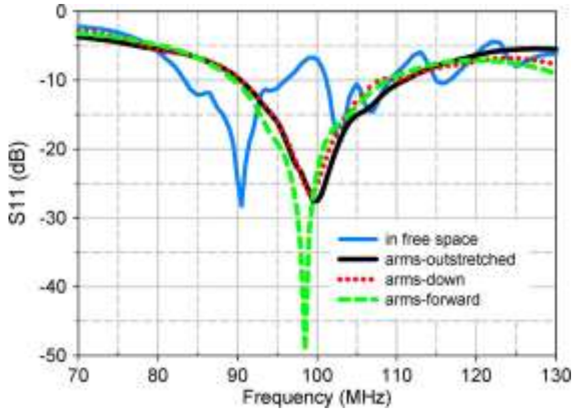


Fig-5: Return loss on embroidered antenna

From the fig 5, The maximum return loss of MCEY(Metal composite embroidery yarn) FM antenna in free space was 28.2 dB at 90.5 MHz.

d) Dielectric constant of fabric material

A novel approach to measure the dielectric constant of fabric substrate materials used for the development of wearable antennas (also called textile antennas) is presented in this paper. The technique reported here is based on the resonance method and focused on the use of microstrip patch radiator, which contains fabric material as its substrate. The accurate value of the dielectric constant of the fabric material can easily be extracted from the measured resonant frequency of the patch radiator. The dielectric constant values of six fabric materials, including jeans cotton, polyester combined cotton, and polyester, have been determined by this way Two of the six textile antenna structures, developed to meet out the primary objective of determining the dielectric constant of fabrics, are tested, and their performance characteristics, such as impedance bandwidth, gain, efficiency, etc., are measured. In addition, another Bluetooth antenna employing polyester fabric substrate is designed considering its measured accurate value of dielectric constant and subjected to radiation pattern measurements.

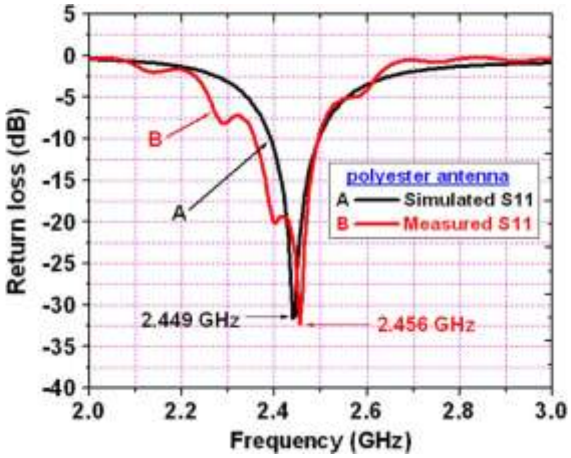
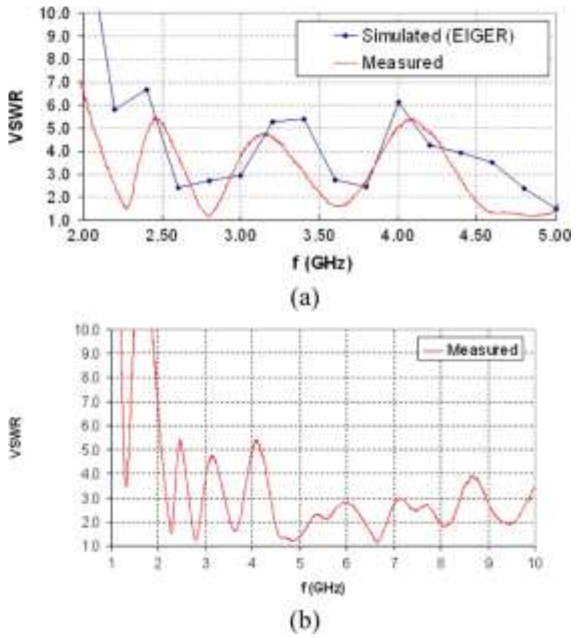


Fig-6: Return loss characteristics

It is clear that from fig 6, For polyester antenna the measured values of resonant frequency and −10-dB return loss bandwidth are 2.456 GHz and 100 MHz.

e) Body-worn E-textile antenna

The increasing applications for wireless data and communications on a body-centric platform requires novel antenna systems that can be integrated with the body-worn environment, while maintaining free-range of movement and minimal mass impact. E-textile antennas show great promise due to their ease of integration with other textile materials, and they are inherently low-mass and flexible relative to conventional antenna materials. Much attention has been given recently to multiple-antenna communication systems due to the increased performance compared to conventional single-antenna systems. For body-centric applications, the low-mass, flexibility, and integration simplicity of e-textile antennas can enable multiple-antenna systems, which otherwise would be precluded by the rigidity and mass of conventional antenna materials. In addition to the conventional array, a wideband multiple-antenna system to support a variety of wireless communication protocols, while maintaining polarization diversity and excellent coverage over a majority of the radian sphere is demonstrated.



(a)

(b)

Fig-7: a) VSWR complementary b) e-textile antenna.

VSWR data for the simulated and measured antennas are plotted with ripple in the VSWR response and the result of the conducting ground plane positioned away from the complementary-8 geometry at 2.1 GHz.

f) Textile antenna for Off body protective cloth

The introduction of intelligent textile systems to increase the wearer's level of protection has exposed the necessity of wearable communication tools and has led to research in textile antennas. However, most textile fabrics are quite thin (0.5 mm), making it challenging for antenna designers to provide an antenna which operates adequately and resiliently in the 2.4–2.4835-GHz industrial-scientific-medical bandwidth. Flexible pad foam is commonly available in protective clothing and it provides a uniform, stable, and sufficient thickness. Moreover, its cellular structure and properties, such as flame retardance and water repellence, make it an excellent substrate material for the integration of antennas into protective garments. The design, manufacture, and performance of the first textile planar antenna to be implemented on flexible protective foam, suitable for firefighter garments. We employed shock absorbing foam with a thickness of 3.94 mm. These outstanding substrate and antenna characteristics result in an antenna that is highly appropriate for garment integration

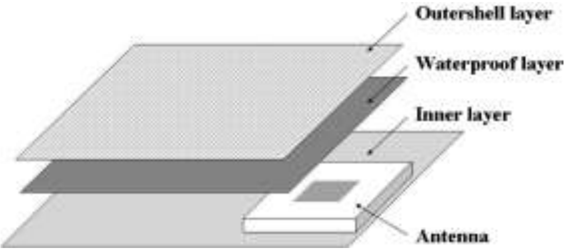


Fig-8 Antenna is integrated between textile layers.

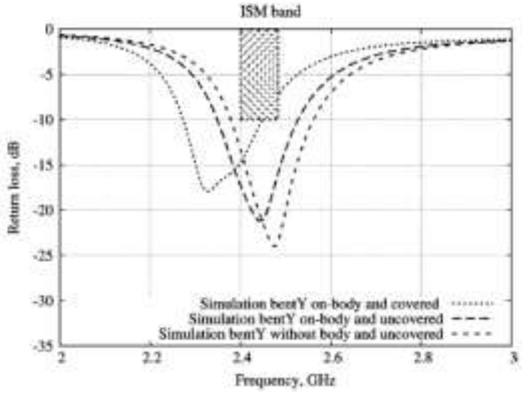


Fig-9: Return loss characteristic

The above fig shows return loss obtained by the proposed antenna is -24 Db. The covering textile layer causes the resonance frequency to decrease and the return loss characteristics shift to lower frequencies.

g)Electro Textile –High frequency

A systematic study of the high frequency electrical properties of electro-textiles is determined. First, conductive thread characterization is completed with a waveguide cavity method. The effect of conductive thread density and comparison of several different types of conductive threads are included. Second, comparisons of knitted patterns and weave patterns are made in terms of effective electrical conductivity through a microstrip resonator method. The effect of various weave patterns on conductive and dielectric loss is detailed. Finally, the relevance of the high frequency characterization of the electro-textile materials is shown through electro-textile patch antenna fabrication and measurements. The efficiency of the fully fabric patch antenna is as high as 78% due to the use of low loss electro-textiles.

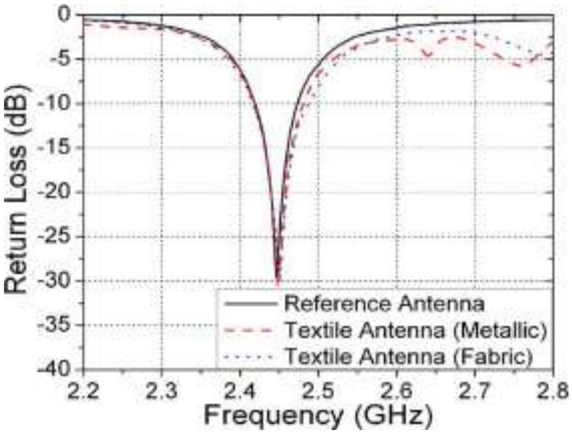


Fig-10: Return loss characteristics

From the above figure the resonant frequencies of three antennas match with each other.

h) Dual polarized textile patch antenna

In the context of wearable textile systems for rescue workers, antennas are needed that exhibit robustness to channel fading and, in addition, are completely integrable into protective garments. Therefore, a dual polarized patch antenna, made out of textile materials, is proposed. The antenna is intended for operation in the ISM band [2.4, 2.4835] GHz, permits to exploit polarization diversity and is fully integrable into protective garments. To our knowledge, it is the first textile antenna with dual polarization. Several prototypes have been realized and their performances were investigated by measurements and simulations, proving the effectiveness of the antenna in open-space and on-body operation.

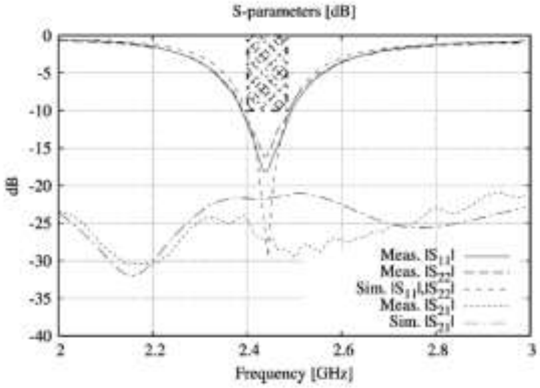


Fig-11: Simulated S-parameter

Fig 11 shows that there is a good agreement between the curves of the measured and simulated S-parameters .The measured-10 dB bandwidths of S11 and S22 are slightly larger than the simulated one and the resonance peaks are less sharp.

3. RESULT AND DISCUSSION

In this paper, the different antennas structures such as microstrip patch antenna, textile antenna, embroidered antenna, dipole textile antenna, array antennas design were analyzed. From the observation it is inferred that microstrip patch antennas provide less return loss. The return loss curve of the H-shaped antenna obtained by simulator produce the value of -35.777Db resonant at the frequency of 49.413GHZ. The VSWR curve of the H-shaped antenna produce the value of 1.239 resonate at the frequency of 49.542GHZ.

4. CONCLUSION

In this survey paper, various antennas designs were analyzed. From the observation it was found microstrip patch antenna produced an lower return loss of -35Db.The proposed H-shaped antenna is designed to place it on human thyroid gland to detect the presence of tumor cell.

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