Simulation Study on Wearable Micro Strip Patch Antenna

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Abstract: In this work, planer monopole antenna [1] with partial ground plane has been designed in simulation platform. The substrate of the designed antenna have been made from different types of substrate fabric materials (flannel and jeans) whereas the divergent component and ground plane square measure made up of self adhesive sheet. The operating frequency of the current manuscript designs spans about 39GHz. Measured results are compared with simulations and good agreement have been observed. Results indicate the suitableness of versatile cloth materials for wearable applications rather than rigid substrate board materials.

Index Terms **-wearable antenna, substrate, textile, HFSS**

I INTRODUCTION

The current trend in miniaturization in microelectronics along with other new technologies enables wearable computing to integrate functionality in clothing. Thus, integration in textiles ideally combines the requirements of wearable computing and wireless body area networks (WBANs), since clothing is unobtrusive and offers large area of close proximity to human body. The micro strip patch antennas[2,3] are playing a decisive role in wireless wearable systems, by the utilization of textile materials[4] for the development of flexible wearable antenna has emerged aiming the robustness, flexibility, and satisfactory of wireless wearable antennas/devices[5]. On the other hand, high frequency transmission device does not need to transmit high-power signal to the receiver and can have a longer battery life or be smaller to reduce the wearable devices size. Several papers have been published about the design, fabrication and applications of wearable antennas and systems. Other researchers have taken quantum leaps in utilizing textile materials as antenna substrate. Wearable antennas [6] have been developed within the variety of versatile metal patches on textile substrates, while a dual band wearable antenna also have been in literature. With all these mentioned findings, markets opened up to a wide range of potential requirements and investigations for these novel materials considering antenna designs and applications. Consistent with all these facts mentioned above, authors of the current manuscript aimed to make closer steps towards real wearable material by merging the antenna technology with textile technology. Therefore, high frequency antennas using clothing materials as antenna substrates are fabricated and presented in this paper. Hence, substrate materials investigations involved two fabrics; flannel and jeans, while the radiating element and ground plane are made from copper self-adhesive conducting sheet. The following sections shall discuss in more details about the specifications of materials used, the proposed antenna designs as well as comparisons between simulated and measured results.

For flexible antennas, textile materials form interesting substrates, because cloth antennas will be simply integrated into garments. Textile materials typically have a awfully low insulator constant, which reduces the surface wave losses and improves the impedance bandwidth of the antenna. In this paper, planer monopole antennas have been designed and analyzed. Fabrics (flannel/ jeans) have been considered for investigations in order to study their aptness to be used as substrate materials. The proposed fabric materials are 100% cotton materials with smooth and firm surface features, while the thickness of each fabric is 1 mm. However, in order to model a fabric, it is important to know its relative permittivity. Thus, the measured relative permittivity at several frequencies for woollen/flannel or towelling material and jeans fabrics was almost 1.7 with loss tangent of 0.025. Conductive parts are made out of copper tape with a thickness of 0.04 mm. These mentioned features together made the antenna flexible in nature. Studies have been made on the thickness of the wearable material with the number of folds possible or any such alteration effect on the dielectric constant. The basic feature which is important in the antenna design is the suitable selection of the substrate material.

II DESIGN PARAMETERS

In general, the design and construction of the planer monopole antenna consist of a circular parch to be placed at the top of fabric substrate material; a micro strip feed line and a partial ground plane beneath the fabric substrate material. At the starting point in designing fabric antenna, the main patch is initially calculated according and using Equation 1 in order to create circular patch. Here a is the radius of the circular patch antenna in millimetre, fr is the resonance frequency in GHz, and εr is the relative permittivity of the textile substrate material.

$$a=87.94/fr(\sqrt{\varepsilon r}) \quad (1)$$

In addition, the transmission line feeding technique is introduced in order to connect the main radiating circular patch to the 50Ω Sub Miniature Version (SMA) connector where the position is determined.

III RESULTS AND DISCUSSION

The simulated results have been done on HFSS software [7]. The results shows S11 and radiation pattern both are acceptable for higher microwave frequency of the order of 39GHz.

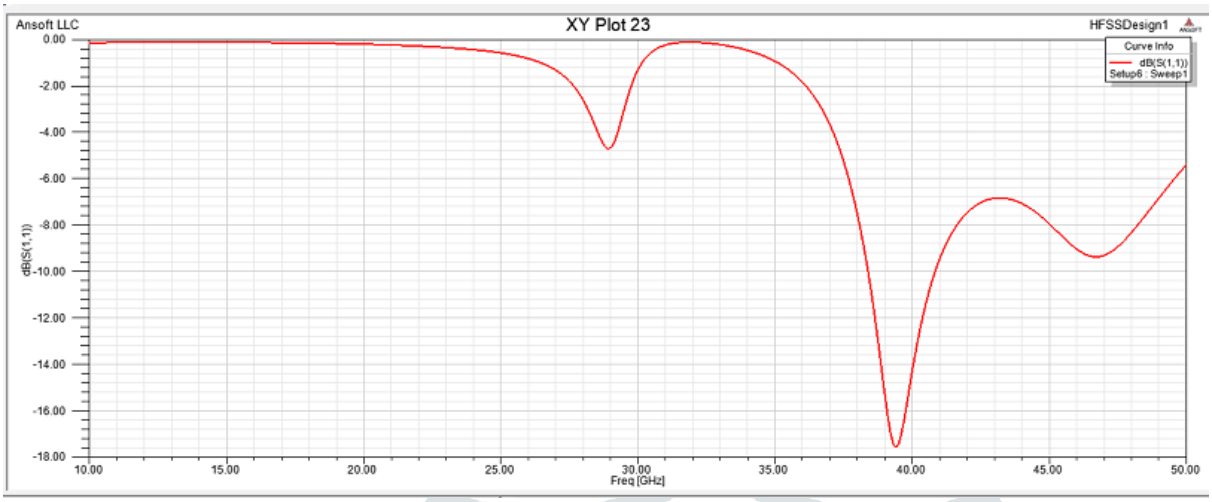

Figure 1: S11 of the proposed antenna

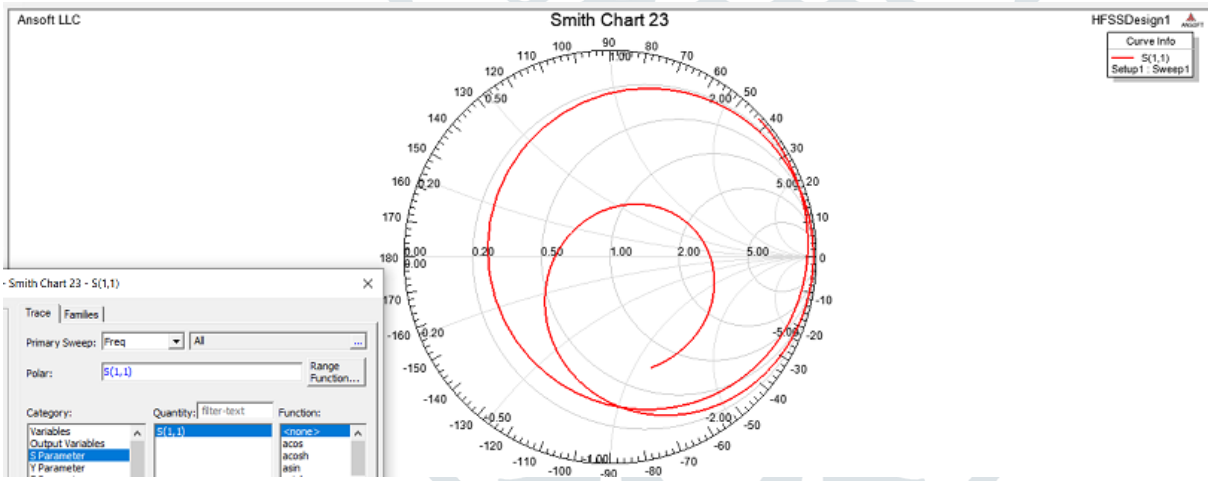

Figure 2: Radiation pattern of the proposed antenna

IV CONCLUSION

In this work focus have been on the base material selection to get a better result. By the HFSS software the simulation have been carried out and a good result have been obtained as per the S11 and radiation pattern. Also the designed antenna may be used for higher microwave frequency. For surveillance/ security purpose this type of wearable antenna may be used.

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