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A Novel Textile UWB Antenna

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1. Introduction

Body-area networks (BANS) are wireless communication systems that enable communications between wearable and/or implanted into the human body electronic devices [1]. Such systems are suitable for mobile computing applications, emergency rescue and wireless telemedicine.

Ultra wide band (UWB) is an emerging wireless technology, recently approved by the Federal Communications Commission (FCC). In low/medium data-rate applications, UWB offers low-power operation and extremely low radiated power, thus being very attractive for body-worn battery-operated devices [2].

Most of the wearable antennas designed in recent years are patch antennas and use flexible metal patches to conform around any surface. The drawback of using flexible metal patches is the easy detunability of the antenna when it is stretched, bent or compressed from its original shape [3].

A wearable antenna with the appearance of a button operates at the 2.45 GHz and 5GHz has been proposed in [4]. Some UWB metallic button antenna is introduced in [3, 5]. These antennas had monopole radiation patterns and can be easily disguised, because of their button appearance.

In this paper, a novel textile UWB antenna with the appearance of a button is proposed. The antenna is able to operate within the 3.1GHz to 10.6GHz. Simulated results are given.

2. Antenna Design

The structure of the antenna is shown in Fig. 1 and the dimensions are tabulated in Table 1. The antenna is a small metallic button structure with a total diameter of 24mm and height of 16.2mm. The antenna is made up of three main components: a cone and two cylinders. Because of the existence of these sequential discontinuities, the antenna is expected that several resonances will be generated.A 60mm×60mm fabric substrate with a relative dielectric constant approximate to 1.3 and a thickness of 2mm is used. The antenna is fed by exciting the cylinders through the flexible ground plane.

3. Simulated Results

Analysis of the UWB button antenna is carried out by a full-wave EM analysis tool, HFSS_v11. The simulated reflection coefficient curves (S11) for the antenna is shown in Fig.2. The simulated S11 for the UWB button antenna achieved a bandwidth from 3.05 GHz to 10.95 GHz. It is sufficient to cover the 3.1 to 10.6 GHz bandwidth for UWB systems.

Furthermore, the effects of h_1 and d_1 are investigated in detail here. All the corresponding dimensions are the same. Fig.3 shows the *S*-parameters of the antenna varying with the height of the cylinder h_1.It can be clearly seen that h_1 affects reflection coefficient in high frequency. From Fig. 4, we can know that, as the parameter d_1 increases from 6.6mm to 8.1mm, the return loss increases.

The simulated radiation patterns at 4GHz, 6.5GHz and 9GHz are plotted in Figs. 5, respectively. It is seen that the radiation patterns are almost omni-directional in E-planes(x-y plane) at 4, 6.5 and 9 GHz. H-planes(x-z plane) examined at the same frequencies are symmetrical around the z-axis. The gain obtained for the UWB antenna was 3.45dB, 5.1dB and 5.6 dB at 4 GHz, 6.5 GHz and 9 GHz respectively.

4. Conclusion

A textile UWB button antenna is designed and analyzed in this paper. The resultant is sufficient to cover the 3.1 to 10.6 GHz bandwidth for UWB systems. The effects of $h_1$and d_1 are investigated in detail. Radiation patterns clearly show the omni-directional performance of the proposed antenna. The gain was between 3.45dB and 5.6dB within in the matched frequency bands.

Acknowledgments

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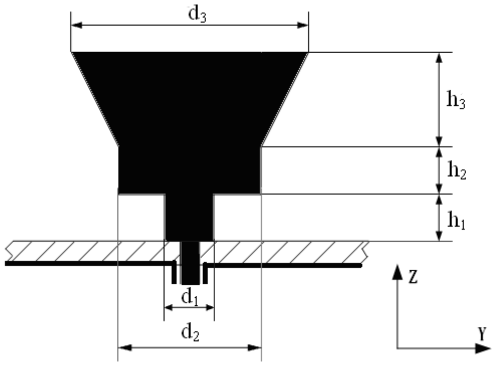


Figure 1: Geometry of a textile UWB antenna

Table 1: Dimensions of a textile UWB antenna

parameter	d_1	d_2	d_3	h_1	h_2	h_3
value(mm)	7.4	18	24	4.6	4.4	7.2

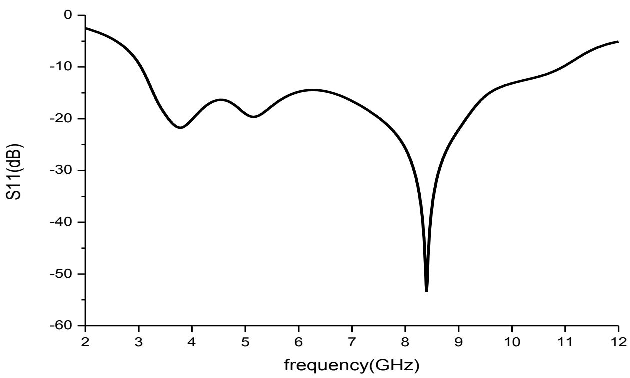


Figure 2: Simulated S_{11} for the textile UWB antenna

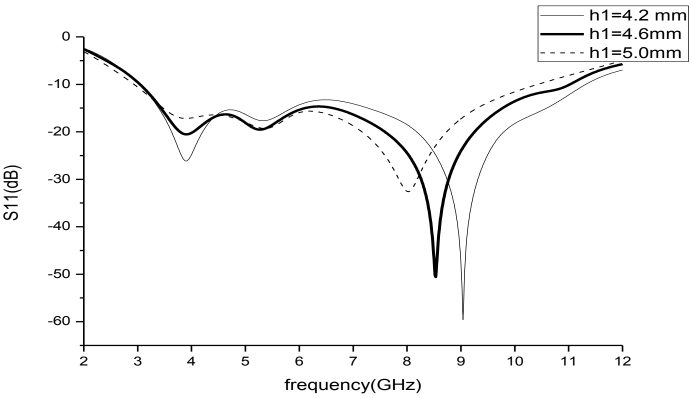


Figure 3: Simulated S_{11} for different h_1

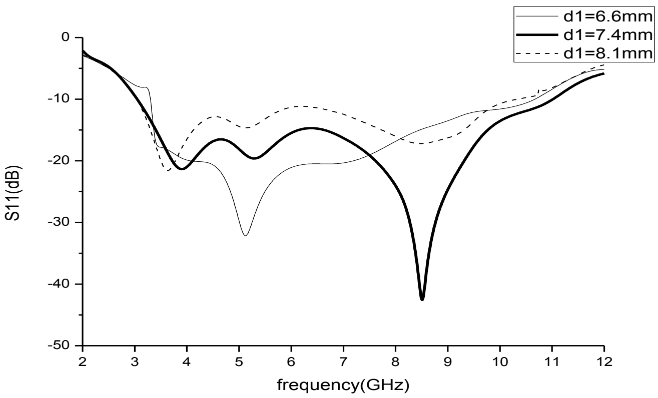
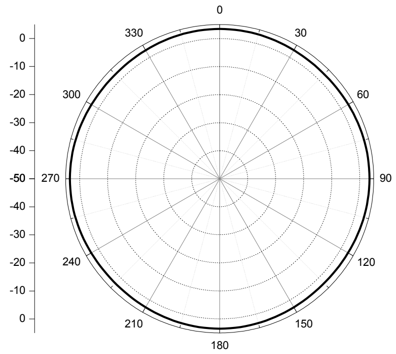
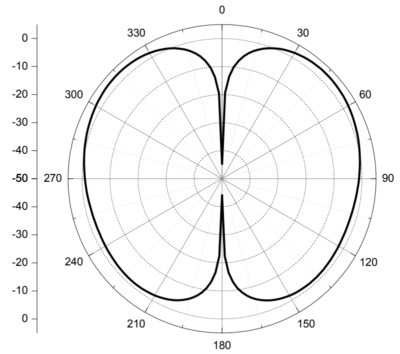


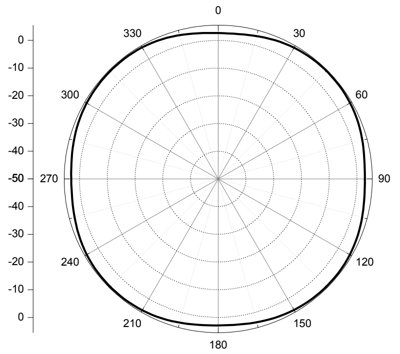
Figure 4: Simulated S_{11} for different d_1



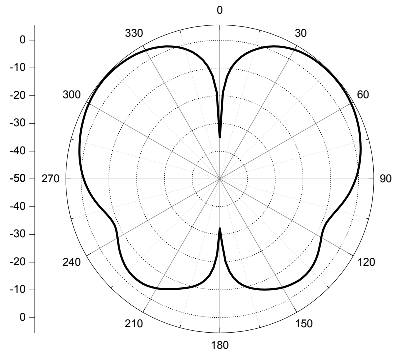
(a) E-plane (4 GHz)



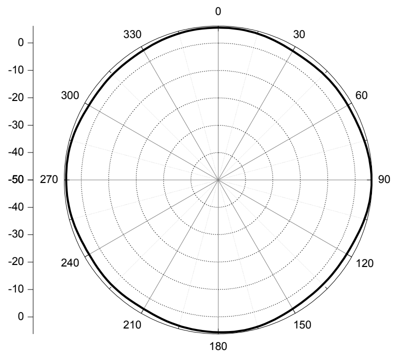
(b) H-plane (4 GHz)



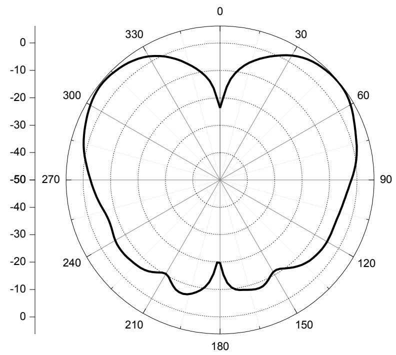
(c) E-plane (6.5 GHz)



(d) H-plane (6.5 GHz)



(e) E-plane (9 GHz)



(f) H-plane (9 GHz)

Figure5: Radiation pattern of the proposed antenna