Wideband Antenna for Microwave Imaging

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Abstract— A robust antenna which designed on fully textile material is presented. A denim jean textile is used as the dielectric substrate while the radiating elements are using conductive shieldit super textile. The simulated operating bandwidth of the antenna is 4540 MHz with maximum −10 dB reflection coefficient magnitudes of 1.46–6 GHz. The antenna has bi-directional radiation pattern and provides simulated gain values that fluctuate between 1.5 to 7 dBi at the entire frequency range. This antenna which operates in the mentioned wideband frequency is highly acceptable for microwave imaging application. In addition, the capability of the textile material to be formed into flexible shape such as bending will be an advantage of its use in flexible microwave imaging purpose.

1. INTRODUCTION

Microwave imaging is a sensing technique that recently proven its use in providing diagnostic capabilities in several areas including body imaging [1]. Several antennas have been reported for microwave imaging application. Antennas in [2–4] are purposely designed for breast microwave imaging. The antennas are made of FR4 based material. Moreover, antennas in [5–8] are introduced for brain microwave imaging and also for body communication. The respective antennas are made of either FR4 or Rogers microstrip. However, all kinds of the mentioned antennas have limitation on flexible feature such as to be bent on various shape of human body. Therefore, fully textile antenna is seen to be the best option that has flexible feature. The flexibility allows the antenna to be used for various part of human body, not only breast and head. Therefore, a wideband textile antenna is proposed in this study.

2. ANTENNA GEOMETRY

A denim jean textile is used as the dielectric substrate while the radiating elements are using conductive shieldit super textile. The thickness of the substrate is 0.7 mm while the conductive textile is 0.17 mm. The conductive textile has surface resistivity value less than 0.5 Ohm/sq. The antenna that fed by coplanar waveguide (CPW) technique consists of radiating patch and ground that attached on the substrate with the dimension of 80 mm × 77.5 mm as presented in Figure 1. The grounding element that comprises of slots and blending edges produce a wideband impedance

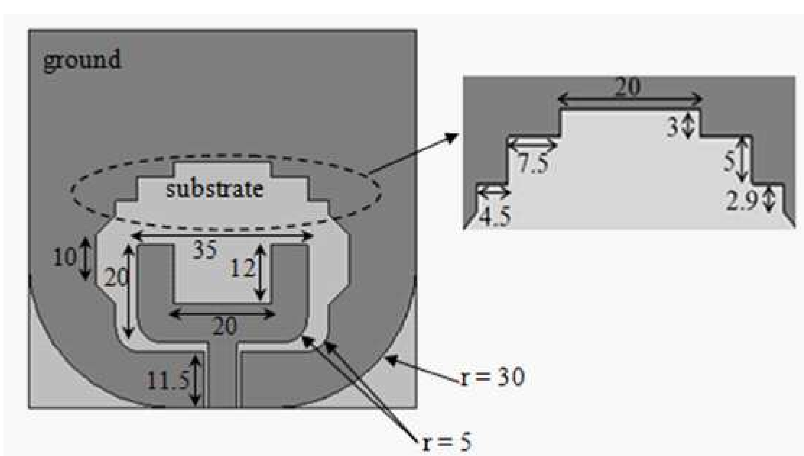

Figure 1: Wideband antenna dimension.

bandwidth. Figure 2 shows the effects of the slots and blending edge on the ground plane towards the reflection coefficients.

According to Figure 2, the initial coplanar waveguide (CPW) ground plane without any slot gives some band rejections. However, while the two symmetrical slots at the side of the ground plane are added, there is improvement of reflection coefficients for the frequency lower than 4 GHz. Furthermore, with the addition of slots at the top side of the ground plane, this enhances the bandwidth for the entire frequency from 1.57 GHz up to 6 GHz. Even though there is slight improvement by having the blending ground plane, it is however improve the reflection coefficient to the lower values and helps the antenna to operate from 1.46 GHz to 6 GHz.

3. RESULT AND DISCUSSION

The antenna is observed on its reflection coefficient and gain. Based on the previous section, it has been determined that the antenna may operates from 1.46 GHz to 6 GHz which covers 4540 MHz bandwidth. The gain of the antenna increases with the frequency from 1.5 to 7 dBi, except at 4 GHz as presented in Figure 3. However, the gain of the antenna is acceptable for microwave imaging purpose.

In addition, radiation patterns of the wideband textile antenna have been simulated and the results are shown in Figure 4. The simulated radiation patterns at phi = 90 (E-plane) and phi = 0 (H-plane) for 2, 4, and 6 GHz are presented. All the results show bi-directional radiation patterns

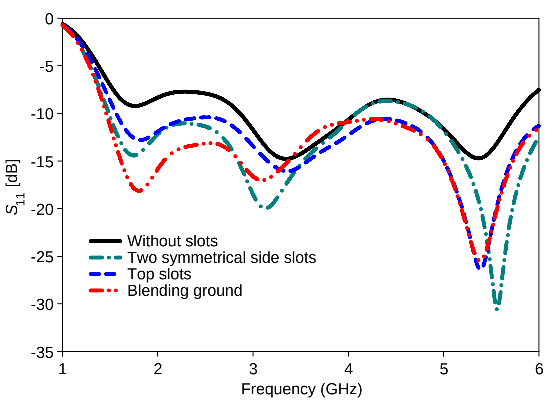

Figure 2: The implementation effects of slots and blending edges on the ground plane.

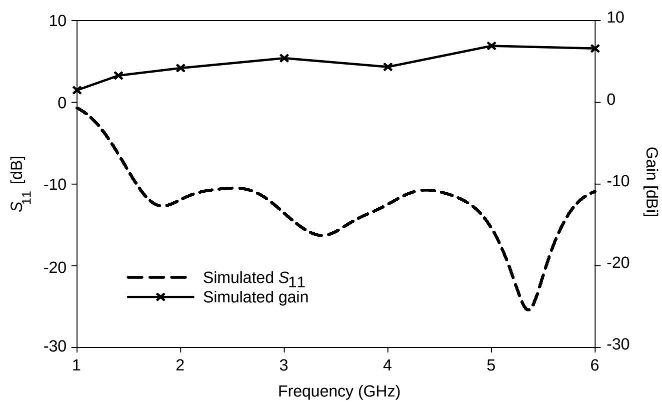

Figure 3: Simulated gain and reflection coefficient magnitudes of the wideband antenna.

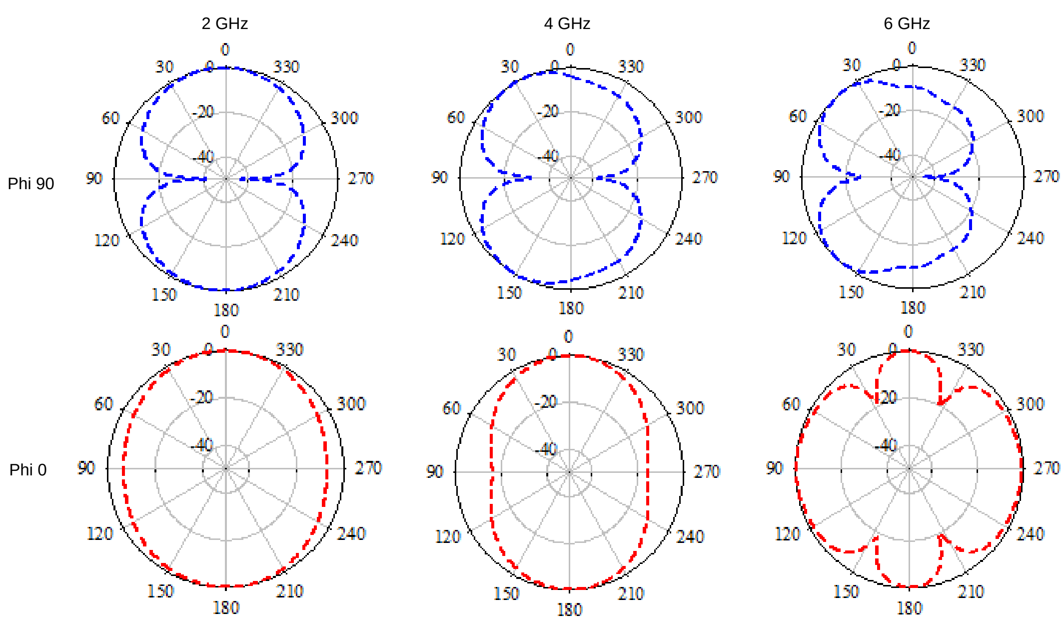

Figure 4: Simulated radiation patterns of the wideband antenna.

at Phi = 90, while it shows nearly omni-directional at phi = 0 at 2 GHz. At the frequency of 4 GHz and 6 GHz, the radiation patterns are different as shown in Figure 4. Moreover, the efficiencies of the antenna changes between 73% and 90% throughout the frequencies.

4. CONCLUSION

Antenna which based on textile material is proposed for microwave imaging. The antenna may operate from as low as 1.46 GHz to 6 GHz, provided with the acceptable gain values. The antenna which is textile based material provides flexibility features of microwave imaging. This will benefit to various shapes and parts of human body microwave imaging application.

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