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A Design of H-shape Slot loaded Wideband Microstrip Patch Antenna

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Abstract-
A new high gain, wideband H-shape slot loaded microstrip patch antenna is presented in this paper. The antenna is printed on a dielectric substrate, backed by a metal board, and directly fed from a 50 Ω coaxial cable. Using IE3D software package of Zeland, according to the set size, the antenna is simulated. The composite effect of integrating these techniques and by introducing the novel slotted patch offers a low profile, wide bandwidth, high gain and compact antenna element. The computer simulation results show that the antenna can realize wide band characters. With adjusted parameters, it exhibits a broad impedance bandwidth (VSWR ≤ 2) of about 19% at a frequency of 2.42 GHz.

Keywords — Microstrip antenna, wideband, H-shape slot, coaxial probe, IE3D

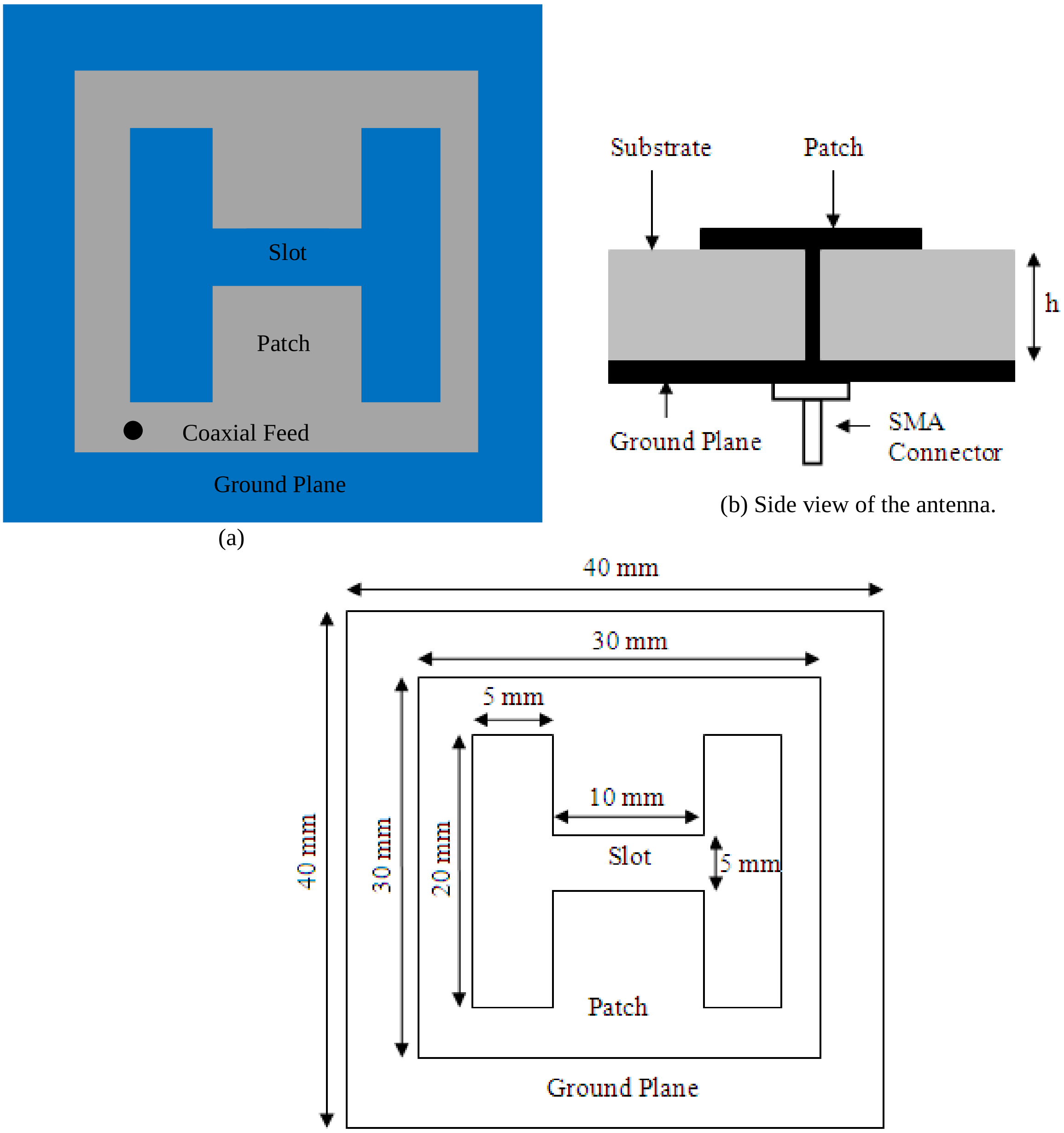
I. INTRODUCTION

The rapid development of wireless communication systems has increased the demand for compact microstrip antennas with high gain and wideband operating frequencies. Microstrip patch antenna has advantages such as low profile, conformal, light weight, simple realization process and low manufacturing cost. However, the general microstrip patch antennas have some disadvantages such as narrow bandwidth etc. Enhancement of the performance to cover the demanding bandwidth is necessary [1]. There are numerous and well- known methods to increase the bandwidth of antennas, including increase of the substrate thickness, the use of a low dielectric substrate, the use of various impedance matching and feeding techniques, and the use of multiple resonators [2-7].

In this paper a printed wide-band antenna fed by a coaxial probe is presented. The antenna is simulated using IE3D, 12.32 version of Zealand. The results show the impedance bandwidth has achieved a good match. Besides to make sure that the antenna designed in this paper can be applied into practice, a slot of H-shape is cut to generate lower frequency.

II. ANTENNA DESIGN

The dielectric constant of the substrate is closely related to the size and the bandwidth of the microstrip antenna. Low dielectric constant of the substrate produces larger bandwidth, while the high dielectric constant of the substrate results in smaller size of antenna. A trade-off relationship exists between antenna size and bandwidth [9].



(a)

(b) Side view of the antenna.

(c)Dimensions of the antenna.

Figure.1. Geometry and dimensions of the proposed antenna.

The resonant frequency of microstrip antenna and the size of the radiation patch can be similar to the following formulas [10].

$$f \cong \frac{c}{2L\sqrt{\varepsilon_r}} \tag{1}$$

$$W = \frac{2}{f_r}\left(\frac{\varepsilon_r + 1}{2}\right)^{\frac{1}{2}} \tag{2}$$

$$L = \frac{c}{2 f_r \sqrt{\varepsilon_r}} - 2\Delta l \tag{3}$$

Where f is the resonant frequency of the antenna, c is the free space velocity of the light, L is the actual length of the current, ε_r is the effective dielectric constant of the substrate and Δl is the length of equivalent radiation gap.

The geometries of the H-shaped slot antenna are shown in figure 1. The antenna is built on a glass epoxy substrate with dielectric constant 4.2 and height h of 1.6 mm. A substrate of low dielectric constant is selected to obtain a compact radiating structure that meets the demanding bandwidth specification. The geometry of the top view and side view of the proposed antenna is shown in figure 1 (a) and (b) respectively. The dimensions of the slotted patch are shown in figure (c).

Reducing the size of the antenna is one of the key factors to miniaturize the wireless communication devices. However, reducing the antenna size will usually reduce its impedance bandwidth as well. Therefore designing a small antenna with a wide impedance bandwidth which satisfies future generation wireless application is a challenging work, especially having stable radiation patterns across the operating frequency band [11-12]. In this paper coaxial probe feeding, slot on the patch provide the wide bandwidth and gain enhancement.

III. RESULTS AND DISCUSSIONS

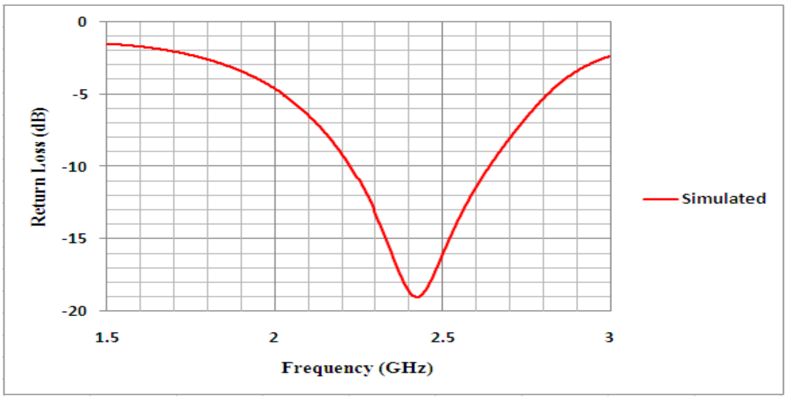


Figure.2. Simulated return loss of the proposed antenna.

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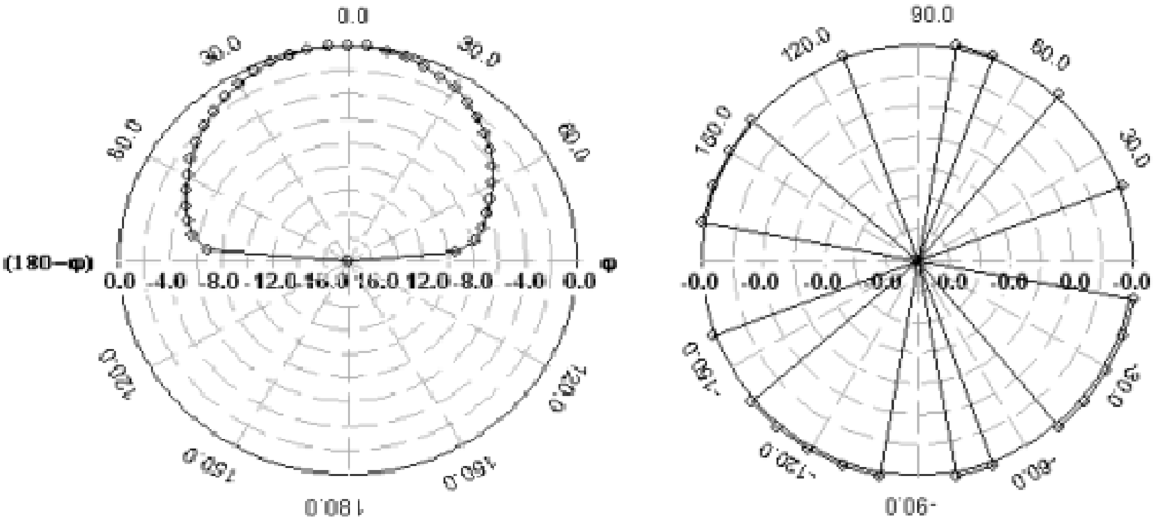

(a) (b)

Figure.3. Radiation pattern of the proposed antenna. (a) Elevation and (b) Azimuth.

The performance of this antenna was simulated and optimized by “IE3D” 12.32 version of Zeland. This was used to calculate the return loss, impedance bandwidth and radiation pattern. The simulated -10 dB return loss of the proposed antenna is shown in the figure 2. The simulated result shows that the resonant frequency locates at about 2.42 GHz covering from 2.2 GHz to 2.65 GHz. The simulated impedance bandwidth of 19% is achieved at -10 dB return loss. The simulated radiation patterns of the elevation and azimuth of the proposed antenna are shown in figure 3. It can be observed that the proposed antenna have the same radiation patterns over the entire frequency band.

IV. CONCLUSION

A novel compact, slot loaded microstrip antenna for enhancing gain and bandwidth has been designed, simulated and analyzed theoretically. Simulation results of a wideband microstrip patch antenna covering 2.2 GHz to 2.65 GHz frequency have been present. Good antenna performance and impedance matching can be realized by adjusting the probe position and the dimensions of the patch. The proposed microstrip patch antenna achieves a fractional bandwidth of 19% at -10 dB return loss. It can be concluded from the results that the designed antenna has satisfactory performance and hence can be used for indoor wireless applications.

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