

Size-Miniaturization for Microstrip Wideband Slot Antenna

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I. Introduction

Recently, the spiral slot antenna becomes popular and attracts more attention due to the advantages of the good circular polarization, the easy impedance matching, the superior radiation efficiency and the ultra-wideband characteristics [1-3]. However, the large size of the spiral slot antenna results into problems for the applications in the physical applications of the wireless communication and satellite communication systems. By adding a circularly microstrip stub at the end of the feedline, the size of the microstrip-fed spiral slot antenna could be reduced by 20%, approximately [4]. In this paper, the technology of reducing the CPW-fed spiral slot antenna has been proposed and demonstrated. By adding the circularly microstrip stub at the end of the feedline, the operated frequency of the CPW-fed spiral slot antenna could be lowered. The whole area of the CPW-fed spiral slot antenna was reduced by 48 %, approximately.

II. Antenna Design

FR-4 was used as a substrate with the dielectric constant of 4.4 and the thickness of 1.6 mm. The length and width of the tested substrate were 90 mm and 75 mm, respectively. Figure 1(a) present the schematic diagram of the conventional CPW-fed spiral slot antenna with the seven turns. The feeding structure and the spiral radiator were designed on the top plane of the substrate so that the circuit fabrication and the position alignment could be simplified. The air bridges were bond-wired cross the feedline so that the leakage of the surface wave excited by the even mode of the CPW transmission line could be suppressed. In our experiment, the widths of the slot and feedline were fixed at 0.6 mm and 1 mm. The radius of the first outer slot was 31 mm. The schematic diagram of the proposed CPW-fed spiral slot antenna with the circularly microstrip stub at the end of the feedline is shown in Fig. 1(b). The inner parts including the feedline and the slot were replaced by the circularly microstrip stub. We changed the radius of the circularly microstrip stub to observe the variations of the lowest operated frequency to find the optimal radius.

III. Results and Discussion

Figure 2 presents the comparison of the measured reflection coefficients of the CPW-fed spiral slot antenna with the seven turns and one with the circular stub at the end of the feedline. The measured lowest operated frequency was successfully shifted from 1.60 GHz to 1.15 GHz, compared to the conventional CPW-fed spiral slot antenna with the seven turns. The reduction of the measured lowest operated frequency was 450 MHz. The radii of the original CPW-fed spiral slot antenna operated at 1.60 GHz and 1.15 GHz could be determined to be 31 mm and 43 mm by using the empirical formula $\lambda_L = 2\pi r_{\max}$. The ratio of the area miniaturization was about 48 %. Figure 3 presents the variations of the measured lowest operated frequency of the antenna versus the radius of the circularly microstrip stub. The optimum radius of the circularly microstrip stub was almost the half of the radius of the first outer slot. The finding was as same as the report proposed in [4]. Figures 4 present the measured radiation patterns of the CPW-fed spiral slot antenna with the circular stub. The power intensity of the cross-polarization radiations of the CPW-fed spiral slot antenna was as similar as one of the co-polarization radiations. The phenomenon might be attributed to the enhancement of the surface wave.

Acknowledgement

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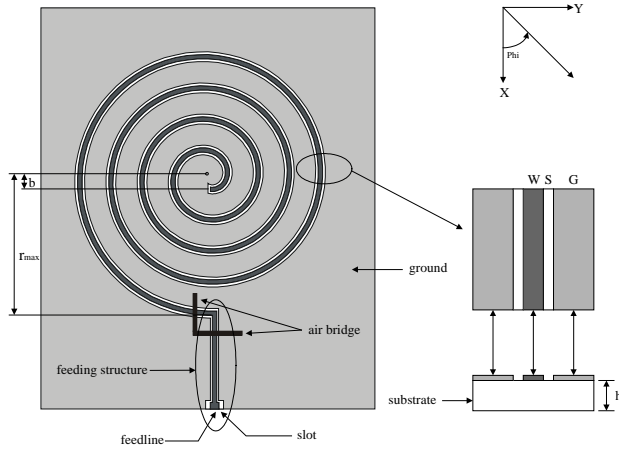


Fig. 1(a) The schematic diagram of the CPW-fed spiral slot antennas with the seven turns

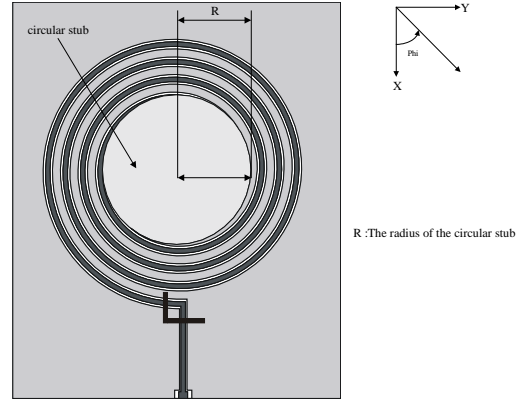


Fig. 1(b) The schematic diagram of the CPW-fed spiral slot antennas with the circularly microstrip stub at the end of the feedline

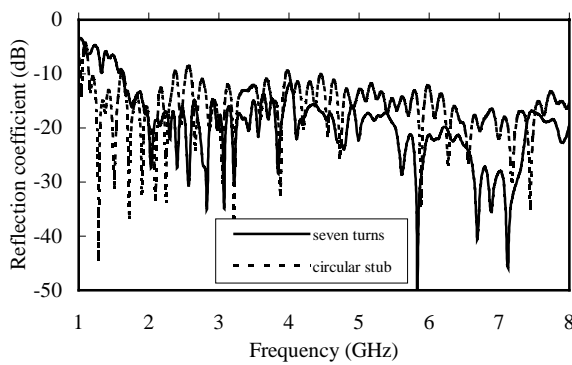


Fig. 2 The comparison of the measured reflection coefficients of the CPW-fed spiral slot antennas with seven turns and the circular stub at the end of the feedline

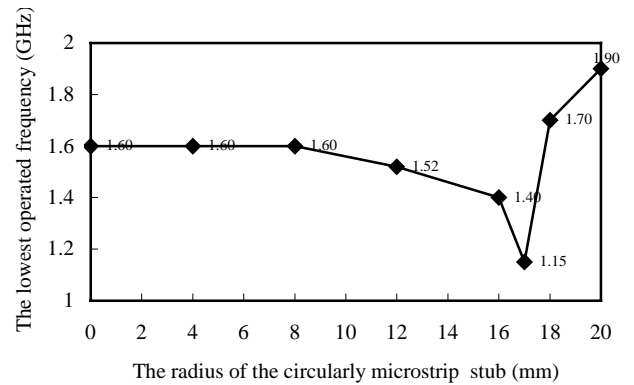


Fig. 3 The variations of the measured lowest operated frequency of the antenna versus the radius of the circular stub

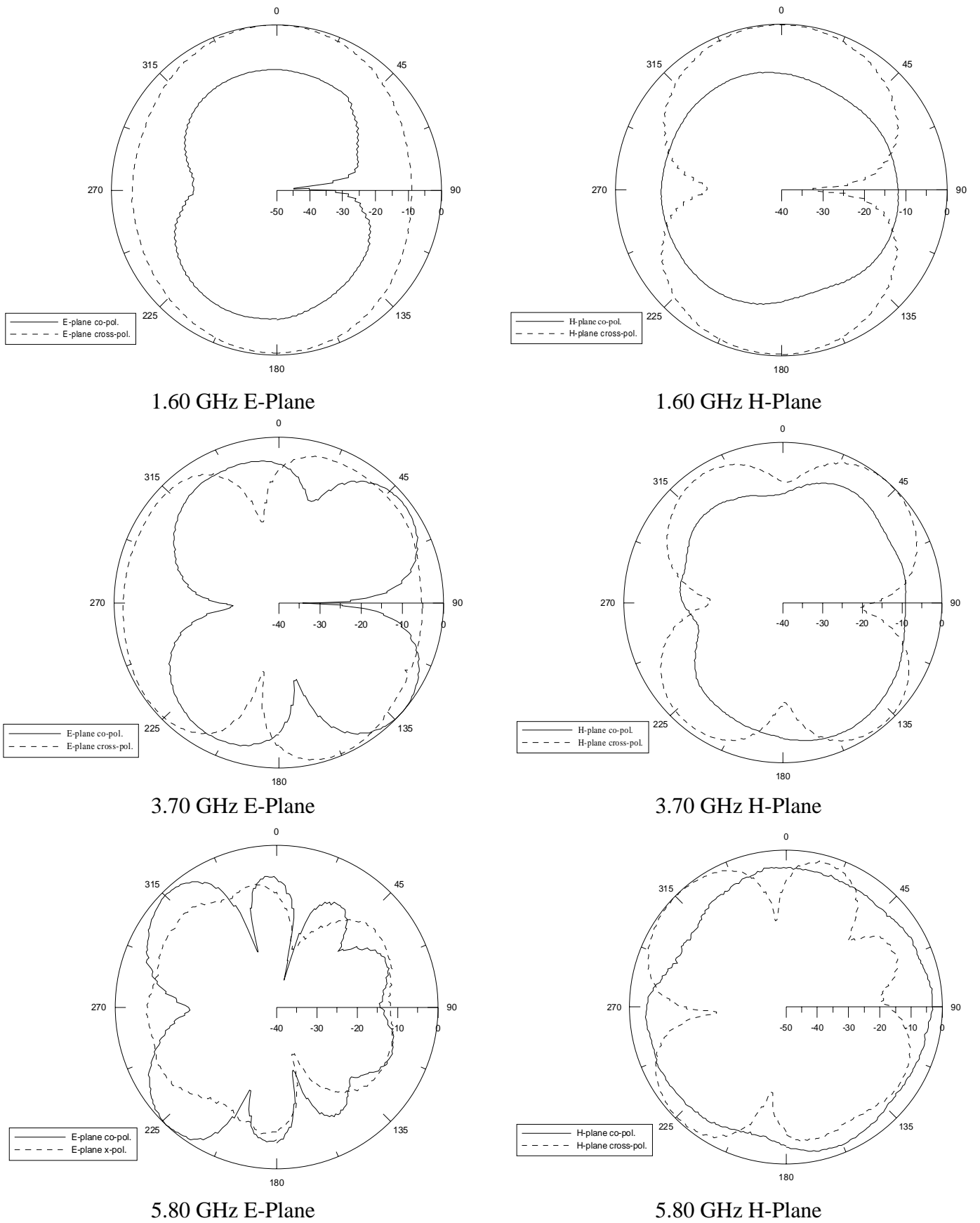


Fig. 4 The measured radiation patterns of the CPW-fed spiral slot antenna with the circular stub