A Low-profile Surface Wave Antenna with Bi-directional Beam Pattern Using Loop Element

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1 Introduction

A low-profile surface wave antenna using microstrip element has been proposed and has achieved to generate vertical polarization with bi-directional radiation pattern [1]. However previous antenna has side lobes in vertical plane. So, we proposed a low profile surface antenna using a loop element to decrease the side lobes at 0° degree in vertical plane resulting in radiating parallel direction to the ground plane.

2 Antenna Structure

Fig.1 shows the proposed antenna in this study. In this structure, total thickness is 3.2 mm, and the radius of the substrate is 30 mm. This dielectric substrate has a dielectric constant of 2.2. The square patch is 5 mm. We designed a loop element which has a dimension of w = 0.5 mm in width. Fig.2 shows current distribution of the proposed antenna. As seen from this figure, loop element length L is 2 λ g, where λ g is the wavelength in dielectric. Also, wavelength in free space λ, it is obtained by $\lambda = \lambda g \times \sqrt{\varepsilon r}$. So, we design the loop element length to be 57.79 mm, and width is 10 mm. This value has been designed so that the resonance frequency can be 7 GHz.

3 Simulation and Measurement Results

Fig.3 shows the simulated results of S_{11} characteristics about proposed antenna. Fig.4 shows the simulated results of radiation pattern about proposed and previous antenna [1] at each resonant frequency. As seen from this figure, the directional beams are strong radiated at both 0° and 180° degrees. However, the proposed antenna has a slightly strong radiation compared to previous antenna at 90° and 270° degrees on horizontal plane. On the other hand, the proposed antenna was able to decrease the radiation at 0° degree on vertical plane.

4 Conclusion

The proposed antenna has a bi-directional beam similar to previous antenna. Furthermore, the proposed antenna can decrease side lobes of vertical plane in the vertical plane to the ground plane by using loop element instead of microstrip element. As a future work, we should decrease the radiation at 90°and 270° degrees in the horizontal plane and at the 180° degree in the vertical plane.

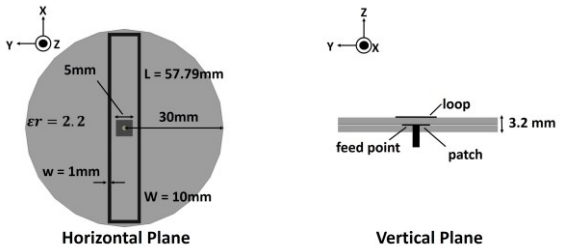

Fig.1 Antenna structure

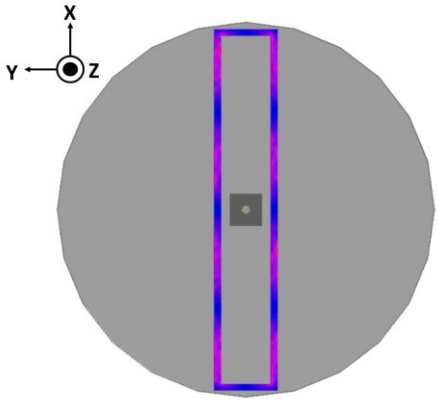

Fig.2 Current distribution

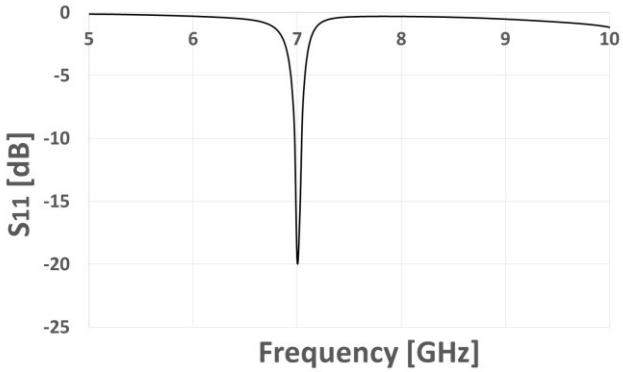

Fig.3 S11 characteristics

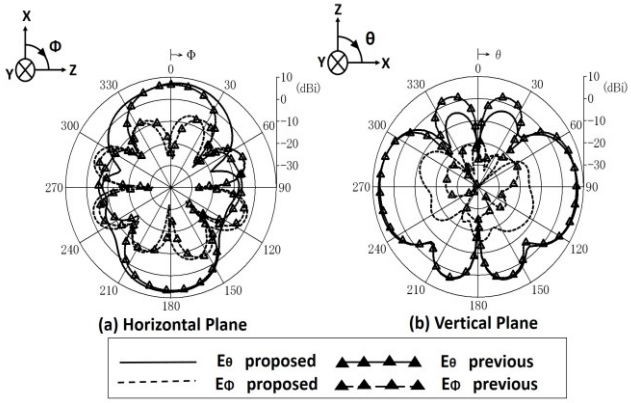

Fig.4 Radiation pattern

References

[1] Yuki Ogata and Takeshi Fukusako, “A low-profile antenna with bi-directional bean pattern using microstrip element”, Electromagnetic: Application and Student Innovation Competition (iWEM),2015 International Workshop on.