Omnidirectional Property Enhancement of Circularly Polarized Collinear Antenna Array

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1. Introduction

Omnidirectional circularly polarized (OCP) antennas take both the advantages of their unique radiation pattern and circular polarization (CP) characteristics. In this paper, we aim at improving the omnidirectional features of the omnidirectional circularly polarized collinear (OCPC) antennas by changing the open-ends of the loops. A ten-stage 4-side arrangement OCPC antenna array is presented as an example. The orientation of the loops are different along the array and roundness of the pattern is improved.

2. Antenna Configuration

The principle of generating CP by combining dipoles and loops is shown in Fig. 1(a), polarization of dipole and loop are orthogonal. Same amplitudes of E_θ and E_ϕ can be obtained by adjusting the current distributions on the two elements, resulting in a good CP property. The center-fed OCPC antenna array is formed by cascading several stages of electric (metallic strips) and magnetic (loops) radiators into a highly compact series-fed array. It seems like a Franklin antenna, but here the reverse current on the loop is used to present horizontal polarization. The length of the dipoles and loops are both half wavelength. It should be noted that the omnidirectional radiation pattern could be destroyed when uniform current distributions are obtained on the electric and magnetic dipoles. A ten-stage 4-side arrangement OCPC antenna array is presented as an example in Fig. 1(b) to solve this problem.

3. Antenna Simulation and Conclusion

The CP radiation patterns of 1-side and 4-side are shown in Fig. 2. It can be seen from Fig. 2(a) that the gain at ϕ = 0° and 90° in the horizontal plane shows an obvious difference, so that the radiation pattern is an ellipse. An excellent omnidirectional property is realized in Fig. 2(b). As a result shown in Fig. 3, although the maximum gain of the CP gain in 4-side case is reduced, the roundness is less than 1dB from 3.6 GHz to 4 GHz, which is far better than the situation when the loops are all arranged in one direction. So far, by arranging the loops in multiple sides, the poor omnidirectional property caused by the non-uniform current on loops can be effectively improved.

Acknowledgement

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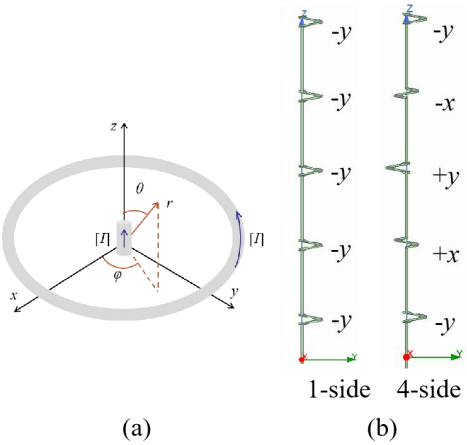

Fig. 1 Configuration of OCP antenna. (a) an ideal omnidirectional circularly polarized antenna combining dipole and loop. (b) the upper half of 1-side and 4-side models.

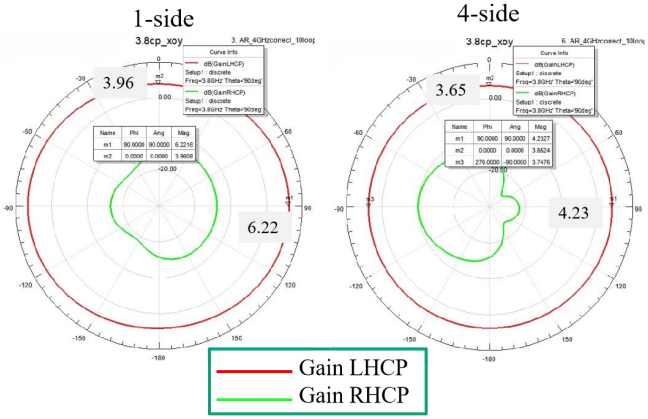

Fig. 2 Radiation pattern of 1-side and 4-side cases in horizontal plane at 3.8 GHz.

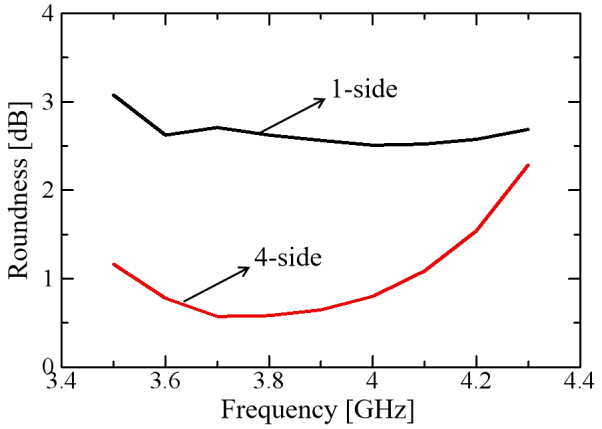

Fig. 3 The relationship between frequency and roundness.