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電磁結合型２周波共用円偏波三角形パッチアレーアンテナ

Dual-band proximity fed circularly polarized triangular microstrip array antenna with a truncated tip

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1. Introduction

Previously, a single-band left-handed circularly polarized (LHCP) proximity-fed equilateral-triangular array antenna with truncated tips for reception was developed in order to support the next generation of mobile satellite communications using Engineering Test Satellite VIII (ETS-VIII) [1]. ETS-VIII will conduct orbital experiments on mobile satellite communications at the S band frequency (2.50, 2.65 GHz). The targeted minimum gain of the antenna is set to 5 dBic and the axial ratio below 3 dB at an elevation of 48° in Tokyo area for applications of a hundred kbps. This time, a simple dual-band configuration of the array antenna both for reception and transmission is proposed. The array antenna consists of three equilateral-triangular patch antennas with a truncated tip for left-hand circular polarization (LHCP) each for reception and transmission unit. The array antenna was numerically investigated by using the method of moments (MoM) and the performances are discussed.

2. Structure of the antenna

Fig. 1 shows the configuration of the dual-band antenna. Each of the antenna elements is simply fed by proximity feeding with a microstrip line. The feed is attached to the 50 Ω transmission line by a step-width Δw. The step-width is set to 30° cut-angle for reactance compensation. A small triangular tip of surface area ΔS is cut in the triangular patch to ensure the effective excited patch surface current path in the *y*-direction is slightly shorter than that in the *x*-direction (element Rx1 in Fig. 1). It gives the *y*-directed resonant mode a resonant frequency slightly larger than that of the *x*-directed resonant mode. That is, the dominant mode of the triangular patch can be divided into two orthogonal resonant modes of equal amplitudes and 90° phase difference for circular polarization operation. Moreover, by shifting the microstrip line by l_f at the effective position away from the center of the patch, LHCP operation can be obtained. By considering the axial ratio performances, the length *c* obtained for reception and transmission is 21 mm and 16 mm, respectively.

3. Performance of the antenna

Fig. 2 represents the *S* parameter of the reception and transmission antennas. The *S* parameter is below -10 dB in the target frequencies both for reception and transmission antennas. The isolation of the closest patches to Rx1 (i.e. Tx1 and Tx3) satisfies the target less than 20 dB.

The beam of the antenna is generated by a simple mechanism that consists in switching OFF one of the radiating elements of each reception and transmission antenna. Here, the two fed elements theoretically will generate a beam shifted of -90° in the conical-cut direction from the element which is switched OFF. For example in the case of the reception antenna, when element #1 is switched OFF, the beam is directed towards the azimuth angle *Az*=0°. Then, the other two beams at *Az*=120° and *Az*=240° can be generated by switching OFF element #2 and #3, respectively. In the same manner, in the case of the transmission antenna the azimuth space can be scanned. Figs. 3(a) and 3(b) depict the radiation characteristics in the conical-cut direction at *El*=48° for each reception and transmission antenna. The minimum gain is 5 dBic over 120° for each beam both for reception and transmission antenna. In addition, the maximum axial ratio is 2.9 dB and 1.8 dB on the whole azimuth range each for reception and transmission antenna, respectively.

4. Conclusion

The design of a dual-band left-handed circular polarized (LHCP) single proximity fed equilateral-triangular array antenna with a truncated tip is proposed. The proposed antenna satisfies the specifications for ETS-VIII with a gain more than 5 dBic and an axial ratio less than 3 dB in the azimuth plane both for reception and transmission units by numerical simulations. In the next step, the antenna will be fabricated and measurement will be made to confirm the simulation results.

Reference

[1] Basari, *et al.*, "Proximity fed circularly polarized triangular microstrip array antenna with a truncated tip," *Proc. 2005 IEICE Society Conf.*, p. 69, Sapporo, Japan, Sep. 2005.

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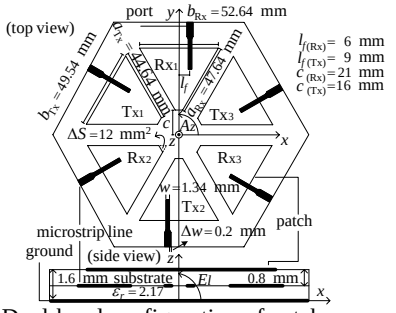

Fig. 1. Dual-band configuration of patch array antenna

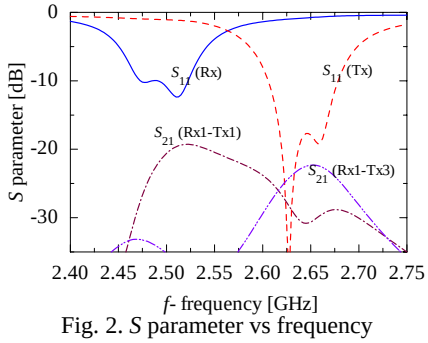

Fig. 2. *S* parameter vs frequency

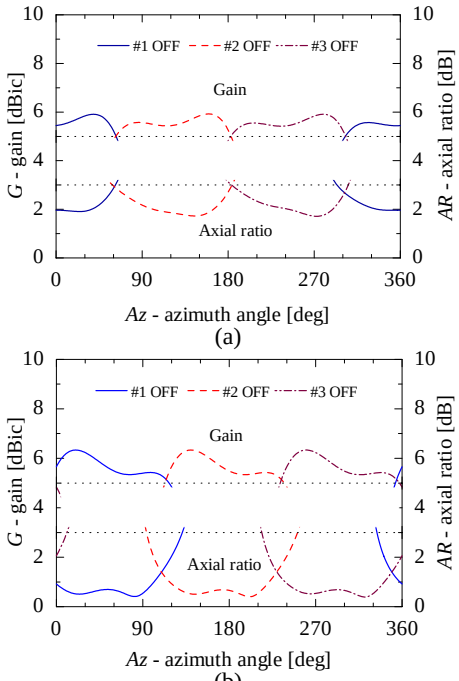

Fig. 3. Gain and axial ratio in the conical-cut plane at elevation angle *El* = 48° (a) Reception (b) Transmission