Measurement Results of Scanning Spot Beam Reflectarray Antenna

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***Abstract*— Conventional multi-spot beams and multi-scanning beams using a single reflector have been developed by combining the characteristics of a reflectarray antenna to change the beam direction according to the frequency and polarization. In previous studies, we showed the design method and analysis results of scanning spot beams, whose beam direction is changed by frequency in the elevation direction and by polarization in the azimuth direction. In this paper, the measurement results of the scanning spot beam reflectarray antenna fabricated based on the designed values are presented.**

Keywords—reflectarray; scanning spot beam; polarization; frequency

I. Introduction

In a multi-beam communication system with reflectarray antennas, a service area can be covered using a few mirror planes by changing the beam direction according to the polarization and frequency [1][2][3][4]. In this paper, we present the measurement results of a reflectarray fabricated using the design method discussed in a previous report [5].

II. Reflectarray Design

The mirror surface was fabricated using the design values obtained in a previous study [5]. The computer-aided design (CAD) figure of the mirror surface of the reflectarray with the respective elements is shown in Fig. 1.

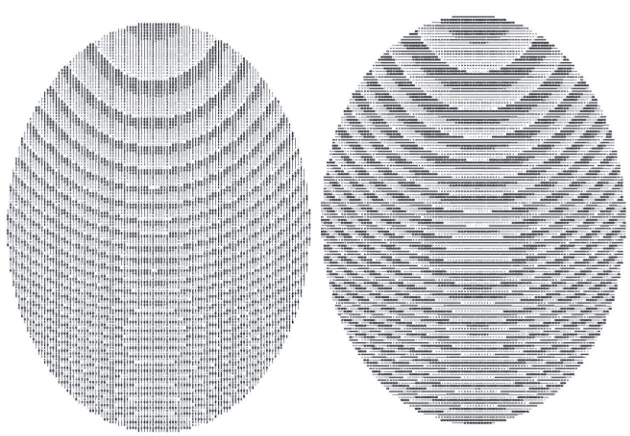

Fig. 1. CAD data of reflectarray

The opening diameter D was $41.2\lambda_0$. In Fig. 1, two CAD drawings are depicted; however, they become a single mirror surface because these are superposed on two layers. The image on the left of Fig. 1 is the V-polarization mirror surface, printed on the back of dielectric layer B. The image on the right is a mirror surface of the H-polarization, printed on the surface of dielectric layer B.

III. Analys Result

The contour map at 35 dBi is shown in Fig. 2. The analysis was performed using the aperture distribution method. It can be confirmed that the beam direction changes with frequency and polarization, efficiently covering the desired area (Fig. 2).

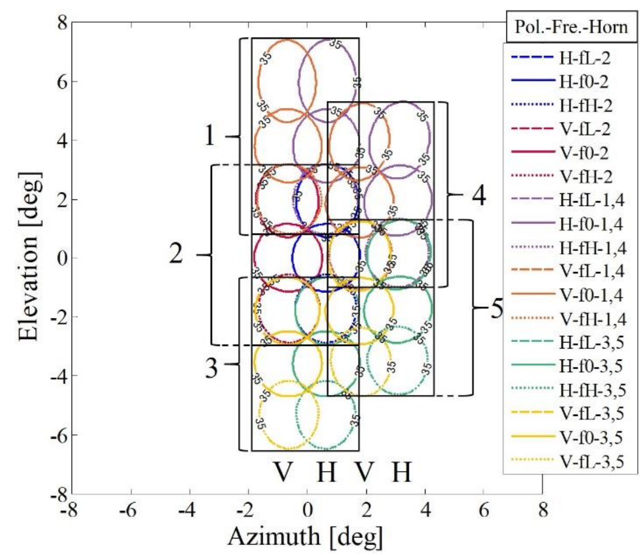

Fig. 2. 35dBi contour map

IV. Measurement Result

The measurement results are presented in terms of directivity gain. The radiation characteristics of V-polarization in the elevation plane are shown in Fig. 3, and those of the H-polarization are shown in Fig. 4. The beam directions at frequencies f_H and f_L were radiated ±1 beam width away from the beam at the center frequency. However, the directivity gain at a high frequency (f_H) of the H-polarization was low, probably owing to an element design problem.

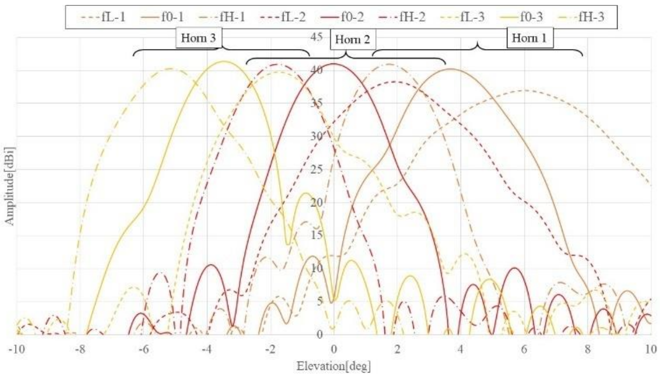

Fig. 3. Radiation patterns of V-polarization (Elevation cut)

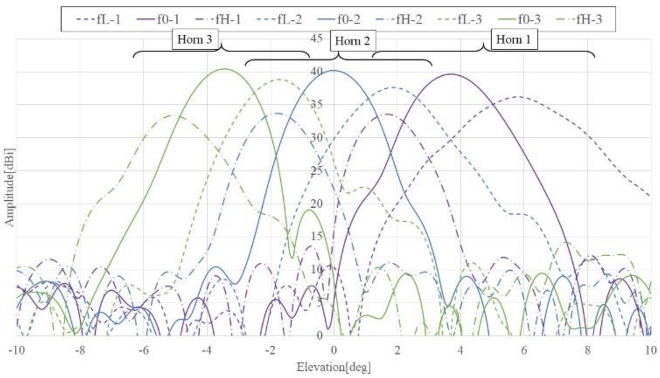

Fig. 4. Radiation patterns of H-polarization (Elevation cut)

The radiation characteristics in the azimuth plane (f_0) are presented in Fig. 5. The V-polarized beam was emitted in the −0.67° direction, and the H-polarized beam was emitted in the +0.76° direction. The V-polarized beam were generally consistent with the analytical results, but the H-polarized beam changed by +0.11° compared with the analytical results.

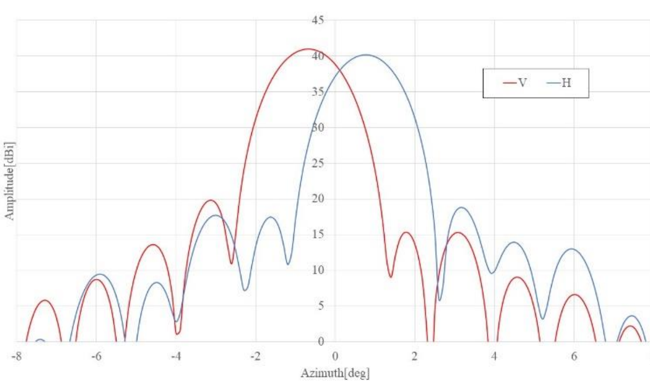

Fig. 5. Radiation pattern of f_0 (Azimurth cut)

The contour map at 35 dBi is shown in Fig. 6. The desired area was efficiently covered by a single reflectarray, as shown in the analysis results. However, the directivity gain at the high-frequency side (f_H) of the H-polarization was low for all five horns.

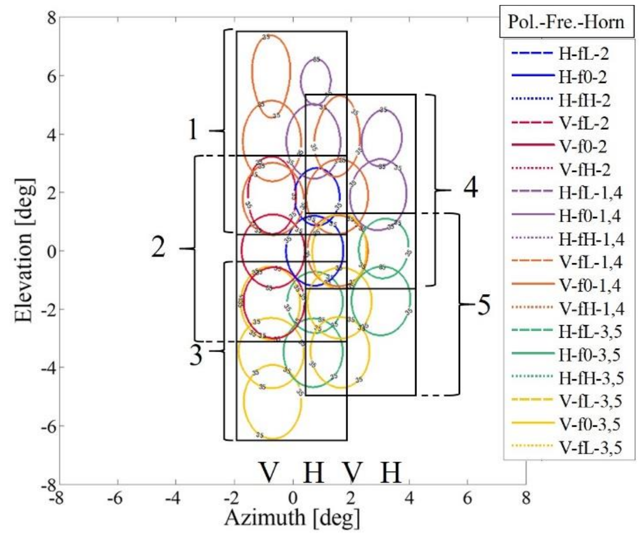

Fig. 6. 35dBi contour map

V. CONCLUSION

The results of a study on reflectarrays with different beam directions, depending on the polarization and frequency, are presented. The measurement results show that the beam changes with frequency in the elevation direction and polarization in the azimuth direction. Thus, it is feasible to cover the desired area efficiently with a single reflectarray.

In the future, we believe that the gain reduction in H-polarization is attributed to the element design. We plan to design a device that does not degrade the gain.

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