

Design of C-band 4.5-m² Flexible Reflectarray Antennas by Textile with Copper Pattern Plating

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Small satellite constellations are a promising platform for providing new applications in wireless communications and Earth observation. Reflectarray antennas are widely used due to their planar structure with high antenna gain characteristics. We have proposed a flexible membrane reflectarray which can be stored compactly (G. Nakayama, et al., “Space demonstration of two-layer pop-up origami deployable membrane reflectarray antenna by 3U CubeSat OrigamiSat-2,” in Proc. 37th Annual AIAA/USU Conference on Small Satellites, 2023, SSC23-WVIII-03). This paper presents the design results of a C-band 4.5-m² foldable reflector array antenna made of flexible textile with copper pattern plating to realize a large area antenna with a small stowage volume.

The reflectarray antenna is composed of a primary radiator and a reflectarray as shown in Fig. 1 (left). The primary radiator is a 2×2-element patch array with different beam width for E- and H-planes to illuminate the reflectarray efficiently with low spill over. The reflectarray has 3.2-m × 1.4-m aperture size and is composed of patch elements shown in Fig. 1 (right). The patch size and the slot length can control the reflection phase by 511 degrees. The reflectarray is composed of two flexible textiles, and the patch and ground are formed by copper pattern plating. These two layers are separated by 5 mm by Styrofoam, which is replaced by air with support structures in future. The reflectarray antenna is measured and the high realized gain of 38.5 dBi was confirmed as shown in Fig. 2.

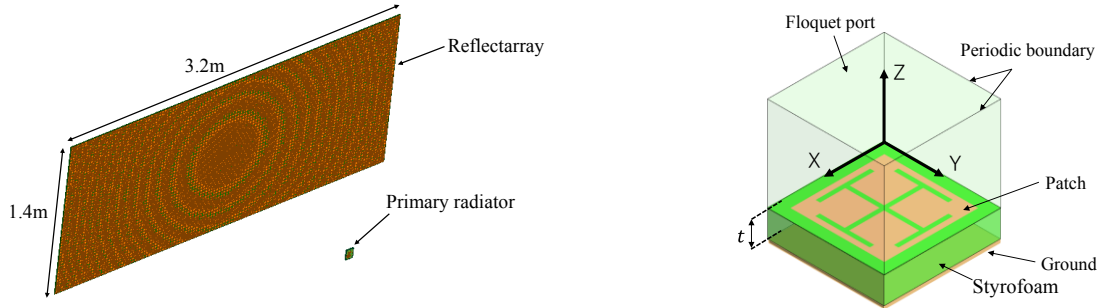


Figure 1. The C-band 4.5-m² flexible reflectarray antenna (left), the reflection element (right).

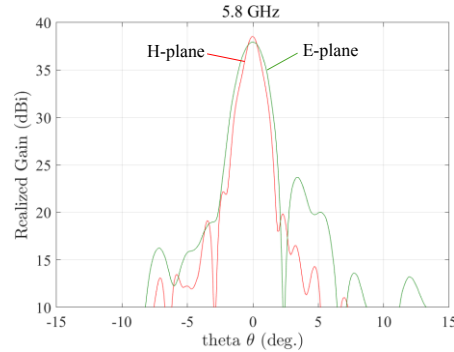


Figure 2. Measured radiation pattern at 5.8 GHz.

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