Paper ID: 84462
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IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advances in Space-based Network and Communication Technologies (7)

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MULTIPLE FOLDING ARRAY ANTENNA WITH HEXAGONAL PANELS FOR EFFICIENT USE OF ROCKET CARGO BAY

Abstract

Large aperture antennas are required for satellites of space communications, remote sensing and solar power generation. Due to the limitation of a cargo bay of a rocket vehicle, a large antenna should be often folded in launch phase. In a conventional deployable antenna, maximally 5 panels have been deployed on a flat plane in one-dimension. In order to overcome the deployment limitation, a multiple folding array antenna was proposed,which admits steps between square panels to deploy in two dimensions. However, square panels are easy to interfere with the inner diameter of a rocket cargo bay.

To avoid the aperture reduction due to mechanical interference, we propose hexagonal panels to be used in a multiple folding array antenna. Each panel has radiating elements in triangular arrangement, which has an excellent matching with hexagonal shape of a panel. However, hexagonal panels are more difficult than square panels, as the panels must be placed on vertical boards keeping steps between panels, and must be folded and deployed in a well-designed sequence. Also, several radiating elements may be missed due to the interference between edges of adjacent hexagons to degrade the radiation pattern. To confirm these issues, a mechanical model was fabricated using a 3-D printer. The mechanical and electrical characteristics are examined.

Mechanical design using simulation and a fabricated model antenna shows that a multiple folding array antenna with hexagonal panels can efficiently use a cylindrical space in a rocket cargo bay in launch phase. The proposed antenna can prevent failures in the complicated mechanism of conventional deployment. The radiation patterns are investigated by simulation. The antenna is assumed to have 7 panels,and 7 elements are installed on each panel. These radiating elements count to ideally 62, but 12 elements are missed. The radiation pattern with the lacks was calculated, and resulted in a circular main lobe and six circular side lobes, which can be supplemented by several means in a real application.

In conclusion, it was shown that the proposed antenna had a merit of efficient use of a cylindrical space in a rocket cargo bay by 30