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DEVELOPMENT OF A HIGH-DIRECTIVITY RECONFIGURABLE ANTENNA FOR SMALL SATELLITE COMMUNICATION APPLICATION

Abstract

As the small satellite revolution is triggering a new space race in the recent years, the requirements of communication between devices on Earth and satellites are significantly increasing. Various communication modes integrated in one single system on small satellite is becoming a challenge. In order to compatible with different communication modes, the reconfigurable antenna in space/frequency domain is becoming one of the core technologies. There is one common problem for the applications of satellite communication: with the increasing of devices on earth, the signal reception becomes almost impossible with low-directivity antennas. However, antennas typical with high-directivity often own fixed beam or frequency band. Reconfigurable antenna with high-directivity is seldom studied. To solve these problems, this paper proposed a lens-loaded reconfigurable configuration to realize antenna high-directivity reconfigurable in both space domain and frequency domain for satellite communication applications. The proposed lens-loaded reconfigurable antenna consists of a 3D-printed hemispherical lens and an array of frequency reconfigurable feed array located on its focal plane. This paper gives the overall structure and work principle of the high-directivity reconfigurable antenna. The antenna is simulated by full-wave EM software CST to estimate its directivity, beam scanning, and isolation performances. The directivity may range from 19dB to 23.6dB at two reconfigurable frequency bands, the beam scanning coverage of over 60is acheived, and the isolation between two feed ports is over 25dB. The analysis results show that the improvement of antenna directivity is over 17dB by loading hemispherical lens on the reconfigurable feed array, almost up to 50 times (in power) more than the average of the reconfigurable feed array. As a result, the numbers of the deployed antenna is reduced, allowing with better signal resolution, space coverage range and more communication device modes. The design issues, analysis processes and the potential applications on satellite communication of the proposed antenna are presented in detail. The proposed antenna could be a good substitution of phased array or conventional fixed-beam/frequency antenna for low-cost and high-directivity small satellite communication applications.