Closely Separated Dual-Band Reflectarray Design for Satellite Communications

Y. Mao*(1), F. Yang (1)(2), and Atef. Z. Elsherbeni(1)
(1) University of Mississippi, University, MS 38677, USA
(2) Tsinghua University, Beijing, China

The goal of this work is to design a planar reflectarray antenna to cover a dual-link satellite communication at Ku-band, 12.25 – 12.75 GHz for transmitting and 14 – 14.5 GHz for receiving, respectively. Dual-linear polarization is desired for both bands. Besides, a singler-layer design is targeted for the sake of simplified fabrication, reduced height and decreased loss.

For the design of a dual-band reflectarray on a single layer substrate, the traditional way is to have two sets of elements, each individually designed for one band. It works well when the two bands are separated far away from each other, because the coupling between neighboring elements is weak. However, in our design project, since the frequency ratio for the two bands is 1.14, which means the coupling becomes stronger and it is required that element bandwidth shall be narrow that the elements of the 1st band barely changed phases within the 2nd band, and vice versa. It has been shown that although somehow a closely separated dual-band reflectarray could be achieved in this way, the element's bandwidth is too narrow to meet the 0.5 GHz requirement for each band.

A novel method, dual-band phase synthesis method, is presented here. By minimizing the total phase error generated from all of the elements, which is the difference between required and achievable phase, a good far-field performance could be obtained at the center frequencies of both bands. Since only one set of elements was used by this method, the coupling problem in the traditional method is not an issue in the current design. As long as the element is properly selected, a dual-band reflectarray achieving 0.5 GHz bandwidth for each band could be realized.

Not only a dual-band reflectarray could be obtained, by choosing an element with wider bandwidth, a wide-band relfectarray can also be designed with this method for a bandwidth large enough to cover both required bands. Comparison of traditional method and the novel method presented here, as well as the bandwidth performance with narrow and wide band elements, will be shown in the presentation.