Array Radiation Pattern Optimization by Antenna Reactive Loading

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The aim of this work is to design an antenna array consisted of overlapped subarray in a wat to achieve maximum subarray directivity. The main idea of the paper is to use reactively loaded subarrays consisting of a small number of directly fed radiating elements surrounded by passive parasitic elements. The array overlapping is achieved thanks to parasitic elements shared by adjacent subarrays. This, in turn, increases the effective aperture of the individual subarray while keeping its physical aperture unaltered. In this way the overall size of the antenna array can be reduced. The additional advantage of the proposed design concept consists in a significant reduction of the complexity of the distribution network.

An array based on overlapping subarrays with high aperture efficiency will be presented for the first time during the forum. The array is designed by using waveguide technology, by virtue of the large power handling, and resistance in harsh outer space environment. In the proposed antenna array configuration, only the central waveguide element of each subarray is fed, whereas all the other elements are passive, and load the active one reactively, in order to maximize the aperture efficiency. To this end, short circuits are properly positioned along the parasitic waveguides {*S. P. Skobelev, Phased Array Antennas with Optimized Element Patterns. Artech House, 2011*}. In this way, one can control the phase of the secondary electromagnetic field contributions scattered by the parasitic waveguide elements. A dedicated optimization design procedure for the considered class of antenna arrays has been developed and validated in the framework of the proposed research study. The adopted optimization algorithm is a hybrid combination of the local optimization technique and a heuristic method, that can address multiple design goals relevant to the radiation properties, as well as the impedance matching characteristics of the structure. Using said design procedure, antenna subarrays with high directivity and efficiency have been synthesized for applications at 20GHz. The results of the proposed research study will be presented during the upcoming forum.