Improvement the Bandwidth of Microstrip Reflectarray Antenna for Use in Microsatellites

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The advantages of microstrip reflectarray make it attractive for use in microsatellites to replace the conventional parabolic reflector antennas.These advantages are low profile, low volume and mass, easy deployability, scannable beam, low manufacturing cost, ability of dual and circular polarization, and dual band frequency. However, the main disadvantage of this antenna is its limited bandwidth.

There are two main methods for design and analysis of the microstrip reflectarrays. In both of them , the first step is to calculate the phase required for each microstrip patch element for a desired main beam angle. In one method the reflectarray is implemented by identical patches and the desired phases can be realized by varying the length of microstrip stubs (open or short circuit) attached to the patches (J. Huang, Proc. ISAP 96, Chibo, Japan, 1177-1180, 1996). In another method the phases can be realized by an array with variable size microstrip patches. Full wave analysis of infinite arrays and the method of moment are then used for element phase determination (D. M. Pozar, S. D. Targonski and H. D. Syrigos, IEEE- AP-45, No. 2, 287-296, Feb. 1997).

In this paper it is proposed to combine the two methods. The reflectarray antenna is a n×n microstrip patch elements planar array which reflects the incident fields radiating from a feed antenna.Each patch element introduces a phase change to the scattered fields.At first it is determined the phases required to be made by patches for radiation in a desired direction. These determined phases are implemented by varying both the size of patches and the length of attached stubs. A full wave analysis consisted of modeling an infinite array by Spectral Domain Electric Field Integral Equation (SDEFIE) implemented to determine the phase shift effect of each stub loaded microstrip patch in the reflectarray. The Method of Moment is used for solving the SDEFIE and obtaining the current distribution on patch elements and open ended stubs. This current distribution is used for determining the far field radiation pattern of the reflectarray. The shape of open ended microstrip stubs are optimized by Least Square Method to improve the bandwidth characterestics of antenna.

In this way , it can be used the advantages of both methods mentioned above and omit the constraints of the antenna bandwidth.