Abstracts

A Discrete Point Approach to the Measurement of Radiated Power of Planar Apertures

A.C. Kak. "A Discrete Point Approach to the Measurement of Radiated Power of Planar Apertures." 1972 Transactions on Microwave Theory and Techniques 20.1 (Jan. 1972 [T-MTT] (Special Issue on Automated Microwave Measurements)): 74-81.

It is shown that for a high-gain circular aperture with linearly polarized and rotationally symmetric excitation the total real radiated power can be expressed as a weighted sum of radiation intensities in N direction, where N is equal to the first integer greater than 2.14D lambda. D lambda is the diameter of the aperture in wavelengths. In an N-point measurement scheme the N directions and the weights involved in the weighted sum of radiation intensities are completely independent of the parameters of the radiation system and can be obtained from the well-known and tabulated properties of the Legendre polynomials. The criterion that N be equal to the first integer greater than 2.14D lambda is independent of any specific distribution in the aperture so long as it is of the type parabolic-on-a-pedestal. Such aperture distributions satisfy most needs and cover typical behavior of actual dish antennas. Even though the result of the theoretical formulation is that the above mentioned criterion for N holds good only for high directivity apertures, computational results show that for D lambda as small as 5 the error involved when N satisfies this criterion is less than 0.02 percent, and for D lambda equal to 7 the error reduces to 0.005 percent. This not only indicates that the criterion that N be equal to the first integer greater than 2.14D lambda holds good even for small values of D lambda, but it also shows the rapid decrease of error with increase in D lambda. A knowledge of the total radiated power is required for the determination of gain and radiation efficiency of an aperture. The discrete point approach to the measurement of total radiated power eliminates the need for using the conventional method of graphical integration of radiation patterns for the determination of the total radiated power. The method of graphical integration has been known to give erroneous results for high-gain apertures. Measurement of radiation intensities in the fine sidelobe structure is another source of error in the conventional method. In the discrete point approach the directions in which the radiation intensity need be measured tend to cluster around the normal to the aperture. This means fewer measurements in the fine sidelobe structure.

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