A METHOD USING FOCAL PLANE ANALYSIS TO DETERMINE THE PERFORMANCE OF REFLECTOR ANTENNAS

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Array feeds for reflectors have a number of important uses which include 1) generating contour coverage patterns, 2) correction for reflector distortions, and 3) improved wide angle scan. Typical methods for optimizing the array feed for each of these applications are very efficient when a fixed array geometry is utilized and only the feed excitation coefficients ate optimized since only one set of radiation integral evaluations is needed. For most existing methods, an optimization which allowed the element type, spacing, and size to vary would be extremely time consuming since a radiation integral evaluation would now be required for each feed element at each step of the optimization process.

A new method for computing the performance of' reflector antennas with array feeds is presented that obviates the need to recompute the reflector radiation fields when the feed element type, size, or spacing is varied. This allows the optimization techniques to efficiently include size and spacing as parameters.

The mathematical formulation is based upon the use of the Lorentz reciprocity theorem, which convolves the focal plane distribution of the reflector system with the feed element aperture field distribution to obtain the element response. The antenna gain can then be obtained from both these responses and the array gain. Thus the time consuming reflector system radiation integral evaluation is only done once for a given scan direction or reflector surface distortion for all array feed geometries considered. The study was restricted to the case where the antenna is illuminated by an incident plane wave and thus the performance evaluation was restricted to only one observation direction. optimizing shaped antenna patterns would require making the correct transformation between the far-field pattern and the focal plane distribution.

Examples are given using this technique to design an array feed for the correction of gravity-induced distortions of a large dual-shaped ground antenna, both conventional and beam waveguide (BWG), as well as the design of an array feed for improved wide-angle scan.