A Simple Modeling of Aperture of Reflector Antennas Using LINPLAN

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1. Introduction

The reflector antenna systems have been the most used high-gain solution over the last decades, especially in radio communications. Considering this fact, there are not many available commercial user-friendly software packeges for this application.
In order to overcome this lack of suitable analysis software, a quick method to calculate radiation characteristics of this antenna systems is developed. This method is based on the analogy with planar antenna arrays. A suitable tool for such analysis is found in the software package of *LINPLAN* [1].

This PC-based software, developed in Institute *IMTEL*, enables analysis and design of arrays of lossless elements arbitrarily arranged in space and uniformly oriented. This program also enhances the comprehensive analysis of two-dimensional planar arrays.

2. Concept and calculation method

A simple concept and realization of the antenna system for radio link operating at 13GHz band is presented in this paper. In order to reduce axial dimension of antenna and avoid expensive self-supported waveguide feeds of swan-neck type, dual-reflector antenna system of *Cassegrain* type is chosen. As a primary feed, linearly polarized, conical dual-mode horn with very symmetrical radiation pattern in E and H plain, is used. Diameter of primary paraboloidal reflector is 0.9m to achieve required gain of about 38-39dBi. Parameters of hyperboloidal subreflector such as: diameter, eccentricity, interfocal distance are calculated using criteria for minimum blockage and basic principles of geometric optics[2].

The *LINPLAN* program includes various pattern functions of real and hypothetical radiating elements, as well as an impressive capability in generating amplitude distribution. By selecting a proper option, user can define his own amplitude distribution. It can be done by generating a file with amplitude distribution and using that file as an input for *LINPLAN*. To calculate far-field pattern, aperture of reflector antenna is represented as two-dimensional array, as it is shown in Figure 1.

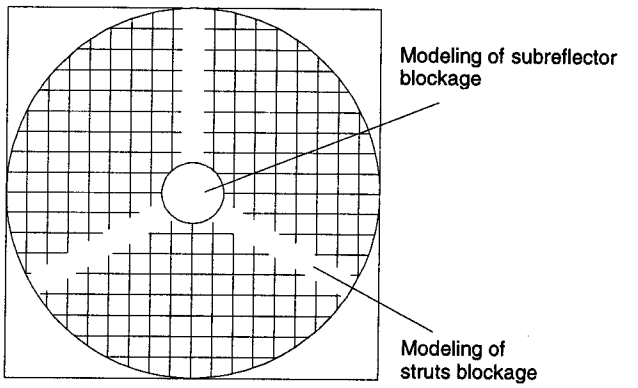

Figure 1. A model of aperture of dual reflector antenna system using planar arrays

The planar array consists of 79×79 isotropic radiators. Distance between the radiators is $\lambda/2$. Circular aperture of the antenna and blockage of the subreflector are achieved by amplitude distribution of $|Ai,j|=0$ within the circle that represents the blockage of subreflector as well as outside the circle that represents the main reflector. Between these two regions, the amplitude distribution is given as $|A|=G(\theta,\varphi)\cos^2(\theta/2)$ using the concept of equivalent parabola [2]. $G(\theta,\varphi)$ is approximated pattern of primary feed, which is given by $2(n+1)\cos^n\theta$ where $n=18$ in this particular case [5]. Amplitude distribution of the aperture surface covered by struts is also zero (Fig.1).

3. Results

Figure 2. shows results of the analysis. Data are given in comparison with the results computed by numerically integrating the free-space dyadic Green's function corresponding to the physical-optics approximation of the surface currents induced on the parabolic surface [3][4]. Both analyses gave similar results.

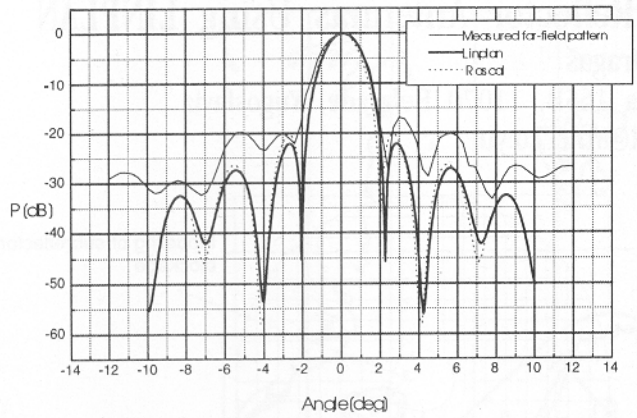

Figure 2. Comparison of the results in H-plane pattern

Also, Figure 2 features measured far-field pattern. Increasing side-lob levels can be noticed, which is due to phase errors resulting from the influence of undesirable reflection from surrounding objects. The shape of main beam and the position of side-lobs are in accordance with the calculation. Figure 3. shows antenna system which is designed using the described analysis.

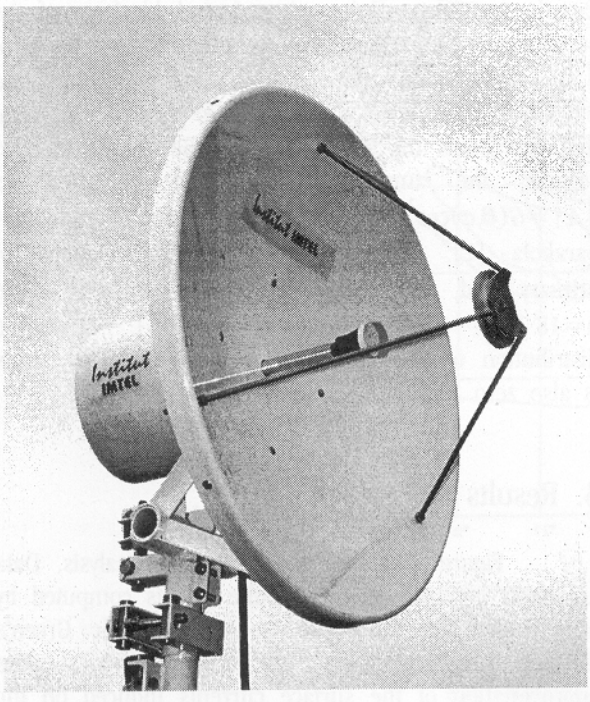

Figure 3. Radio link operating at 13GHz band developed in Institute IMTEL, with dual-reflector antenna system

3. Conclusions

Modeling of the aperture described above gives useful results for prediction of far-field pattern. The method is quick and simple. Influence of subreflector and struts blockage on decrease of directivity can also be investigated. By creating a proper amplitude distribution, influence of actual antenna system elements can be taken into consideration. Disadvantage of this method is impossibility of cross-polar characteristics calculation.

4. Acknowledgments

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5. References

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