PATTERN PREDICTION BY THE UTD FOR A FILL-IN ANTENNA ON A SATELLITE

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ABSTRACT: This paper deals with the application of the UTD method for predicting the radiation pattern of a fill-in S-band antenna mounted under a satellite.

The computed patterns are compared with the measured data and a good agreement is found.

INTRODUCTION

When we mount an antenna on a satellite, the most important effects are the reflections and diffractions by the faces and edges of the structure illuminated by the antenna. These effects can become impotant and degradate the requirements of coverage.

In the last years the Uniform Geometrical Theory of Diffraction (UTD) [2], [3], has been largely used for predicting the pattern degradation of antennas mounted on structures which are large in terms of wave lengths.

A computer program, based on the UTD, for predicting the radiation pattern of the TT and C antennas on the HIPPARCOS satellite has been developed. HIPPARCOS will include two S-band antennas, a main cardioid antenna 1 and a fill-in antenna to get full spherical coverage.

This paper deals with the fill-in antenna on satellite.

A model simulating the main contributions of the actual structure has been measured and compared with de computations, of the mathematical model, by employing the UTD.

DESCRIPTION OF THE MODEL

The mock-up of the model and ray tracing for a far field direction is shown in figure 1. The antenna is a S-band log-periodic antenna, which is able to provide a coverage of - 4 dBi up to ± 85º from its axis (Fig. 2).

It operates with circular polarization on axis. The phase center of the antenna is represented by O' in the figure 1.

The ray tracing shows the different kinds of rays, which

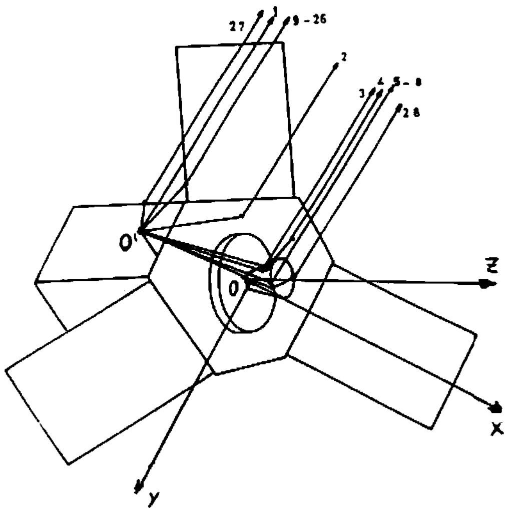

Fig. 1.- Mock-up and ray tracing.

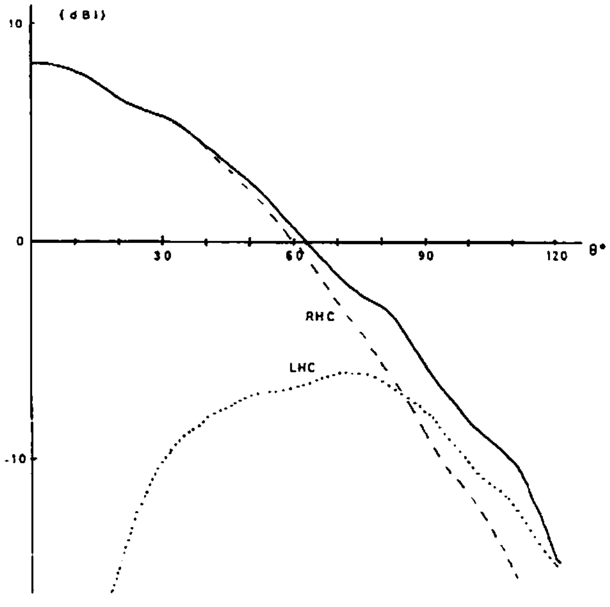

Fig. 2.- Fill-in antenna pattern.
f = 2.241 GHz.

contribute to the total field.

1.- Direct ray.

2.- Reflected ray on platform.

3.- Reflected ray on ABM.

4.- Doubly reflected ray on ABM and platform.

5,8.- Diffractes rays by ABM edge.

9,26.- Diffractes rays on platform edges and solar panels edges

27.- Diffractes rays by edges of vertical plates.

28.- Doubly diffracted ray on ABM edge.

The calculations are based on the UTD |2|, |3|. The contributions from the corners are considered according to |4|. For the computation we supose a rotationally symmetric pattern from the isolated antenna.

RESULTS AND CONCLUSIONS

The φ = 90º, 270º and 330º planes have been computed and compared with the measurements. They are shown in figures 3, 4 and 5, where we have represented the directivity for the main polarization.

In the φ = 330º plane, (figure 5), considered as the worst case, we can see a minimum before θ = 70º. This minimum must be controlled in or-

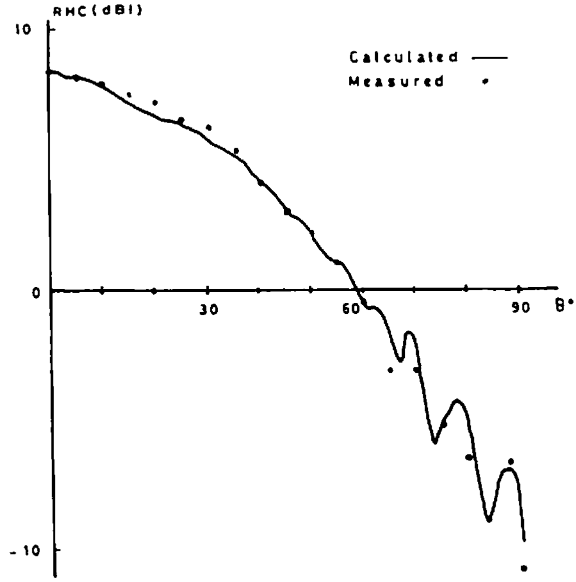

*Fig. 3.- Partial directivity with structure. ϕ = 90º.
f = 2.241 GHz.*

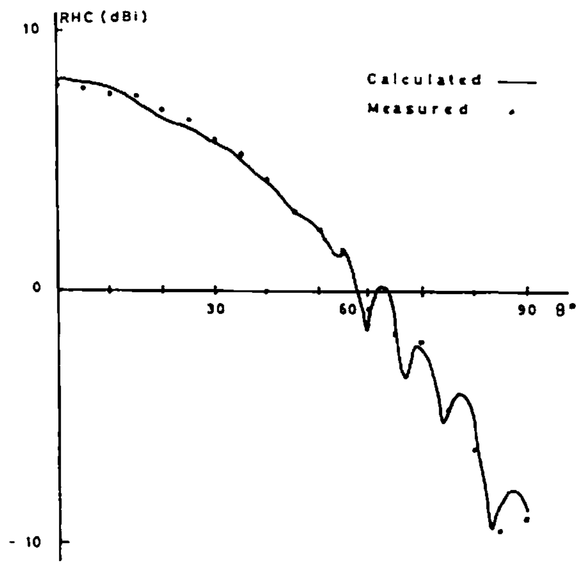

*Fig. 4.- Partial directivity with structure. ϕ = 270º.
f = 2.241 GHz.*

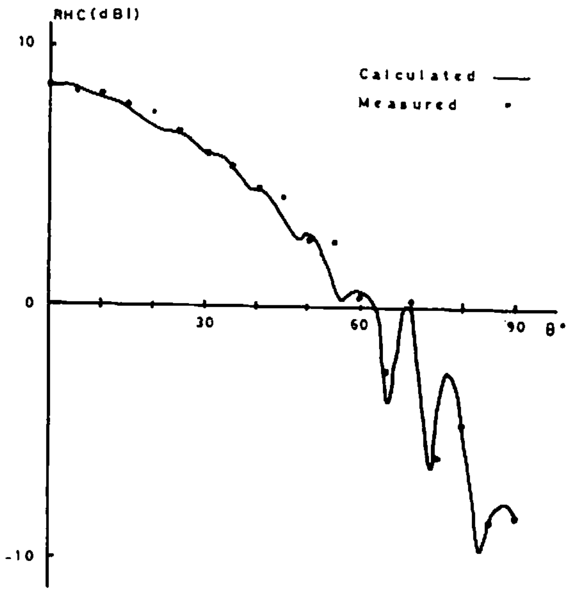

Fig. 5.- Partial directivity with structure. φ = 330º.
f = 2.241 GHz.

der to get a coverage of - 6 dBi up to ±70º for the main polarization.

REFERENCES

|1|.- *M. MARTINEZ, R. VILLAR and J. TORRES. "Pattern prediction for S-band antenna on a polyhedrical satellite", JINA' 84, Nice, nov. 1984.*

|2|.- *R. G. KOUYOUMJIAM and P. H. PATHAK. "A uniform geometrical theory of diffraction for an edge in a perflecty conducting surface". Proc. IEEE, 62, 1974, pp. 1448-61.*

|3|.- *R. G. KOUYOUMJIAM. "The geometrical theory of diffraction and its applications", in "Numerical and asymtotic techniques in electromagnetics" of R. MITTRA, New York-Springer-Verlarg, 1975.*

|4|.- *N. C. ALBERTSEN. "A study on radiation pattern prediction for high frequency satellite antennas". Estec-contract nº 2290/74, oct. 1975.*