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 mea-
sured 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 ed
ges 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 Diffrac
tion (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 ra
diation pattern of the TT and C antennas on the HIPPARCOS satelli
te 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 s-
tructure 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 di
rection 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.
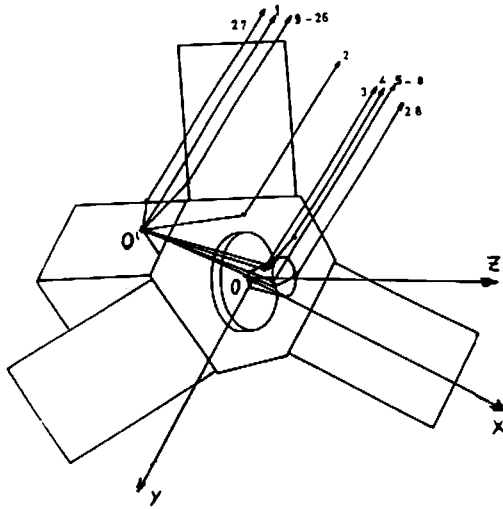
The ray tracing shows the different kinds of rays, which
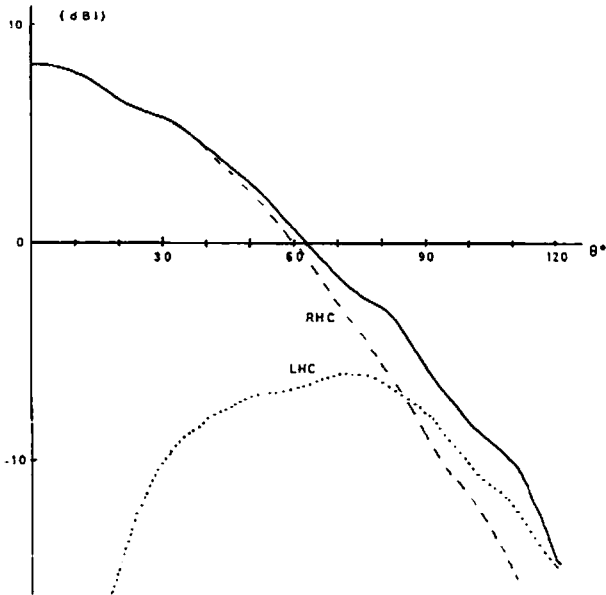
Fig. 1.- Mock-up and ray tracing.

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

contribute to the total field.

1.- Direct ray.

2.- Reflected ray on plat_form.

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 a_re based on the UTD |2|_ |3|. The contributions from the corners are con_sidered according to |4|. For the computation we supose a rotationally sym_metric 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 ha-ve represented the direc_tivity for the main pola_rization.

    In the ϕ = 330º pla_ne, (figure 5), conside-red as the worst case, we can see a minimum before θ = 70º. This minimum must be controlled in or-
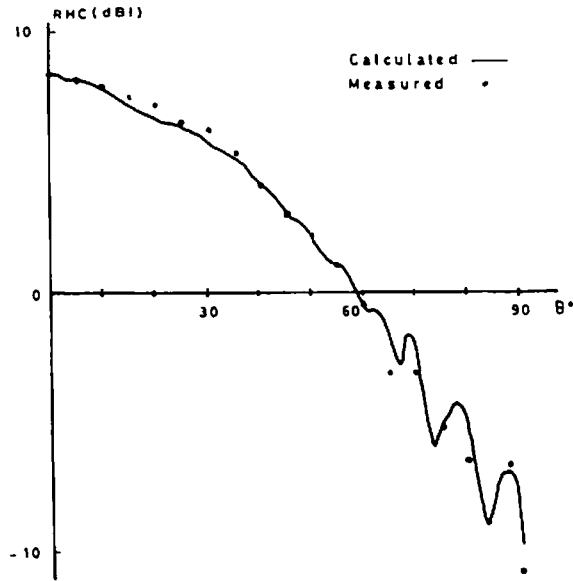
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·Fig. 3.- Partial directivity with structure. φ = 90º.
f = 2.241 GHz.

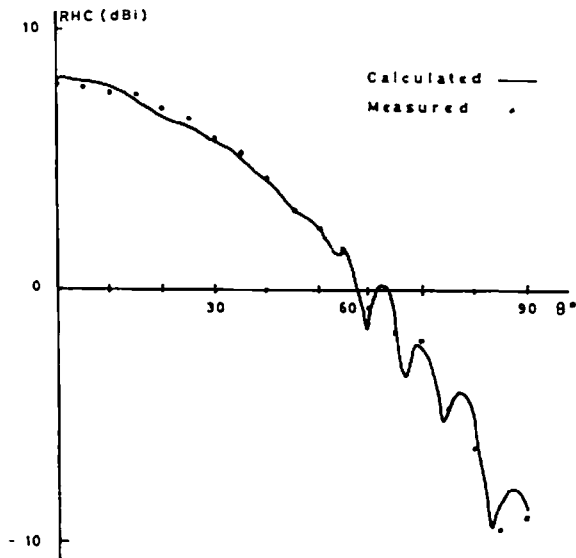·Fig. 4.- Partial directivity with structure. φ = 270º.
f = 2.241 GHz.

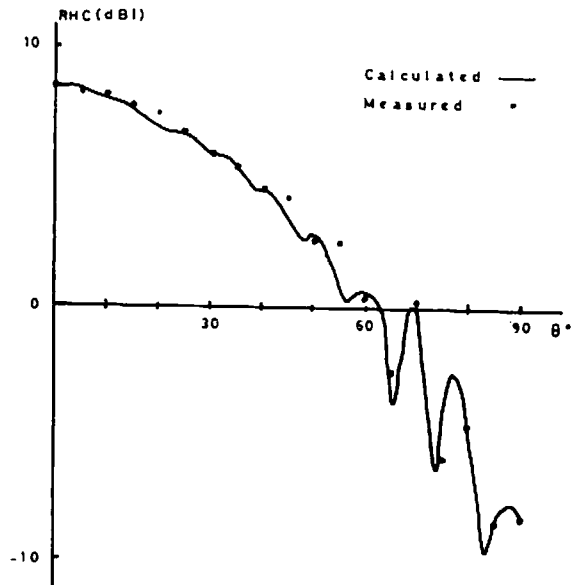*Fig. 5.- Partial directivity with structure. φ = 330º.*
  f = 2.241 GHz.

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

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 asumtotic techni-
      ques 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.