Publicações em Antenas

Number 11 | February 2013

On the Design of Reflector Antennas for Cosecant Squared Power Pattern

Jose R. Bergmann

F.J.V.Hasselmann

Publicações em Antenas

Number 11 | February 2013

On the Design of Reflector Antennas for Cosecant Squared Power Pattern

Jose R. Bergmann

F.J.V.Hasselmann

CRÉDITOS

Publisher:
MAXWELL / LAMBDA-DEE
Sistema Maxwell / Laboratório de Automação de Museus, Bibliotecas Digitais e Arquivos
http://www.maxwell.lambda.ele.puc-rio.br/

Editor:
Jose Ricardo Bergmann

Capa:
Ana Cristina Costa Ribeiro

ON THE DESIGN OF REFLECTOR ANTENNAS FOR COSECANT SQUARED POWER PATTERN

J.R. Bergmann and F.J.V.Hasselmann
CETUC-Center for Telecommunications Studies of the Catholic University,
Rio de Janeiro, RJ 22453-900, Brasil

INTRODUCTION

The characteristics of a reflector antenna radiating omnidirectionally in azimuth with a cosecant-squared power pattern in vertical planes, as intended for point-to-multipoint services in the millimetric wave range and comprising a single circularly symmetrical shaped reflector surface fed by an axial horn, were presented in [1], as an alternative to configurations reported elsewhere, involving nodal stations with up to four antennas for quadrant sectors coverage [2] or dual reflector arrangements for omnidirectional coverage [3]. Reported results, considering a rigorous feed model for the constructed prototype, then highlighted the main features of the proposed design. The present work extends the previous investigation by considering the effect of employing larger feed apertures yielding more collimated primary fields, with a view towards synthesizing more compact reflector surfaces.

ANTENNA DESIGN AND RESULTS

The antenna design explored herein comprises a single conically shaped reflector surface of revolution fed by an axial horn placed below the reflector and pointing towards the zenith, thus resulting in a horizontal reflector with spillover energy directed above the horizon line. The reflector surface generatrix is first synthesized according to Geometrical Optics (GO) postulates for a cosecant squared secondary antenna pattern in the vertical plane, so as to account for free-space attenuation between base station and receiver ends, while concentrating energy below the horizon line for reduced interference. The resulting surface is then used as an initial solution to the more comprehensive Physical Optics synthesis, involving the minimization of an objective function descriptive of the difference between PO-obtained and specified cosecant-squared power patterns in the main coverage region. As stated above, a larger feed aperture was employed so as to radiate a narrower primary lobe onto the reflector, allowing the use of a more compact reflector surface. Fig. 1 compares the feed pattern of the present configuration and that previously investigated [1], revealing that larger edge illumination levels may now be responsible for otherwise reduced diffraction as well as spillover effects. Nevertheless, a reflector diameter reduction (of almost 50%) to 20λ was now possible as revealed in Fig. 2 where both previous and present geometries and corresponding ray structures are illustrated. The resulting antenna radiation pattern shows, in comparison to the previous one as depicted in Fig. 3, not only a enhanced spillover sidelobe distribution above the horizon line but also a more explicit interference (diffraction caused) pattern in the main coverage region, as introduced by feed bak-scattering effects and higher edge diffraction on the reflector itself. As in the previous study, the interference caused by feed back-scattered energy may be alleviated by placing a corrugated flange in the feed aperture; optimized feed designs and corresponding effects are presently under consideration.

REFERENCES

[1] J.R. Bergmann, F.J.V. Hasselmann and M.G.C. Branco, "A shaped reflector antenna for mobile communications", IEEE AP-S Int. Symp. Digest, 1999.

[2] J.R. Bergmann and F.J.V. Hasselmann, "Considerations on the design and analysis of a shaped reflector antenna for nodal stations in metropolitan areas", Proc. 9th IEE Int. Conf. Antennas Propagat., vol. 1, pp. 195-198, 1995.

[3] M. Orefice and P. Pirinoli, "A dual reflector antenna for omnidirectional coverage", IEEE AP-S Int. Symp. Digest, pp. 274-277, 1993.

ACKNOWLEDGEMENT

This work was supported by Financiadora de Estudos e Projetos under Covenant FINEP 41.96.0901.00-PRONEX.

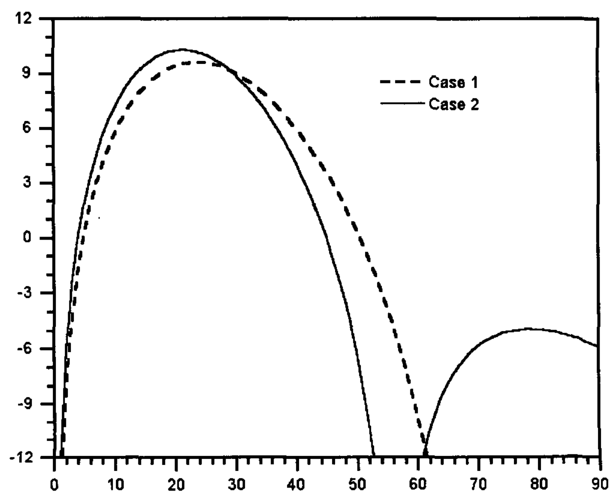

Fig 1 - Feed primary patterns

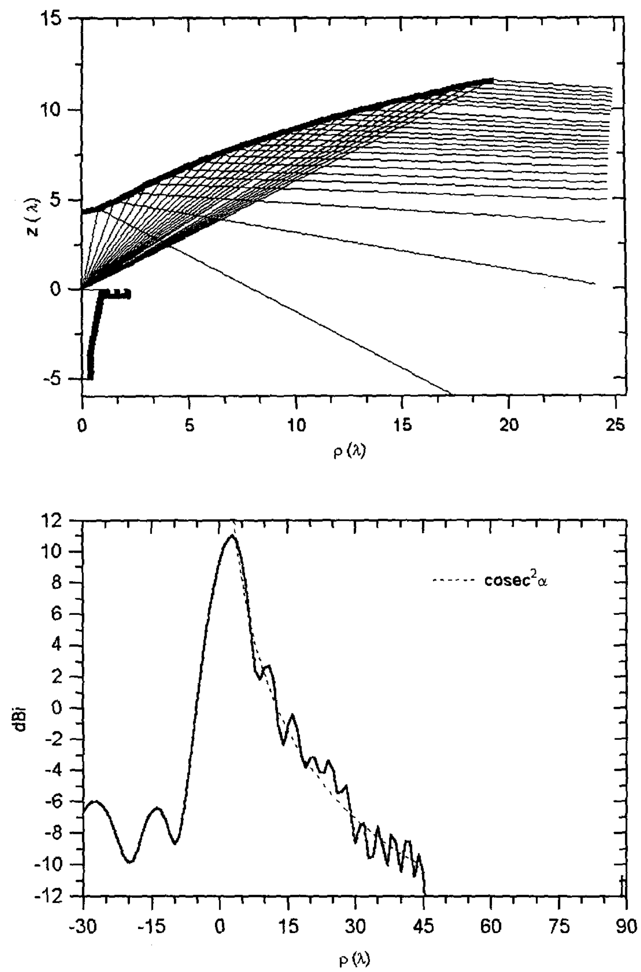

Figure 2 - Antenna geometry and pattern for original design

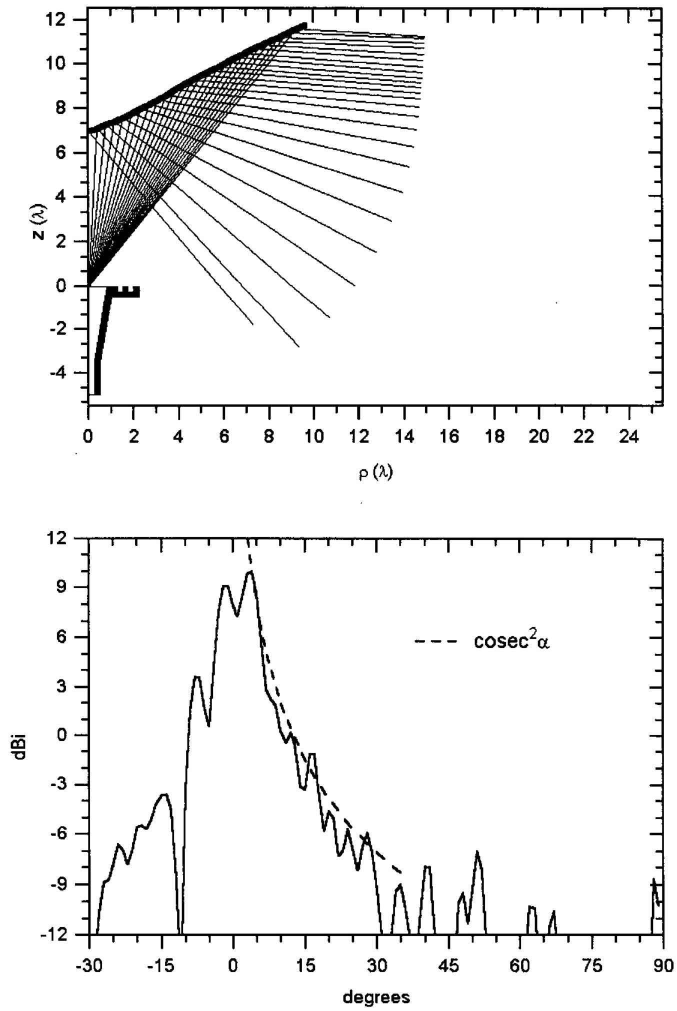

Figure 3 - Antenna geometry and pattern for present design