

WRAPAROUND PATCH ANTENNA ON A SPHERICAL BODY

K M LUK and W Y TAM

Department of Electronics, The Chinese University of Hong Kong,
Shatin, Hong Kong.

INTRODUCTION

Low profile printed antennas are most advantageous in conformal applications. Recently, the investigations of printed antennas on cylinders were reported by several researchers, e.g. [1-2]. In Luk et al [2], the characteristics of rectangular patch antennas mounted on an infinitely long cylindrical surface were calculated by assuming the substrate thickness to be much smaller than wavelength and radius of curvature. In this paper, based on the similar assumption, the far field patterns of a wraparound antenna on the surface of a sphere are investigated. The results are of practical importance as microstrip antennas are usually mounted on three-dimensional bodies.

THEORY

The geometrical structure is shown in Fig.1. the microstrip wraparound antenna is placed on top of the metallic sphere, separated by a thin dielectric.

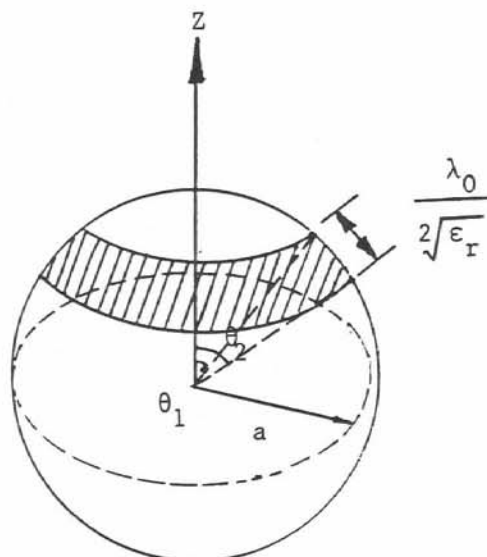


Fig.1 Geometry of wraparound antenna

Based on cavity model theory and since the surface current is rotationally symmetric, the far fields can be calculated by the ϕ -independent equivalent magnetic current rings located at θ_1 and θ_2 . The far field radiation of a magnetic current on the surface of a spherical conductor has been considered in [3]. Using the result of [3], the far-zone electric field is derived as follows :

$$E_{\theta} = E_0 \frac{e^{-jkr}}{r} \left[\sin\theta_1 \sum_{n=1}^{\infty} \frac{j^n (2n+1) P_n^1(\cos\theta_1)}{n(n+1) \hat{H}_n^{(2)}(ka)} P_n^1(\cos\theta) + \right. \\ \left. \sin\theta_2 \sum_{n=1}^{\infty} \frac{j^n (2n+1) P_n^1(\cos\theta_2)}{n(n+1) \hat{H}_n^{(2)}(ka)} P_n^1(\cos\theta) + \right]$$

where P_n^1 and $\hat{H}_n^{(2)}$ are respectively the Associated Legendre polynomial and the spherical Hankel function of second kind.

To demonstrate the curvature effect of the sphere on the antenna, various cases, obtained by altering the radius of the sphere as well as the position of the antenna, are plotted in Fig.2 .

Apart from the interesting result, the radiation pattern of a circular disk antenna on a sphere is also investigated using the same approach. The results will be presented at the conference.

REFERENCE

- 1 J.Ashkenazy, S.Shikman and D.Treves, "Electric surface current model for the analysis of microstrip antennas on cylindrical bodies", IEEE Trans., AP-33, pp.295-300, 1985.
2. K.M.Luk, K.F.Lee, J.S.Dahele, "Analysis of the cylindrical -rectangular patch antenna", ibid (to be published).
3. R.F.Harrington, TIME-HARMONIC ELECTROMAGNETIC FIELDS, 1961, McGraw-Hill, New York.

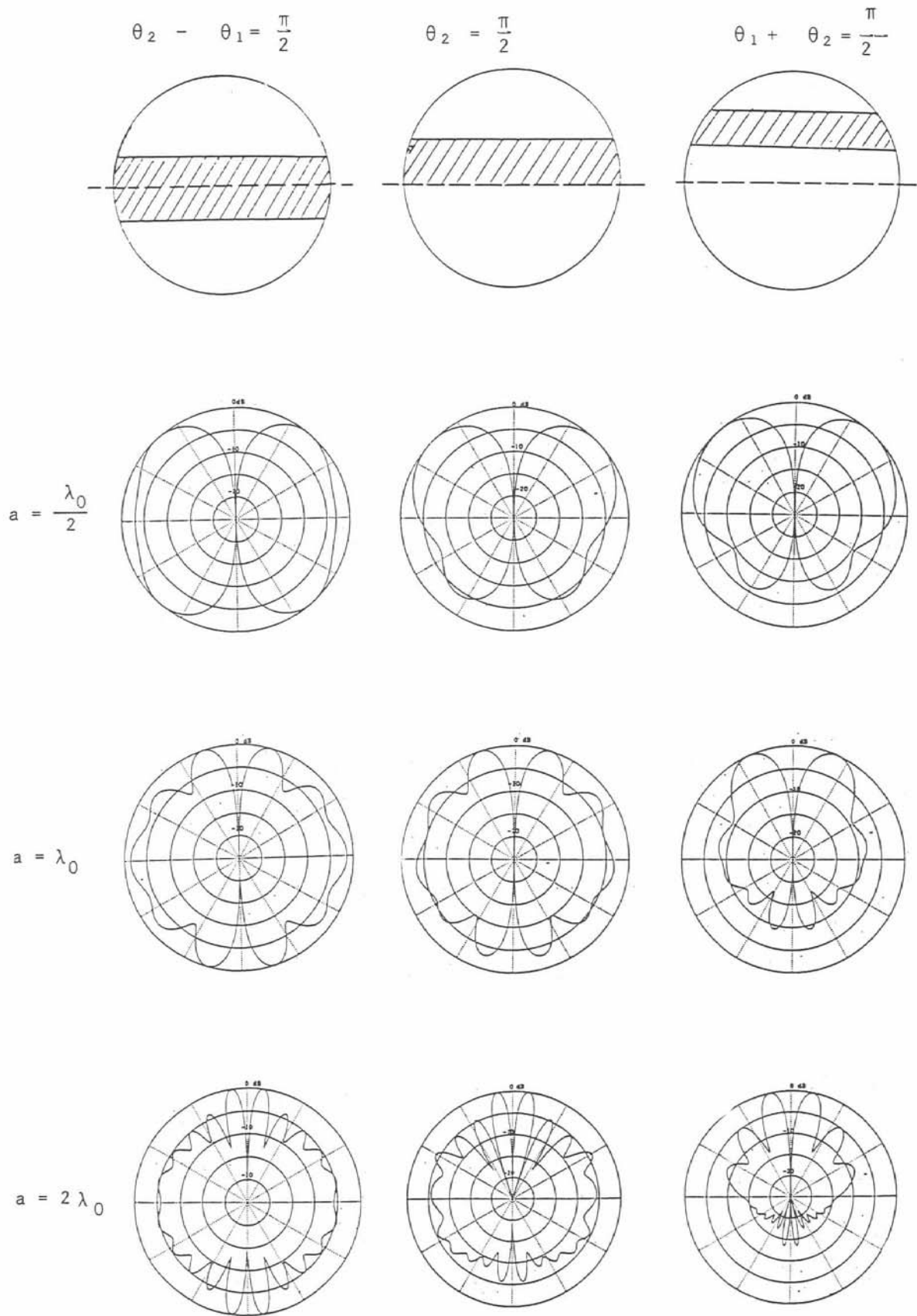


Fig. 2 E-plane Pattern of wraparound antenna on the surface of a sphere