ECE 6341

Spring 2009

Project

Project Description

A microstrip antenna is placed on the surface of a rocket (see the figure below). The center of the patch is located on the *x* axis. The two radiating edges of the microstrip antenna are modeled as two slots, each having a one volt drop (V = 1) across the edge, measured from bottom to top. Therefore, for each slot the electric field is given by

$$\underline{E} = \hat{\underline{z}}\left(\frac{1}{\delta}\right),$$

where δ is the width of each slot. The slots may be assumed to be of infinitesimal width, so that $\delta \to 0$. The electric field is assumed to be uniform across the width of the patch, in the ϕ direction. The length of the microstrip antenna is L in the z direction (the two radiating edges, or slots, are located at $z = L/2$ and $z = -L/2$), and the width of the patch is W in the ϕ direction (the angle subtended by the two nonradiating edges is $\Delta\phi = W / a$, with the slot fields existing in the region $-\Delta\phi / 2 < \phi < \Delta\phi / 2$).

Assume the following parameters: f = 10 GHz, $a = 10\lambda_0$, $L = 0.5\lambda_0 / \sqrt{\varepsilon_r}$ with $\varepsilon_r = 2.2$, and $W = 1.5L$.

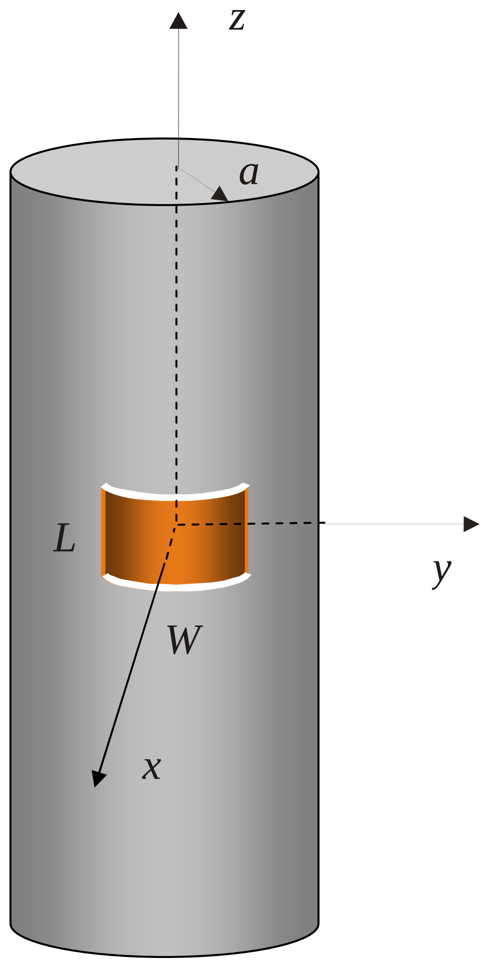
Project Tasks:

1) Determine the far field pattern components $E_\theta(r, \theta, \phi)$ and $E_\phi(r, \theta, \phi)$.

2) Write a program (in Mathcad, Matlab, Mathematica, Fortran, etc.) to calculate the radiation pattern $|E_\theta|$ versus ϕ for $\theta = \pi / 2$ (the xy plane). Make a polar plot of the normalized pattern $|E_\theta|$ (normalized to a value of 1.0 at the peak) for $0 < \phi < 2\pi$. Plot the normalized pattern in dB, so that the pattern is zero dB at the peak.

3) Make a polar plot of the normalized pattern $|E_\theta|$ in dB for $1^o < \theta < 179^o$, for $\phi = 0$ (the xz plane) for the same case as above. What happens to the far-field pattern as $\theta \to 0$ or π? Look at the formulation for E_θ to explain your conclusion.

4) Repeat parts (2) and (3) for a "wraparound" microstrip antenna, which has the same length L but the width W is now equal to the circumference of the rocket, so that $W = 2\pi a$.



Computational Note:

Please check to make sure that you have convergence in your summations when you calculate the far-field patterns!