Antennas Theory

Assignment 1

October 2024

1. Polarization

a) The axial ratio of a circularly polarized wave is 1 dB. Find the relative cross-polar level and the polarization efficiency.
b) A desired linearly polarized wave has an axial ratio of 20 dB. Find the relative cross-polar level and the polarization efficiency.

2. Phase Center

The table below shows a measured phase pattern.

Theta	0	±10 deg	±20 deg	±30 deg	±40 deg
Phase	95 deg	105 deg	140 deg	−175 deg	−90 deg

a) Calculate the phase center location within the **±20** deg sector. Calculate the phases for all angles when the phase reference point is moved to this phase center.
b) Calculate the phase center location within the **±30** deg sector. Calculate the phases for all angles when the phase reference point is moved to this phase center.

3. Relative Cross Polarization

a) Evaluate and compare the relative cross polar levels in dB of the linearly *y*-polarized incremental electric current source at $\theta = 20^o$ in the $\phi = 0$, 45^o and 90^o planes.

b) Compare also the level of the back radiation at $\theta = 180^o$.

4. BOR_0 Antenna

Antennas for telemetry, tracking and command (TTC) of satellites are often rotationally symmetric biconical antennas with a rotational symmetric radiation field function of the BOR_0 form:

$$\vec{G}(\theta,\phi) = B_0(\theta)\hat{\theta},$$

where $B_0(\theta)$ is a complex function. The *z*-axis is herein referred as the vertical axis.

a. Which polarization does the radiation field function have in the horizontal plane?

b. Which value must $B_0(\theta)$ have in the vertical direction and why?

c. Calculate the directive gain when

$$B_0(\theta) = \begin{cases} A & \text{for } 70° < \theta < 110° \\ 0 & \text{elsewhere} \end{cases}$$

where A is a real constant. Give the answer in dBi.

~ End of Assignment 1 ~