Antennas

19/06/14

Name:

Exercise 1

a) Define gain and directivity and comment their importance.

b) Define the half-power beamwidth.

c) Define the resolution of an antenna and show that it is related to its directivity.

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Exercise 2

The EM field radiated by a short dipole is given by the following formulas (in spherical coordinates):

$$E_r = \frac{1}{j\omega\varepsilon}\frac{1}{2\pi}\frac{e^{-j\beta r}}{r^2} I_0\, dz \cos\vartheta \left[j\beta + \frac{1}{r} \right]$$

$$E_\vartheta = \frac{1}{j\omega\varepsilon}\frac{1}{4\pi}\frac{e^{-j\beta r}}{r} I_0\, dz \sin\vartheta \left[-\beta^2 + \frac{j\beta}{r} + \frac{1}{r^2} \right]$$

$$H_\varphi = \frac{1}{4\pi}\frac{e^{-j\beta r}}{r} I_0\, dz\, \sin\vartheta \left[j\beta + \frac{1}{r} \right]$$

a) Explain the meaning of the far-field of an antenna and write the far field of the short dipole.

b) Calculate the total power radiated by the short dipole if only the far field is considered.

c) Calculate the total power radiated by the short dipole without the far field hypothesis. Explain the difference of this total power with respect to the result obtained in the previous point b).

d) Define the following quantities used to characterize an antenna: input impedance, input resistance, radiation resistance.

e) Calculate the radiation resistance of the short dipole.

f) Calculate the directivity of the short dipole.

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Exercise 3

A uniform array is composed of 3 isotropic antennas.The signal frequency is 3 GHz, the distance between two antennas is 0.1 m and the phase delay from one antenna to the next is 2π .

a) Find the maximum directions and the null directions of the radiation pattern.

b) Plot the radiation pattern.

c) If each antenna of the array is replaced by a short dipole perpendicular to the direction of alignment of the array, how does the total radiation pattern change ? Plot the new radiation pattern.