Antennas

18/06/15

Name:

Exercise 1

The electromagnetic field radiated by a short dipole reads as

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

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

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

a) Obtain the far field of the short dipole.

b) Plot the radiation pattern of the short dipole both in the E-plane and in the H-plane.

c) Calculate the real power radiated by the short dipole.

d) Calculate the radiation resistance of the short dipole.

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Exercise 2

a) Define the gain of an antenna.

b) Obtain the Friis transmission equation.

c) Define the radar cross section and give some typical values of this parameter for real targets.

d) Explain briefly how a monostatic radar works and obtain the corresponding radar range equation.

e) Explain briefly how a bistatic radar works and obtain the corresponding radar range equation.

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Exercise 3

Let us consider a linear uniform array composed of 4 isotropic antennas working at a frequency of 60 GHz; the separation between two adjacent antennas is 2 mm and the phase delay between two adjacent antennas is $4\pi/5$.

a) Calculate the directions of the main lobes.

b) Calculate the null directions.

c) Plot the radiation pattern.