Antennas

17/07/14

Name:

Exercise 1

a) Define gain and directivity and comment their importance.

b) Define the radar cross section of an electromagnetic scatterer (a target).

c) Obtain and explain the Friis transmission equation.

d) Obtain and explain the radar range equation for a monostatic radar.

e) Obtain and explain the radar range equation for a bistatic radar.

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Exercise 2

a) Write a mathematical expression for the current distribution along a half-wavelength dipole and plot the current as a function of the position on the dipole.
Justify this expression.

b) Starting from the knowledge of the far-field of a short dipole (having length *dz*)

$$E_\theta = j\eta \frac{\beta}{4\pi} I_0 dz \frac{e^{-j\beta r}}{r} \sin\vartheta$$

$$H_\varphi = j \frac{\beta}{4\pi} I_0 dz \frac{e^{-j\beta r}}{r} \sin\vartheta$$

show how the far-field of the half-wavelength antenna can be calculated (the explicit solution of the final integrals is not required).

c) What is the value of the input impedance of a half-wavelength dipole at the working frequency ?

d) Plot qualitatively the input resistance of a wire antenna as a function of its length.

e) Plot qualitatively the input reactance of a wire antenna as a function of its length.

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Exercise 3

Let us consider a uniform array composed of 4 isotropic antennas; the main lobe of the radiation pattern is oriented at an angle of 60º with respect to the alignment direction of the array and the alignment direction (0º) is one of the two null directions bounding the main lobe.

a) Calculate the phase delay and the distance between two adjacent elements of the array.

b) Calculate the directions of the main lobes and the null directions.

c) Plot the radiation pattern.