Antennas

Name:

Exercise 1

The far field of a short dipole is described by the following formulas (in spherical coordinates):

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

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

a) Plot the radiation pattern in a plane perpendicular to the antenna and passing through its center.

b) Plot the radiation pattern in a plane containing the antenna itself.

c) Calculate the directivity of the short dipole.

d) Calculate the radiation resistance of the short dipole. Is there any difference with respect to the input resistance ?

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Exercise 2

a) Define and explain the linear polarization of the electromagnetic field. Give an example of a source emitting a linearly polarized field.

b) Define and explain the circular polarization of the electromagnetic field. Give an example of a source emitting a circularly polarized field.

c) Define and explain the elliptical polarization of the electromagnetic field.

d) Starting from Maxwell's equations, prove that if the electric field is circularly polarized the magnetic field is circularly polarized, as well.

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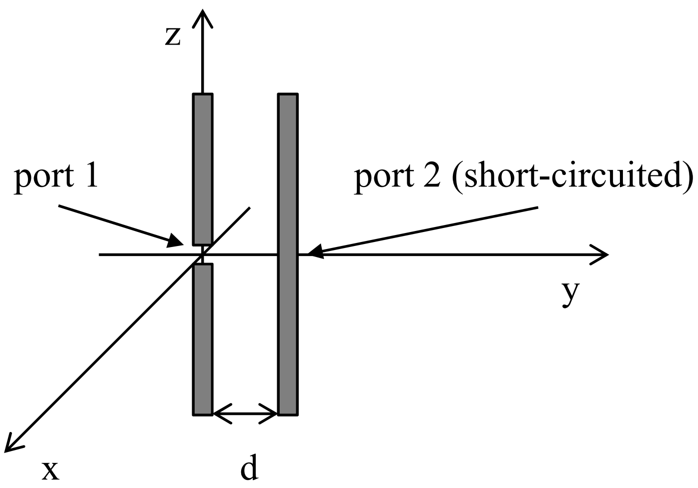
Exercise 3

Let us consider an array composed of 2 half-wave radiators (their separation is d=0.2 λ).



Their impedance matrix reads as:

$$Z = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} = \begin{bmatrix} 73 + j42 & 50 - j20 \\ 50 - j20 & 73 + j42 \end{bmatrix}$$

a) Obtain the array complex composition factor.

b) Calculate the maximum and minimum directions of the complex composition factor (if there is any).

c) Calculate the null directions of the complex composition factor (if there is any).

d) Plot the radiation pattern in the (x,y) plane.

e) Plot the radiation pattern in the (y,z) plane.