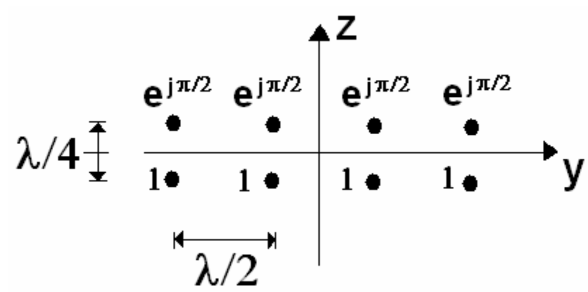
EEE 452 ANTENNAS AND PROPAGATION
Spring 2004

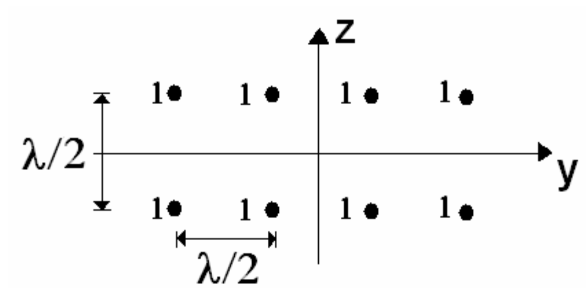
HW 7

Note: Work independently. According to Bilkent University policy, the act of cheating is punishable by up to two semesters of suspension from the school.



1) The figure shows a two dimensional array of isotropic elements. The separation between the elements and excitations are also shown in the figure.

- **a)** Find the magnitude of the normalized array factor by treating the pairs of elements oriented vertically as the "elements" of 4-element-array aligned in the y-direction. Plot it on the x-y, z-y and, z-x cuts.
- **b)** Find the magnitude of the normalized array factor by treating the horizontal groups (4 elements) as the "elements" of 2-element-array aligned in the z-direction.
- **c)** Derive the magnitude of the normalized array factor of the 2-D array shown below, **by using the array factor of the array in (a&b).** Plot the magnitude of the normalized array factor on the x-y, z-y, and z-x cuts.



2) An array of N elements is placed along z-axis with uniform separation of $\lambda/2$ and excitations have different amplitudes but zero progressive phase.

- **a)** Find N and excitation of each element by using Schelkunoff's method, if the array factor is desired to have zeros at $\theta = 0°, 60°, 120°$ and $180°$. Plot the magnitude of the normalized array factor on polar coordinates with respect to θ.
- **b)** What do you expect (by using Schelkunoff's method), if the first and last elements of the array in (a) are removed from the array? Plot the magnitude of the new array factor to validate your expectation.

c) How would you change the excitations to shift the zeros at 60° and 120° to 45° and 135°? Plot the magnitude of the normalized array factor with the new excitations. What happened to side lobes?

d) Multiply the excitation of the middle element of the array in (a) by two and plot the magnitude of the normalized array factor on polar coordinates. What can you say about the new location of the zeros of the AF in z-space?

3)

a) Determine the current distribution and the approximate radiation pattern of a line-source placed along the z-axis whose desired radiation pattern is symmetrical about θ = π/2, and is given by

$$SF(\theta) = \begin{Bmatrix} 1 & 40^\circ \le \theta \le 140^\circ \\ 0 & \text{elsewhere} \end{Bmatrix}$$

b) Plot the radiation pattern using the expression you have found in (a). Not that you need to evaluate the "Si" function. (This is optional: Bonus +10)

d) Determine the excitation coefficients and plot the resultant pattern for a broadside 11-element array (linear array) whose element-space is as d = λ/2 and array factor closely approximates the desired pattern given by

$$SF(\theta) = \begin{Bmatrix} 1 & 60^\circ \le \theta \le 120^\circ \\ 0 & \text{elsewhere} \end{Bmatrix}.$$

Compare the resulting pattern with the desired one.

4) What do you think about the HWs of this course? Please write your suggestions, objections and thoughts that you may want to share with us.

Ö.E.