Experiment No. 5 PERFORMANCE COMPARISON OF BROADSIDE ARRAY AND ENDFIRE ARRAY

Aim:

To observe the radiation patterns and compare the performance parameters of broadside array and end-fire array.

Software requirements:

Software- 4nec2 (Numeric Electromagnetic Coder)
Operating System- Windows XP, windows 7 and above

Theory:

Usually the radiation pattern of a single element is relatively wide, and each element provides low values of directivity (gain). In many applications it is necessary to design antennas with very directive characteristics (very high gains) to meet the demands of long distance communication. This can only be accomplished by increasing the electrical size of the antenna. Enlarging the dimensions of single elements often leads to more directive characteristics. Another way to enlarge the dimensions of the antenna, without necessarily increasing the size of the individual elements, is to form an assembly of radiating elements in an electrical and geometrical configuration. This new antenna, formed by, is referred multi elements to as an array. In most cases, the elements of an array are identical. This is not necessary, but it is often convenient, simpler, and more practical. The individual elements of an array may be of any form (wires, apertures, etc.).

The total field of the array is determined by the vector addition of the fields radiated by the individual elements. This assumes that the current in each element is the same as that of the isolated element (neglecting coupling). This is usually not the case and depends on the separation between the elements. To provide very directive patterns, it is necessary that the fields from the elements of the array interfere constructively (add) in the desired directions and interfere destructively (cancel each other) in the remaining space. Ideally this can be accomplished, but practically it is only approached.

Broadside Array:

Broadside array is one in which number of identical parallel antennas are set up along a line drawn perpendicular to their respective axes as shown in Fig.-

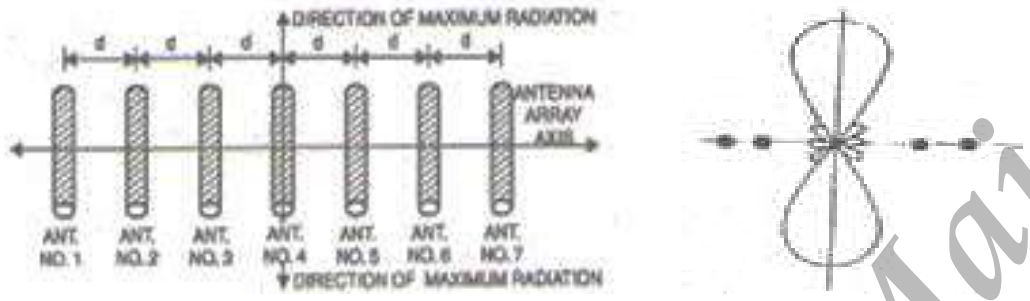


Fig. – Broadside array arrangement and typical radiation pattern

In broadside array, it is desired to have maximum radiation of an array directed normal to the axis of the array to optimize the design, the maxima of single element can be accomplished by the choice of the radiators and those of array factor by the proper separation and excitation of the individual radiators.

End Fire Array:

End fire array defined as the arrangement in which the principal direction of radiation coincides with the direction of the array axis. It may be noted that end fire array may be bidirectional also.

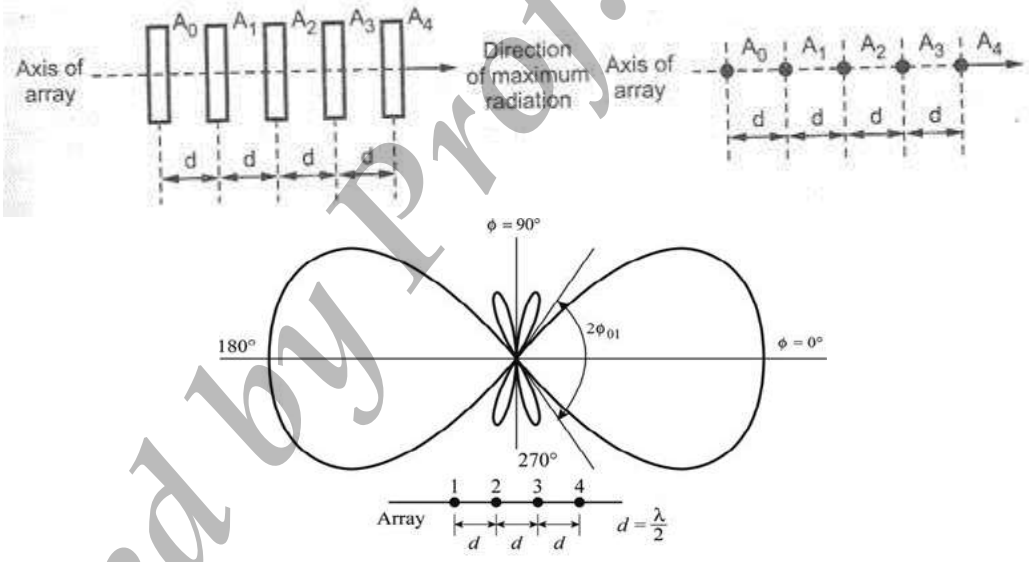
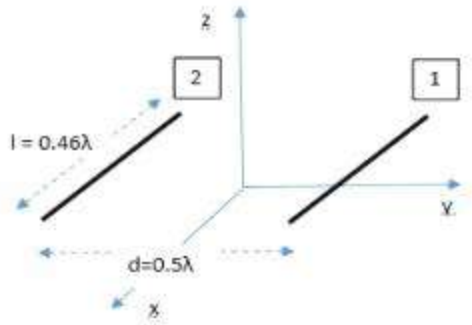


Fig. – Endfire array arrangement and typical radiation pattern

Design:

Two element antenna array



Location of antenna 1 = (l/2, d/2, 0) to (-l/2, d/2, 0)

Location of antenna 2 = (l/2, -d/2, 0) to (-l/2, -d/2, 0)

Supply to antennas:

Broadside array: antenna 1 (1 V), antenna 2 (1 V) [no phase difference]

Endfire array: antenna 1 (1 V), antenna 2 (-1 V) [180 deg phase difference]

(These configurations must be designed using 4NEC2 so as to verify the simulation results for broadside array and end-fire array).

Observation Table:

Sr. No.	Array Type	HPBW (in degrees)	Gain (in dB)
1	Broadside array		
2	Endfire array		

Conclusion:

1. In Broadside array, the maximum radiation is perpendicular to axis of antenna array and more radiation can be obtained by increasing number of elements.
2. In Endfire array, the maximum radiation is along the direction of axis of antenna array and beamwidth can be decreased (i.e., directivity & gain can be enhanced) by Hansen-Woodyard endfire array.