### SIDELOBE REDUCTION USING ELEMENT SPACE

#### DISTRIBUTION

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## I) INTRODUCTION:

Narrow beams with low sidelobes are important if accurate angular measurements are to be made or if targets close to one another are to be resolved by the radar. The required beams are generated conveniently from an array of radiating elements. The array may consist of either similar or dissimilar radiating elements. The radiating elements may be either monopole, dipole, open ended waveguides or waveguide slots. The type of radiating element is chosen depending upon the space availability, frequency and application. Usually, slot array antennas are preferred for higher radar frequencies. In the desired range of frequencies, the radiation patterns from the array antennas are controlled by [1-5] (1) aperture distribution, (2) number of elements in the array, (3) type of radiating element, (4) phase distribution. The radiation patterns from the array of radiating elements consists of a main beam in the required direction and some sidelobes in the undesired directions. The low sidelobe radiation patterns are desired to be generated from radar, for all the applications. Usually the first sidelobe nearest to the main beam in the radiation pattern is the highest. If this is very high strong echo signals can enter the receiver and appear as false targets. High sidelobe level also makes jamming of the radar much easier. If the large amount of energy is concentrated in the sidelobes, the energy in the main beam is reduced resulting in lowering of maximum gain. It is, therefore, essential to generate radiation patterns with the sidelobe levels as low as possible. Low sidelobe patterns can be generated from tapered excitations. However, highly tapered aperture excitation reduces the relative gain of the antenna.

It is, hence, essential to generate a narrow beam with very low first sidelobe level by some other methods other than tapered aperture distributions. In the present paper, the space distribution of the radiating elements in the array is designed in such a way that the resultant radiation pattern contains very low level first sidelobe. Computations have been carried out to obtain the radiation patterns both for uniform as well as non-uniform spacing. Results of radiation patterns for 21 elements are presented in u (sin  $\not \! p$ )-domain.

### II) ANALYSIS:

The far-field of a continuous line source in terms of aperture distribution is given by  ${\it I}$ 

 $E(u) = f(u) \int_{-L}^{L} A(s) Exp(jkus) ds \qquad --- (1)$ 

where 2L is the length of the array,  $u = \sin(\phi)$ , f(u) is the field function associated with the type of the radiating element and  $\phi$  is shown in fig.(1).

With the substitution x = s/L, the line source extends from -1 to

+1 and the expression (1) representing the radiation pattern reduces to the form

$$E(u) = f(u) \int_{-1}^{1} A(x) Exp (j2\pi Lux/\gamma) dx \qquad --- (2)$$

Where A(x) is the aperture distribution.

For an array of N isotropic radiators, discretizing the line source distribution, the integral of expression(2) is replaced by a summation and the expression (2) reduces to

$$E(u) = \sum_{n=1}^{N} A(X_n) \operatorname{Exp} (j2\pi LuX_n/\lambda) \qquad --- (3)$$

where  $X_n$  is the position of n th element in the array.

# III) RESULTS AND CONCLUSIONS:

Radiation patterns are evaluated from expression (3) for

$$X_n = (2n-N-1)/N$$
 --- (4)

and for a non-uniform spacing given by

$$X_{n} = \frac{[2-\log(100-n)]}{[2-\log(100-(N-1)/2)]} --- (5)$$

where n=1,2,...,(N-1)/2

Computations are carried out for N=21, 2  $L/\lambda$  =10.5 and for

$$A(X_n) = 1 + a \cos(\pi X_n) \qquad --- (6)$$

The radiation patterns are presented in figs.(2-5) for a=0.4 and 0.5. It is found from the results that the first sidelobe level obtained by the space distribution described in expression (5) is very much lower that that of uniform spacing of expression (4). In the situations where it is difficult to obtain highly tapered distributions, the non-uniform spacing presented in expression(5) is very useful.

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