CHAPTER IV

DESIGN EXAMPLES OF NONUNIFORMLY SPACED ARRAYS

The half-wave dipole collinear broadside array is chosen as the design example of nonuniformly spaced array. As design conditions we consider the following items :

(a) The total length of the half-wave dipole array is given.

(b) We wish to reduce the sidelobe level to as low a value as possible .

(c) The beamwidth constraint must be satisfied.

(d) We wish to make the number of element as small as possible .

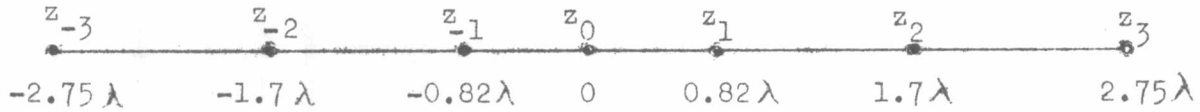
These are conditions which clearly conflict with each other.For example, suppose the sidelobe level is permitted to be as high as -15 dB or 0.18 (as can be designed with small number of elements) and the total length of the antenna array is required to be 6.5λ Since it is the half-wave dipole collinear array,the actual total length which implies the distance between the centers of the two far end elements should equal to 5.5λ

According to Fig.14 and 15 if the beamwidth is required in the range of 10 degree , the number of elements should not be lower than 7 . Lower number than this will cause an increase in average element spacing and the increase of sidelobe levels is inevitable.

The minimum sidelobe level occurs when the average element spacings is around 0.85 to 0.95 wavelength as illustrated in Fig. 15 .

For this reason if the total length is equal to 5.5 wavelengths the number of element should be 7 from the requirement (d) that the number of elements should be small as possible.

The approximate locations of 7 elements can be found from the - density tapering method shown in Fig.A9 of an appendix as follow :



Then the directional is examined and improved to the desired type by the perturbation done with an analog computer. The results of the best element locations are as follow :

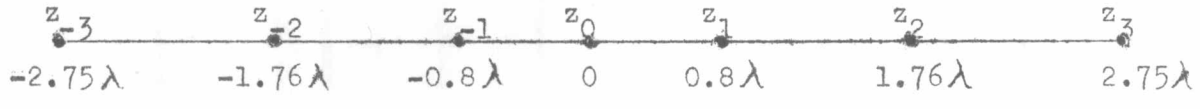


Figure 16 shows the directional pattern of the antenna array designed in the above paragraphs.In this figure the approximate directional pattern of the 7 element nonuniformly spaced array designed from density tapering method and the 7 element(spacing .916λ) equally spaced array having the same total length are shown by the dot-dash line and dotted line respectively for comparison .

It can be seen that,by using unequally spaced array(where the central part of the array is made denser) it is possible to make the sidelobe nearly uniform in all directions and thus reduce the side lobe level somewhat in comparison with the case of equally spaced array. In the case when the number of element is given,it is possible to make the sidelobe minimum by choosing the average element spacing around o.85 to 0,95 wavelengths .

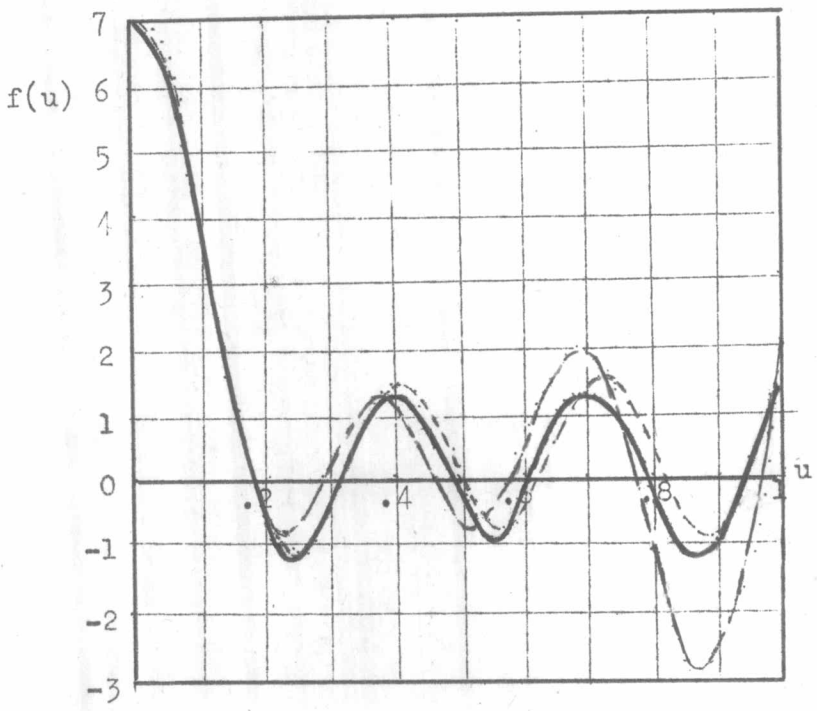


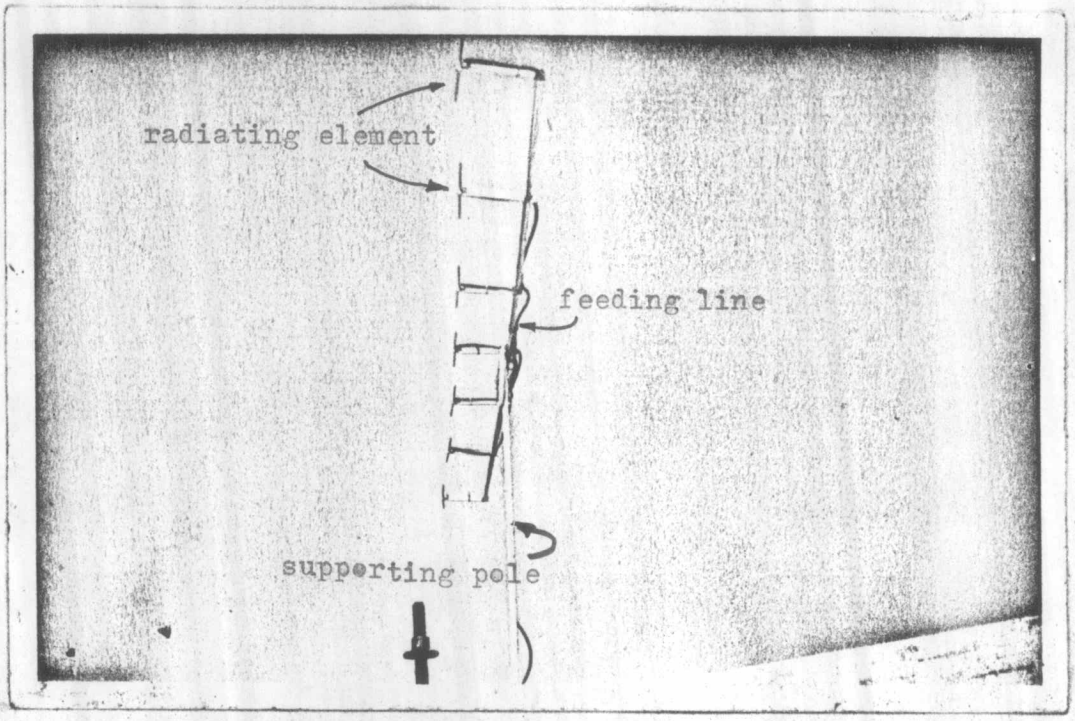
Fig.16 Patterns of the designed arrays

_____ nonuniformly spaced array (perturbation)

_ _ _ _ _ Nonuniform array (density tapering)

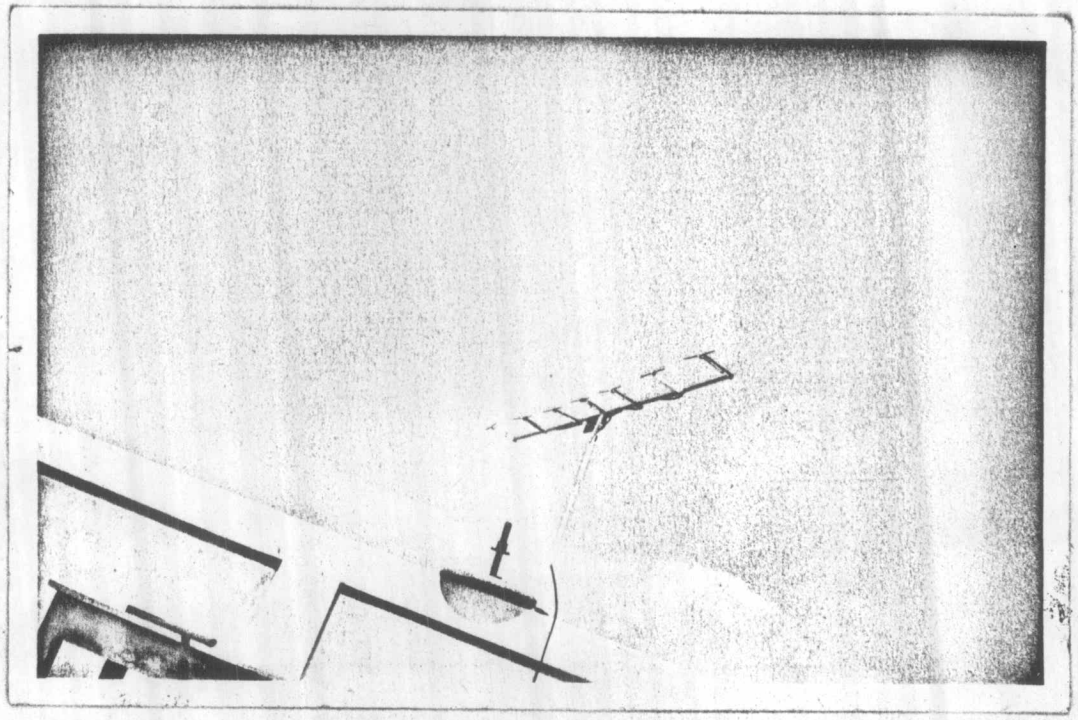
------ uniformly spaced array

The nonuniformly spaced array so designed was constructed as shown in Fig.17 and its directional pattern was practically tested by the experiment. This result was illustrated in Fig.18.



(a)

Operating frequency 900 MHz , Total length 6.5 wavelengths



(b)

Fig.17 The half-wave dipole broadside nonuniformly spaced array as construted for an example.

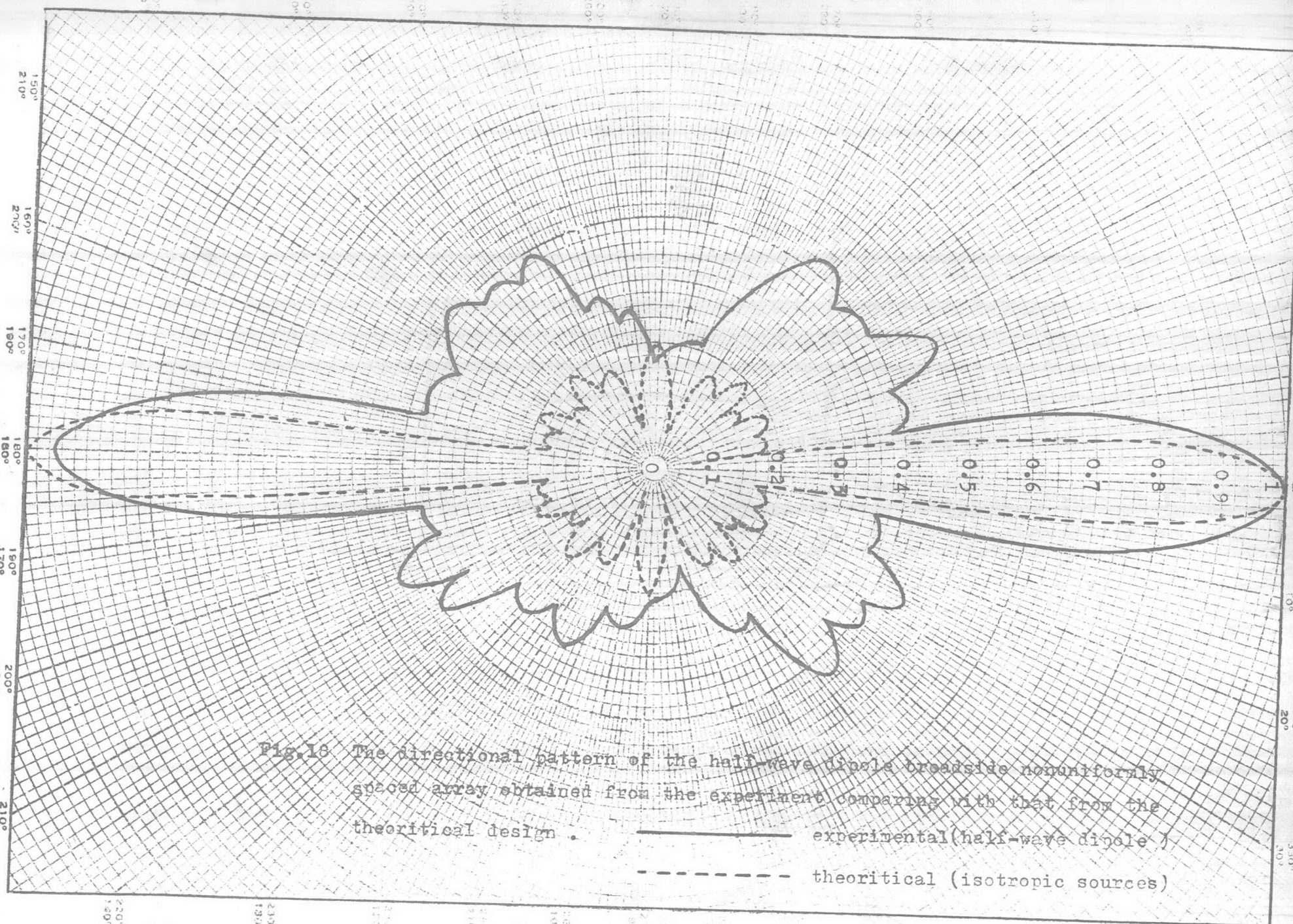


Fig.16 The directional pattern of the half-wave dipole broadside nonuniformly spaced array obtained from the experiment comparing with that from the theoritical design .