CHAPTER I

INTRODUCTION

For many applications in modern techniques it is not possible with a single simple antenna,to obtain the value of directivity or the beamwidth required. One convenient method of overcoming this difficulty is to form the antenna system composed of several similar-antennas or elements. Such antenna systems are called "array".

Most linear antenna arrays employ equal spacings between adjacent elements. The theory is well understood,and convenient analytical procedures are available for antenna design and radiation pattern synthesis. It is possible,however,to operate antenna array with nonuniform or unequal spacings between adjacent elements.The element spaqing provides another parameter in addition to amplitude and phase of element current,with which to control the radiation pattern . Since there are more parameter than in the case of equally spaced - arrays, the theory is difficult to formulate in simple terms and an " optimum pattern " is rarely obtained,even for a antenna array consisting of only several elements .

By using unequal spacings for a given total length of antenna and using smaller number of elements it is possible to obtain the pattern with a same beamwidth as with an equally spaced array , and without grating lobes. Since fewer elements than the conventional - array are required, unequally spaced array is said to be " thinned". The conventional array with half wavelength spacing is called a " filled array ". The pattern of the thinned array can not be controlled as well as that of the filled array, and its average side-

lobe relative to the peak gain,will not be as low. However,if the thinning is not severe (number of element is nearly equal to the the filled array) the peak sidelobe can be kept to a reasonable-value and can be made compatitative with that of a conventional - design. For this reason studies on the reduction of sidelobe level by appropriate distribution of element positions have been made . It will be shown that nonuniformly spaced array with sidelobe le-vel better than those of a uniform array,are thinned at the end , while those worse are thinned in the center.

This thesis is concerned with the antenna pattern synthesis-by nonuniformly spaced array which the element spacing is consid-ered as the main parameter (the current at each element is chosen to be equal). This might be of importance in practices where it is not convenient to adjust the amplitude of current at each element. In so doing the nonuniformly spaced array pattern is approximated with that of the continuous line source, i.e, the density of the equally excited,unequally spaced radiating elements as a function of the location within the array is decided to be of the same form as the continuous current density function of the conventional - antenna used as the model. This design procedure is called "space tapering" or "density tapering" to distinguish it from the more usual " amplitude tapering ".

It is the purpose of this thesis to report some results of this study and suggest the applications of an analog computer for finding the best element locations that can provided the radiation pattern more satisfied than the approximated one .