ABSTRACT

The use of wireless communication techniques in satellite, radar or mobile communication makes it important to investigate new distributed beamforming techniques by array antenna. The requirement of high directivity signal with very fast beam steering is not possible by a single antenna. This requisite is succour by phased array antenna which is a combination of a number of small antennas that can generate beam with high directivity with very fast electronic beam steering. The radiation pattern of an antenna array depends strongly on the weighting method and the geometry of the array. Selection of the weights has received extensive attention, primarily because the radiation pattern is a function of the weights. However, the array geometry has received relatively little attention even though it also strongly influences the radiation pattern. According to various radiation pattern requirement in practice, there are mostly three categories of beam synthesis is accomplished, such as narrow beam synthesis (Tchebyscheff, Taylor, Binomial Array), beam formation by Null placement (Schelkunoff Array) and sector beam synthesis (Fourier Series, Woodward-Lawson Method). Phased array and classical narrow beam patterns are suffered from the problems of high side lobe level and grating lobe, Schelkunoff Array can only place the nulls on desired direction and has no control on side lobe level and there is no readily available method for Flat-Top sector beam synthesis. These issues related with beam pattern causing high interference in communication which restrict them use in practice. To overcome these limitations, optimization technology such as Genetic Algorithm and Particle Swarm Optimization are applied in combination with the classical array synthesis methods for phased array synthesis. An optimization problem is derived whose solution yields an optimal array for suppressing interference due to high side lobe level and grating lobe. Results are presented for optimal arrays of varying array geometry, with different number of antenna elements, and for distinct beamwidths and scan angles. The resulting radiation pattern by various proposed methods are simulated and after analyzing these pattern it was observed that the proposed arrays are able to counteract the issues and can be used in practice.