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Novel Particle Swarm Optimization Based side lobe reduction for Linear Antenna Arrays with Rayleigh Distribution

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ABSTRACT

The main motive of present work is to narrate the design of linear antenna array with extensive band and satisfactory gain using suitable input parameters. The prime attention in this work is reduction of side lobe using perturbation of the elements amplitude in Rayleigh's distributed arrays. Computer simulations illuminate recommend reduction in the side lobe structure. A qualitative survey for side lobe diminution is postulated effectively [8][9]. The results are analogized with those acquirable from the uniform amplitude distribution technique. This array of antennas immensely useful for base stations of regular aerospace application and wide range mobile users. In general antennas used at the base station are always required to cover more than an average HPBW for the desirable operation. Present work discussed on diminution of side lobes using an evolutionary algorithm PSO [2].

Keywords: side lobes, amplitude excitation, Rayleigh distributed.

1. INTRODUCTION

The basic parameters of isotropic array antenna on which the pattern distribution rely are excitation of amplitude, phase and locations [3]. Most of the present communication scenario, the space reserved by a communicating antenna is strongly limited. Therefore, antennas with sizeable bandwidth, more than a average angular width, gain with high value and size of compact type are extremely advantageous for aerospace applications and various base stations in future generation communication systems.[6][7]

The problem of N dimensional multi objects can be effectively solved by using a foremost evolutionary algorithm using PSO [10]. The set of parameters of antenna for intent of radiation pattern are obtained by the practice of PSO. The PSO method used to generate the SLL disclose that design of antenna arrays using PSO based formulated distribution shows best possible results compared with the uniformly distributed even and odd linear array elements.

PSO introduced by Kennedy and Eberhart in 1995. PSO algorithm shows best contingent on the communal interaction in between the various agents of independent type, here the independent agents are called as particles, here fitness function is used for searching the optimum solution [4][5]. The major concentration of this paper is not to intend the importance and implementation of PSO, so here only the important threads of this algorithm are mentioned. Figure 1 shows flow sheet of a PSO algorithm.

With help this computed values the design of antenna made easier for diversity of frequencies, which is suitable for many other applications requiring more than an average angular width, broad coverage and better gain antennas.

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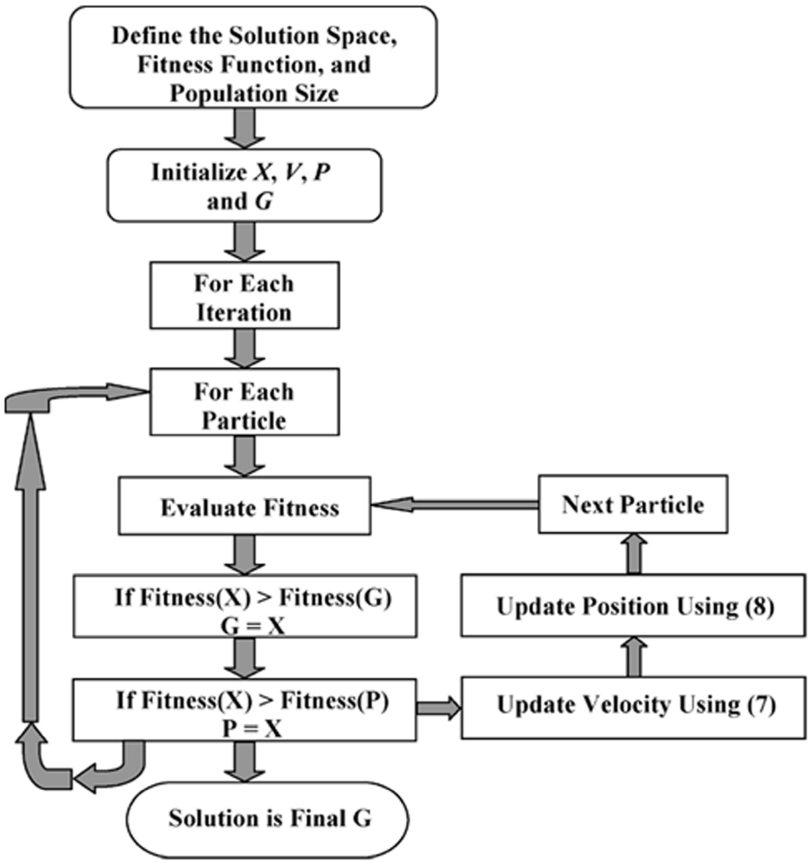

Figure 1: Representation Flow sheet for implementation of PSO computation

2. LINEAR ANTENNA ARRAY

The geometry of even, odd number of elements uniformly placed on linear antenna array along the X- axis symmetrically. Fig. 2 & 3 shows this arrangement.

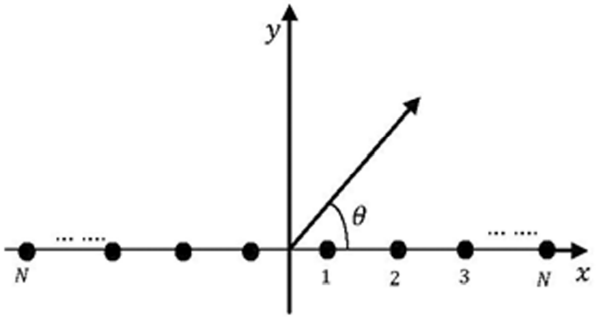

Figure 2: Representation of symmetrically placed even number of element linear array antenna

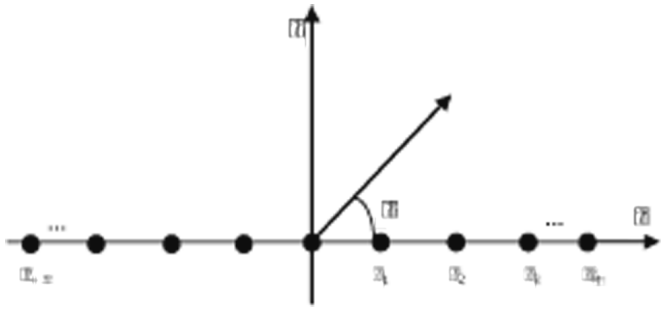

Figure 3: Representation of symmetrically placed odd number of element linear array antenna.

The N element Linear array antenna, array factor is stated as follow [1][3]

$$AF(\theta)_{even} = \sum_{n=1}^{2N} I_n \cos\left[kx_n \cos(\theta) + \varphi_n \right]$$

Where x_n, $k = 2\pi/\lambda$, I_n, φ_n are position, amplitude excitation and distinct phase of element n correspondingly.

For uniform amplitude and phases, we contemplate as $I_n = 1$ and $\varphi_n = 0$.

2.1. Results

A Convergence plot is observed for linear array antenna using PSO algorithm, figure 4 shows the convergence plot. Figure 5 and figure 6 shows the comparison of a radiation plot for even and odd number element array with Rayleigh distribution with uniform distribution.

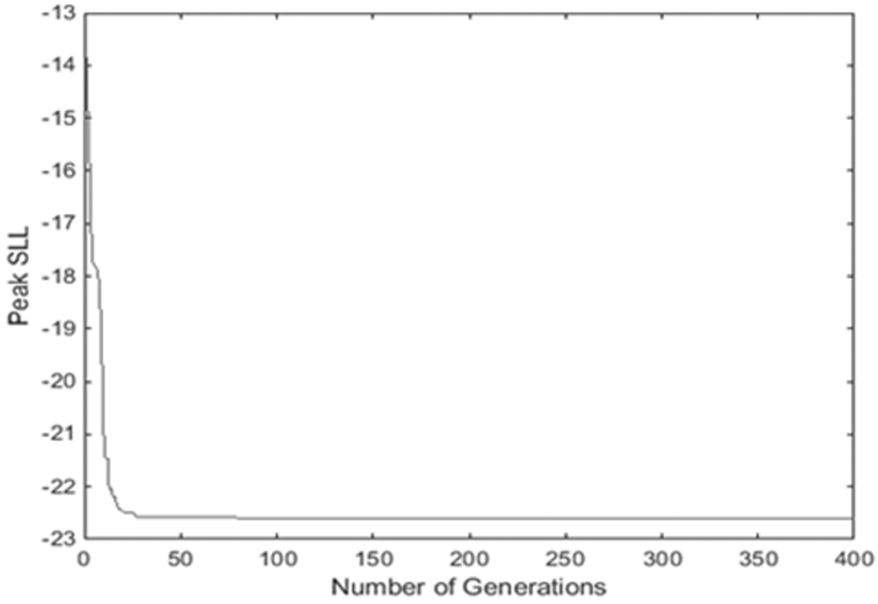

Figure 4: A Convergence plot for linear array antenna using PSO

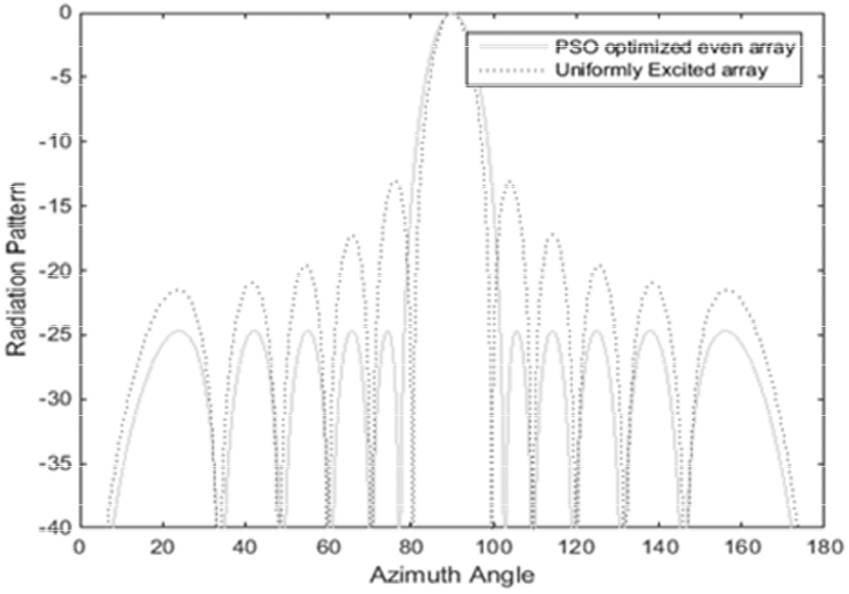

Figure 5: Radiation plot for even element array Rayleigh distribution compared with uniform distribution

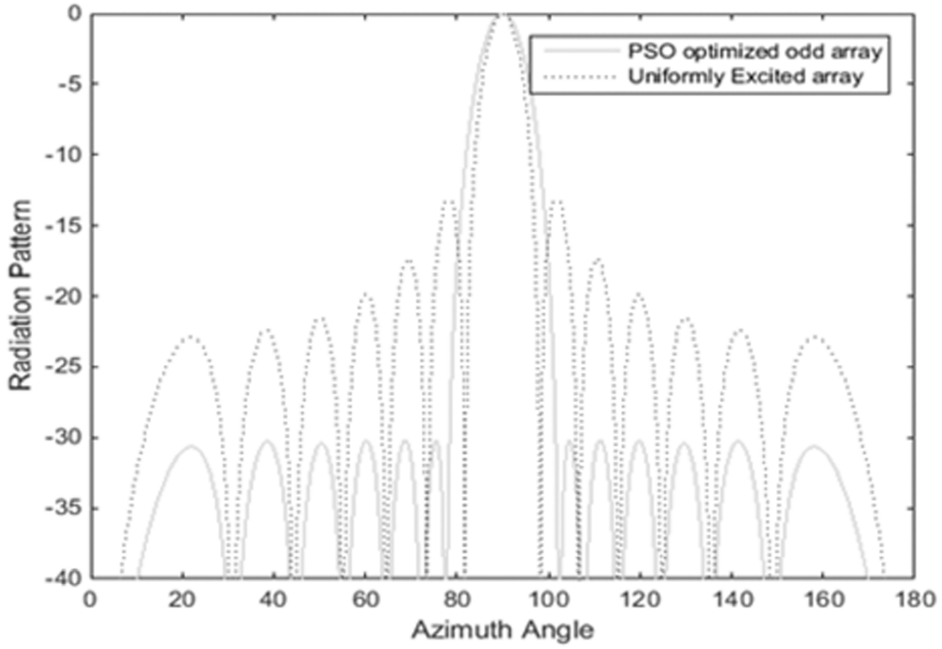

Figure 6: Radiation plot for odd element array Rayleigh distribution compared with uniform distribution

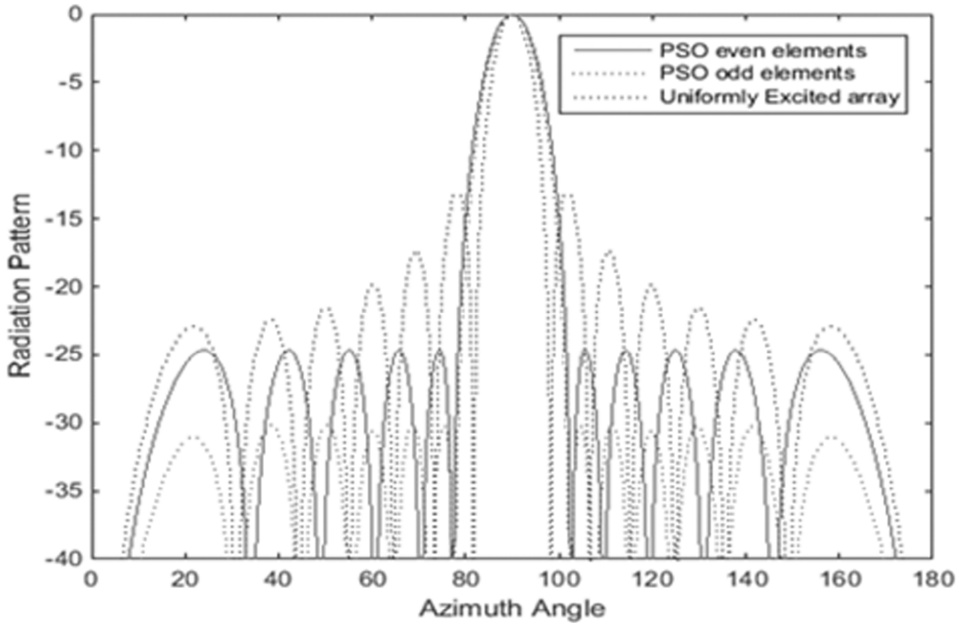

Figure 7: Comparison of uniform excited array, PSO with even elements and odd number of elements.

3. CONCLUSION

With an effective utilization of PSO synthesis of the equally spaced linear array of antenna is postulated. Rayleigh's distribution is adopted to intensifythe local and global search capabilities of PSO.An exploration was done for even and odd number of elements. The Minimization of side lobe level up to the 25db achieved for even number elements of array, and 31db for odd number of elements. The results obtained for a linear array with uniform amplitude, is compared with the radiation pattern of same linear array with Rayleigh amplitude distribution for even, odd number of elements.

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