I. INTRODUCTION

An antenna is defined but Webster’s Dictionary as “a usually metallic device (as a wire or rod) for radiating or receiving radio waves”. The Antenna or aerial as “a means for radiating or receiving radio waves”. In other words the antenna is the transitional structure between free-space and a guiding device. The guiding device or transmission line may take the form of a coaxial line or a hollow pipe. And it is used to transport electromagnetic energy from the transmitting source to the antenna or from the antenna to the receiver. In addition to receiving or transmitting energy, an antenna in an advanced wireless system is usually required to optimize the radiation energy in some directions and suppress it in others. For wireless communication systems, the antenna is one of the most critical components. A good design of the antenna can relax system requirement and improve overall system performance. A typical example is TV for which the overall broadcast reception can be improved by utilizing a high-performance antenna. Antenna array are defined many application require radiation characteristics that may not be achievable by single element. Radiation β characteristics of single element antennas were discussed and analyzed. Usually the radiation pattern of a single element is relatively wide, and each element provides low values of directivity (gain). In may application it is necessary to design antennas with very directive characteristics (very high gains) to meet the demands of long distance communication. This can only be accomplished by increasing the electrical size of the antenna. This new antenna formed by multi elements, is referred to as an array. In most cases the elements of an array are identical. This is not necessary, but it is often convenient, simpler, and more practical. This is usually not case and depends on the separation between the elements.

II. WI-MAX APPLICATION

WI-MAX is a short name for worldwide interoperability of Microwave Access. WI-MAX is described that wireless metropolitan area network (MAN) standard. It is expected that WI-MAX compliant system will provide fixed wireless alternative to conventional DSL and Cable station. For WI-MAX frequency range of 3.3GHz. Typically application will be in remote areas where it is not economically feasible to have a DSL or Cable internet. WI-MAX is also expected to be more reliable due to wireless nature of communication between the customer permission and the base station. There are provided the reliability and speed for meeting the requirements of small and medium size.

A. Disadvantage:

One disadvantage of WI-MAX is the spectral limitation; in other world limitation of wireless bandwidth may not be sufficient to cater to the needs of a large clientele, driving the costs high.

III. DESIGN EQUATION

Optimization technique generates a beam width as compared to conventional beam width improved performance of SLI and directivity that depend on the variation of exponent parameter value. In most cases, the elements of an array are identical, this is not necessary. But it is often more convenient, simpler, and more practical with array. It is practical not only to synthesis almost any desired amplitude radiation pattern, but the main lobe can be scanned but controlling the relative phase excitation between the element. For a linear antenna array the inter element spacing in either direction is λ/2 in order to steer the beam in that particular direction. The sum beam can be created by summation of the absolute value of complex left and right half beam. Consider a broadside array of N equally spaced isotropic elements as shown in fig1.

IV. DESIGN OF A LINEAR ANTENNA ARRAY

In this section, Taguchi’s method is used in the synthesis of linear antenna array. A set of phase shift weights are generated in order to steer the beam towards any desired direction. Figure.2 presents the antenna array geometry. It has N equally spaced element along the x axis. The element spacing the half – wavelength and the excitation of array

Keywords: Linear Antenna Array, Array Factor, RCGA, PSO, Taguchi’s Algorithm, WI-MAX

Abstract—In this paper we investigate comparative analysis of different antenna parameter (directivity, side lobe level and convergence time) by using different type of optimizing technique such as Taguchi’s, PSO, RCGA for synthesis of broad side and end fire linear antenna array in WI-MAX application. On ampere current is provided to each element and radiated power is decreases and radiation intensity increases in the given direction. Simulation results show that PSO is better other than other optimizing techniques such as RCGA, Taguchi’s.

elements are symmetric with respect to the array. For N element symmetrical array, the array factor can be written as:

$$AF(\Theta) = \sum_{N=1}^{n} I_n e^{j(n-1)Kd[\sin \Theta \cos \phi - \sin \Theta \cos \phi]}$$

Where
- $\Theta$ = angle of radiation of electromagnetic plane wave;
- $d$ = spacing between elements;
- $K$ = propagation constant;
- $I_n$ = excitation amplitude of $n^{th}$ element.

V. Taguchi's Optimization Method

Taguchi’s optimization method will be briefly described here. Using the concept of the orthogonal array (OA), Taguchi method effectively reduces the number of tests required in an optimization process. For more details, the interested reader may consult The steps taken in Taguchi’s optimization can be illustrated as follows.

VI. Particle Swarm Optimization (PSO)

Particle swarm optimization (PSO) algorithm is a simple and swarm based global optimization algorithm. It has been used for the optimization purpose in our problem. The terminology, which has been widely used in the PSO algorithm, is necessary to know before beginning of the algorithm. An individual one from the group of members is called ‘particle’ or ‘agent’ and the whole group is known as ‘swarm’. A particle representation in the N-dimensional coordinate can be representing by its location or position. The term ‘fitness’ or ‘cost’ is a single number, which represents the goodness of a given solution.

VII. Problem Formulation

This step includes formulating a suitable fitness (or objective) functions defining the solution space, and selecting an appropriate orthogonal array (OA). The fitness function and the solution space are chosen according to optimization goal. The selection of the orthogonal array depends on many parameters such as the number of element and directivity, side lobe level, beam width. Directivity is an important antenna parameter for linear antenna array. High directivity means long distance communication. But as the radiate power and side lobe level increase the directivity decreases. For enhance the directivity different optimization technique is proposed, after comparison the optimizing algorithms (RCGA, PSO, TEGUSHI’S), we obtain the best result by PSO method.

VIII. Results

To illustrated the optimizing technique described above for synthesis of linear antenna array for Wi-MAX application the following parameter are consider which is given in table 1. The comparison between of WO, PSO, RCGA and Taguchi’s are shown in table 2. From the table 2 it is clear that the radiation pattern of PSO with reduces to the side lobe level and directivity increases as compared to the other algorithm.

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Frequency of operation</td>
<td>3.3GHz</td>
</tr>
<tr>
<td>2</td>
<td>Spacing between elements(d)</td>
<td>4.5 cm</td>
</tr>
<tr>
<td>3</td>
<td>Phase between two elements</td>
<td>0 radian</td>
</tr>
<tr>
<td>4</td>
<td>Number of elements</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Output parameters</td>
<td>SLL, Directivity, Beam width</td>
</tr>
</tbody>
</table>

Table 1: Parameter for multiple optimization techniques
Reduction of Side Lobe Levels in Linear Antenna Array using Multiple Optimization techniques for Wi-Max Application

Table 2: Comparison between without optimization, RCGA, PSO, and Taguchi’s method for N = 3 element

<table>
<thead>
<tr>
<th>S.N.</th>
<th>PARAMETER</th>
<th>WO</th>
<th>RCGA</th>
<th>PSO</th>
<th>TEACHU’S</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Side lobe level (dB)</td>
<td>9.55</td>
<td>47.29</td>
<td>48.91</td>
<td>-37.84</td>
</tr>
<tr>
<td>2</td>
<td>Directivity (dB)</td>
<td>9.59</td>
<td>9.49</td>
<td>9.49</td>
<td>9.53</td>
</tr>
<tr>
<td>3</td>
<td>Beam width (dB)</td>
<td>9.60</td>
<td>42.45</td>
<td>41.61</td>
<td>31.56</td>
</tr>
<tr>
<td>4</td>
<td>Convergence time (sec)</td>
<td>Nil</td>
<td>11.41</td>
<td>2.40</td>
<td>2.22</td>
</tr>
</tbody>
</table>

IX. CONCLUSION

In this paper PSO optimization algorithm method using mat lab code is used to obtain maximum reduction in side lobe level relative to the main beam. This work show that the significant reduction of side lobe level with the use of PSO optimization method better values of side lobe levels comparison to the other optimization method, which we used in this paper. We found that the significant reduction of side lobe level in PSO method (-48.91dB) and in the Taguchi’s method(-37.84dB), which illustrated the better performance of the PSO method.

REFERENCE


