A Hybrid Approach for SLL Reduction in Phase Array Antenna Using Combination BFO-PSO and BFO-GA

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Abstract- TRM array antenna is working in wireless communication networks. There are plentiful of drawback that can take place although the transmission of the data. The furthermost imperative drawback is of antenna is specifically its failureIn an active antenna array, as soon as a small number of components doesn't work attributable to some specific issues. Genetic Algorithm is executed and then coordinated with Particle Swarm Optimization intended for linear array synthesis on behalf of far field side lobe indentation utilizing amplitude individually to acquire the anticipated radiation sample with the help of stated SLL. Genetic Algorithm contributes utmost favorable elucidation of the issue as compared to PSO. BFO procedure has appealed loads of attention through a high performance optimizer as a consequence of its faster convergence in addition to global search methodology. This papers mainly emphases on the better routing exploitation of hybrid BFO-GA as compared with the given routing of BFO-PSO.

Keywords- *TRM antenna, Genetic Algorithm, particle swarm optimization algorithm, Bacterial foraging optimization algorithm, Wireless communication network.*

I. INTRODUCTION

WSN comprises of a particular arrangement of nodes of characteristically low performance [1]. They co-operate with each other to complete sensing jobs in a specified background. A wireless sensor network may possibly encompass one or more sink nodules (i.e. Base Stations) to assemble sensed information and also convey it to a central processing in addition to storage arrangement. An Antenna is an intermediary which could simply transmit, send and receive signals, such as microwaves radio or satellite signal. Antennas send signals, receive signals, or both. Antennas send signals, receive signals, or both. Antenna changes the signal in the air into electricity. Antennas give out the energy into all direction. All wireless devices contain an antenna, or either an understandable pole on the external network. The sensor clients are generally cell phones, laptops, or some other type of wireless sensor equipment although the sensor routers forward traffic to and from the entryways which may possibly, however need not, link to the Internet. The coverage zone of the broadcasting nodes operational as a single network is sometimes called a sensor cloud. Access to this sensor cloud is reliant on the radio nodes working in agreement with each other to create a radio networks. A sensor network is reliable and proposes redundancy property. The small node could perhaps no longer functional; the all left out nodes could be able to still interconnect with each other, straightly or over one or more transitional nodes. Wireless sensor networks can be implement with various wireless technology contain 802.11[2], cellular technologies, 802.15, 802.16, or combination of more than one type. Sensor networking is a type of networking where each node must not only arrest and distribute its own information, then again also give a hand as a relay planned for quite a few other nodes, to be precise, it is necessary to work together to broadcast the data in the network.In general, the antenna array regularly consists of vast number of a range of radiating elements due to which large number of elements is existing in an array, there is every time a likelihood of failure of the one or more elements nearby in the antenna array system.

II. TRM ANTENNA FAILURE

The antenna array is one of the most important mechanisms to improve the system capacity and spectral efficiency. The active antenna array is widely used in many applications like satellite announcement, sonar, mobile communication etc. for signal acquisition purpose. These array antenna systems are installing outdoors over long periods of time [4]. Therefore, a number of factors such as dilapidation of the performance of solid-state devices, counting semiconductor and integrated circuits and RF circuits, or changes in the characteristics of the active devices can deteriorate the performance of the entire system. Distortion of the beam pattern degrades the entire system performance. Generally the antenna array consists of large number of radiating elements due to large number of elements presented in an array; there is always a possibility of failure of one or more elements in the antenna array system. The failures of elements in the array destroy the symmetry and may cause sharp variation in field intensity across the array and distort the pattern in the form of augmented side lobe level. In some situation like space platform the replacement of the defective element of the array is not possible [5].The TRM antenna is used in satellites, SONAR for realization of signals. Due to large number of arrays presents, sometimes TRM antenna failure takes place. When a transmitter/receiver module error occurs, the beam pattern is distorted. In this case, re-synthesizing the optimal beam pattern with all functioning [6]

TRMs, without failed TRM, is preferable to TRM repair or replacement the degradation of the capacity of transmitter/receiver module distorts the beam pattern; that is, the side lobe level increases. One major fact regarding the antenna breakdown is that the communication system should not stop in [7] between even though if the antennas are not operational properly.

III. PURPOSED ALGORITHM

A. GENETIC ALGORITHM

An initial population is actually randomly created, the actual algorithm advances by means of a few operators [8]:

1. **Selection:** gives preference to better individuals, letting them offer their genetics to knowledge. This amazing benefit of every specific is dependent upon the fitness.
2. **Crossover:** represent mating concerning persons; a couple individual is chosen in the population using the selection operator. Any crossover site over the bit strings is actually randomly picked. The significance of every string is actually exchange up to this point. Each new young offspring made from this specific mating are placed in your next generation from the population [9].
3. **Mutation:** Features random alterations. The point of mutation is always to keep diversity within the population and prevent uncontrolled convergence. With a number of low chances, a small portion of the new individuals will have some of their bits dipped. Mutations as well as variety develop parallel, noise-tolerant, hill-climbing algorithms.

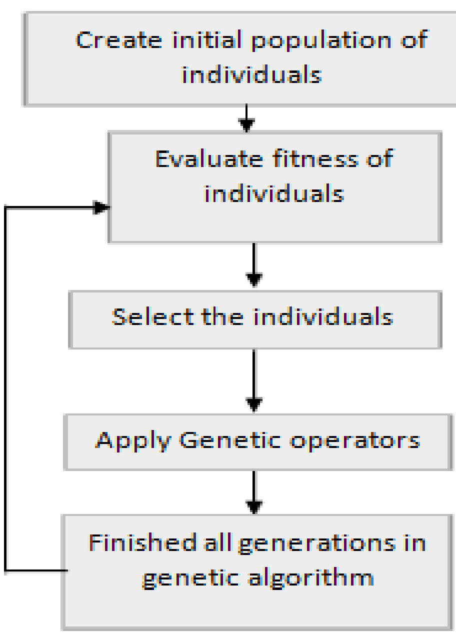

Fig.1: Genetic Algorithm

B.BACTERIAL FORAGING OPTIMIZATION

All through foraging of the real bacteria, locomotion is achieved by a set of tensile flagella. Flagella help an E.coli bacterium to fall or swim, that are two important operations performed by a bacterium at the instance of foraging. When they revolve the flagella in the clockwise direction, every flagellum pulls over the cell [10]. Those consequences in the moving of flagella unconnectedly and lastly the bacterium tumbles with smaller amount of tumbling while in a harmful place it tumbles frequently to find a nutrient gradient. Stirring the flagella in the counter clockwise direction helps the bacterium to swim at a very prompt rate. In the above mentioned algorithm the bacteria undergoes chemo taxis, where they like to shift towards a nutrient gradient and shun detrimental atmosphere.

C.PARTICLE SWARM OPTIMIZATION

In PSO procedure particles are hovered over a multi-dimensional exploration space, where the location of each particle is adjusted according to its own experience and that of its neighbors [10].

Step 1	:	Explain the solution space: Prepare an array of the populace of particles using random locations as well as velocities inside D dimensions in problem space.
Step 2	:	Calculate the fitness operator in D variables intended for each individual particle. The fitness operator in addition to the solution space which needs to be precisely established meant for every particular optimization; the rest of the optimization, however, is independent of the physical system being optimized.
Step 3	:	Relate and then compare every single particle's fitness assessment through pbest. If the current value is better than phase best (pbest), then save the current assessment as pbest as well as let the position signify the existing position inside D dimensional space.
Step 4	:	Also compare the fitness assessment with the given populace's generally earlier best i.e. gbest. If the current value is better than gbest, then save the current value as gbest to the current particles array index and value.
Step 5	:	Bring up-to-date the location as well as swiftness of the given particles.
Step 6	:	In any condition the preferred criterion is not happened, then just go to step 2, or else halt the process.

IV. METHODOLOGY

Consider an N-element linear array antenna with some defective elements. Assuming that the elements are located over the z-axis, the array factor can be written as

F (Q) $=\sum^{N}_{n}$(In / Imax)e $^{+jnkdsinQ}$Where *I*, *represents* the excitation of the n-element *(I max)* is the maximum value or Iheexcitations), *d* the incremental spacing and Q the angle from broadside. In the case of the ith-element failure, its excitation *Ii*i assumed to be zero. To recover the performance of the degraded pattern, we disturb the amplitude excitation of some of the non-defective elements. The locations of the elements used to compensate the pattern as well as their excitations are calculated using a genetic algorithm, BFO and PSO.In the optimization process, we want to recover the side lobe level of the original pattern, md, at the same time, to minimize the number of cleanness used for the pattern restoration. During the operation of an array antenna system, TRM failure can occur at any time. When a TRM failure occurs, the TRM is supposed to be turned off.

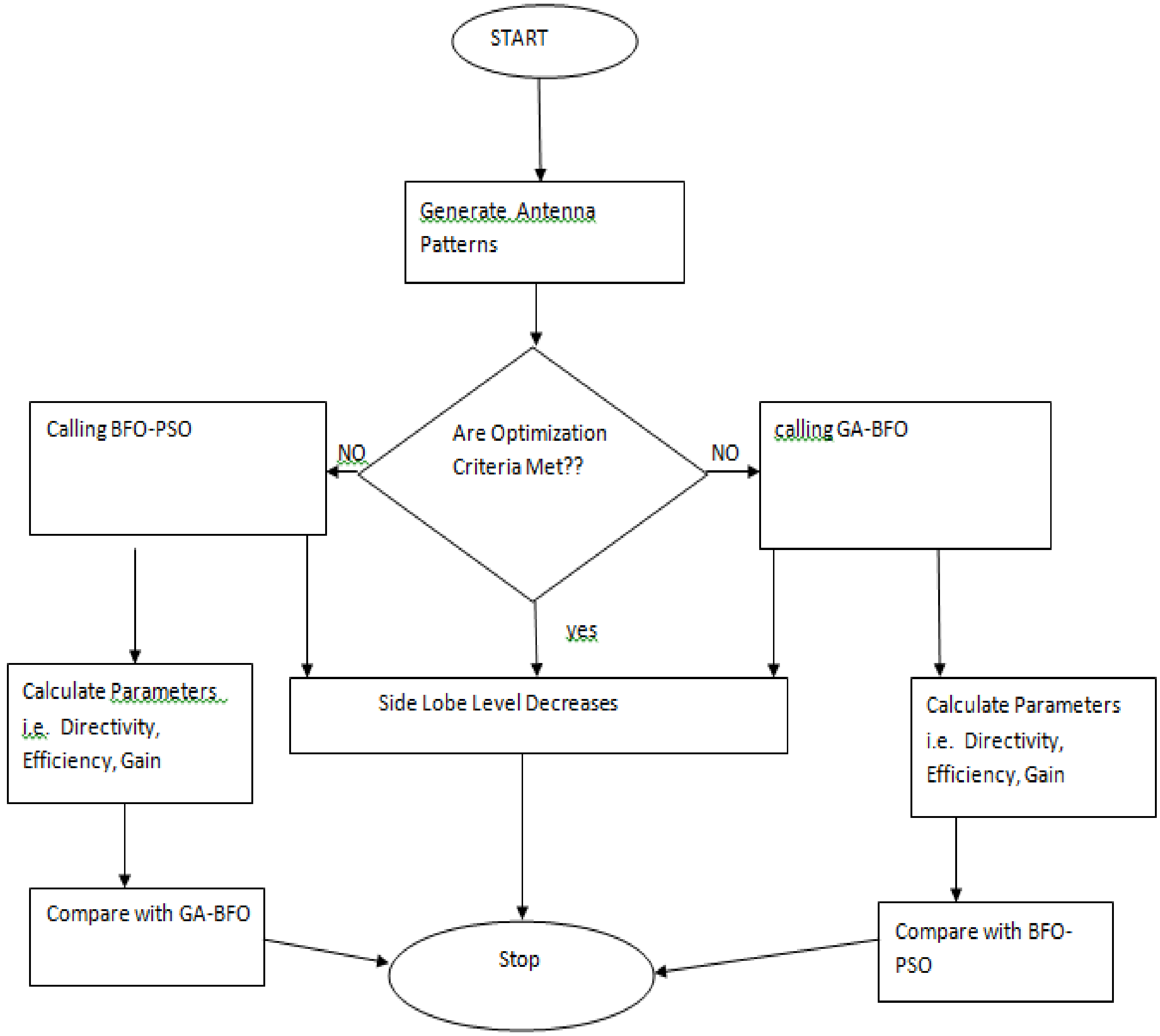

Fig.2: Purposed Methodology

V. RESULT ANALYSIS

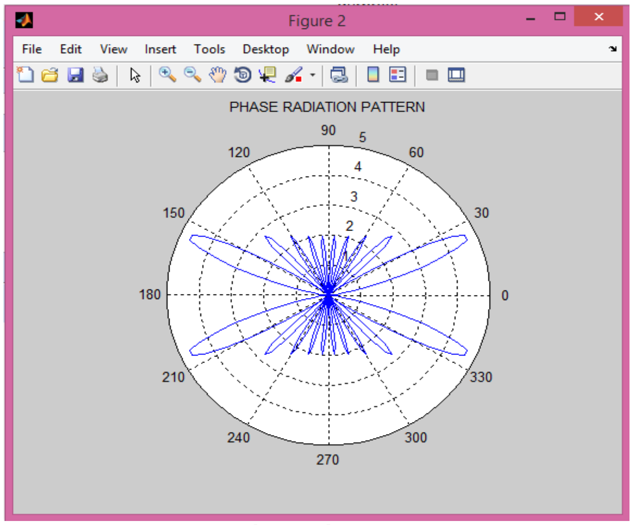

Fig.3: Phase Radiation Pattern

Phase-only reconfigurable array antennas capable of radiating multiple radiation patterns with a fixed amplitude distribution. The generation of multiple radiation patterns by a single antenna array with pre- fixed or common amplitude distribution greatly simplifies the hardware implementation. Above figure shows the antenna with one narrow major lobe and negligible radiation in its minor lobes, the beam solid angle may be approximated by Q1,Q2. Where Q1 and Q2 are radians. Here the antenna with low side lobes has half-power beam widths of 20^0 in both principal planes (E-plane and H-plane).

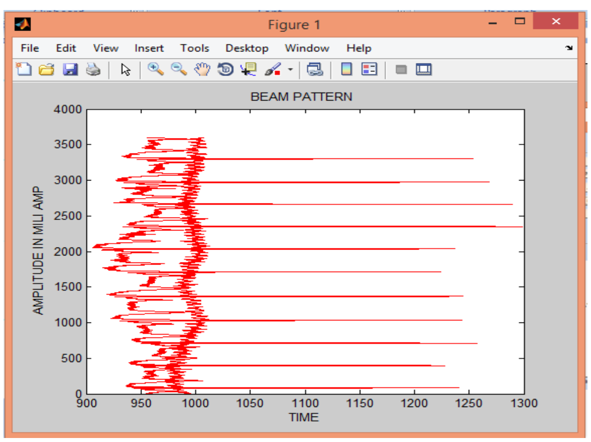

Fig.4: Beam pattern

The above figure shows the beam pattern of the signal whose units have been described on their axis.

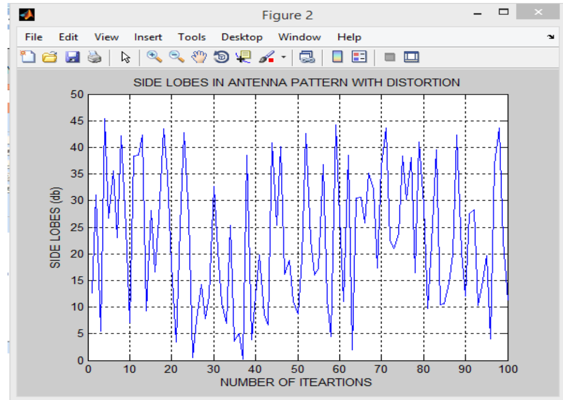

Fig.5: SLL

The figure shown above describes the side lobe level of the signal whose units have been described on their axis .This is the uncompensated structure with distortion. The y axis is the side lobe level and the x axis represents number of iterations.

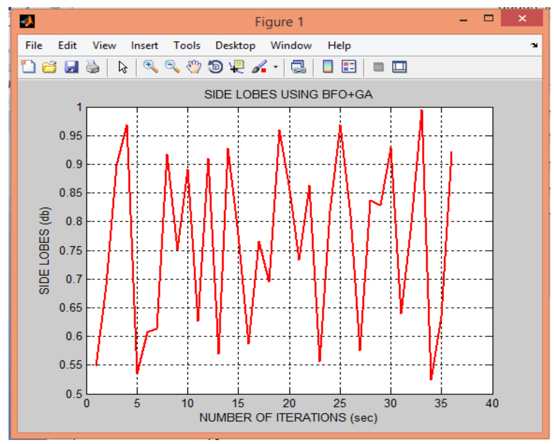

Fig.6: SIDE Lobes using BFO+GA

The figure shown above describes the side lobe level of the signal whose units have been described on their axis .This is the compensated structure using the BFO + GA algorithm.

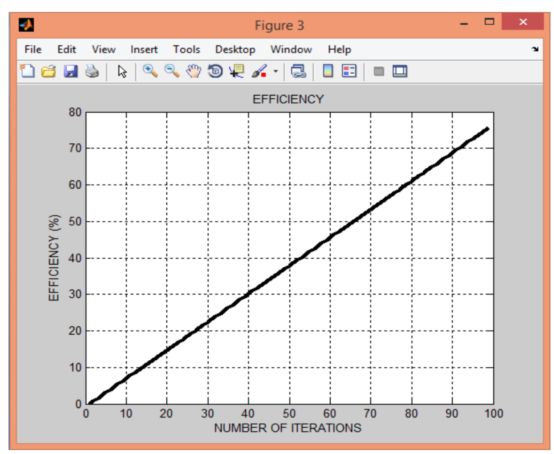

Fig.7: Efficiency graph

Above figure shows the efficiency in the antenna network. Above figure shows the high efficiency in antenna network when SLL compensation is done using BFO+GA.

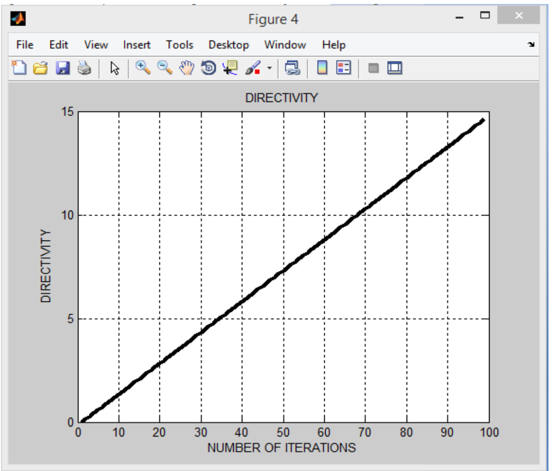

Fig.8: Directivity Graph

Above figure shows the Directivity in the antenna network. Above figure shows the high directivity in antenna network when SLL compensation is done using BFO+GA.

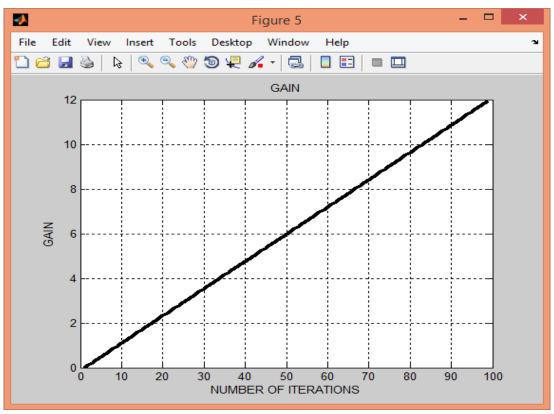

Fig.9: GAIN graph

Above figure shows the GAIN Graph in the antenna network. Above figure shows the high GAIN value in antenna network when SLL compensation is done using BFO+GA.

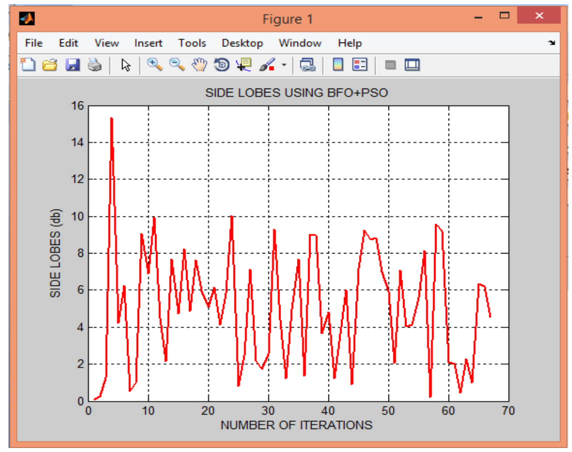

Fig.10: SLL using BFO + PSO.

The figure shown above describes the side lobe level of the signal whose units have been described on their axis .This is the compensated structure using the BFO + PSO algorithm. The y axis is the side lobe level and the x axis represents the number of iterations. At the y axis, .1 represents 16 db of sll.

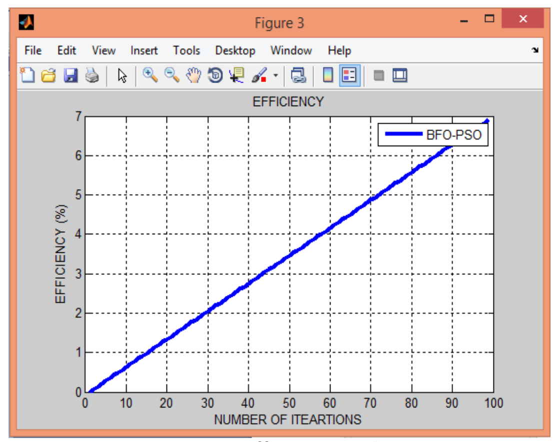

Fig.11: Efficiency graph

Above figure shows the efficiency in the antenna network. Above figure shows the high efficiency in antenna network when SLL compensation is done using BFO+PSO.

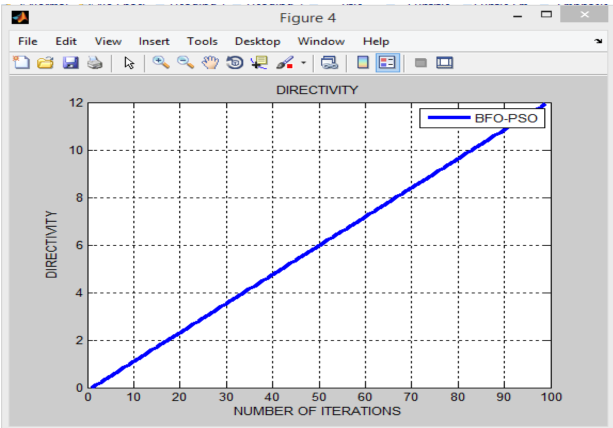

Fig.12: Directivity Graph

Above figure shows the Directivity in the antenna network. Above figure shows the high directivity in antenna network when SLL compensation is done using BFO+PSO.

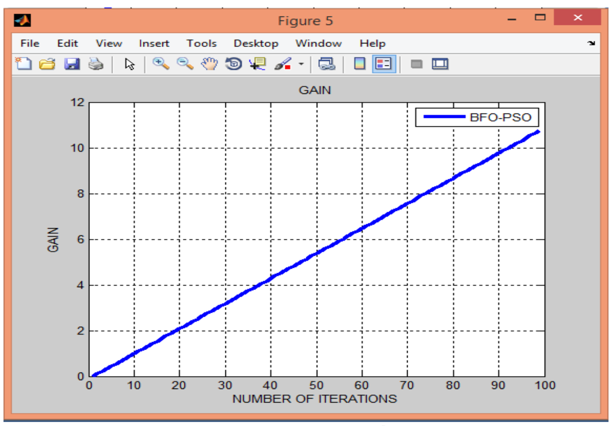

Fig.13: GAIN graph

Above figure shows the GAIN Graph in the antenna network. Above figure shows the high GAIN value in antenna network when SLL compensation is done using BFO+PSO.

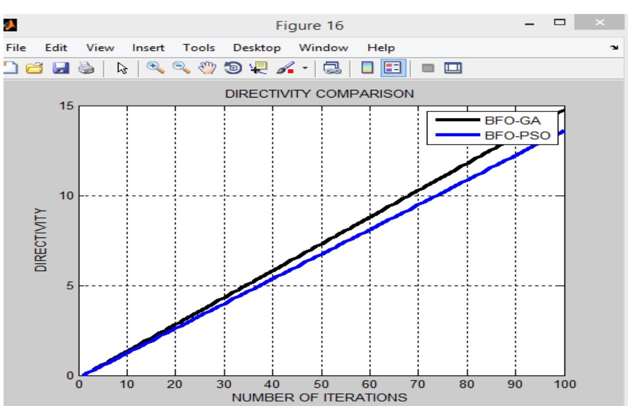

Fig.14: Directivity Comparison

The above figure shows the Directivity of TRM antenna which is one of the performance parameter which can be evaluated as larger directional field strength which shows that the hybrid technique using BFO-GA performs better in terms of signal field strength than the hybrid approach using BFO-PSO.

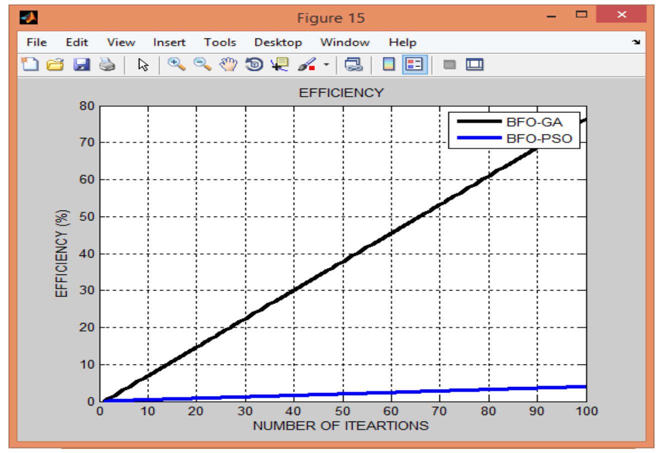

Fig.15: Efficiency comparison

The above figure shows the efficiency parameter using hybrid approaches and shows that the hybrid approach using BFO-GA performs better than BFO-PSO which shows that the antenna efficiency in terms of transmitting signals with number of iterations.

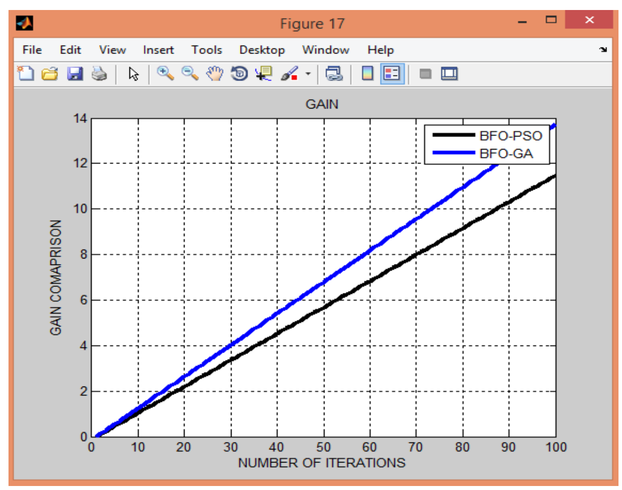

Fig.16: Gain comparison

The above figure shows the gain parameter using hybrid approaches and shows that the hybrid approach using BFO-GA performs better than BFO-PSO which combines both antenna directivity and efficiency to decrease the side lobes so that antenna power can be redistributed to radiate more power in the certain direction.

Table 1: Comparison Table

No. Of Iterations	Gain(BFO-PSO)	Gain(BFO-GA)
20	2	2.2
40	4.1	4.8
60	6.4	8.1
80	8.5	10.4
100	11.5	14

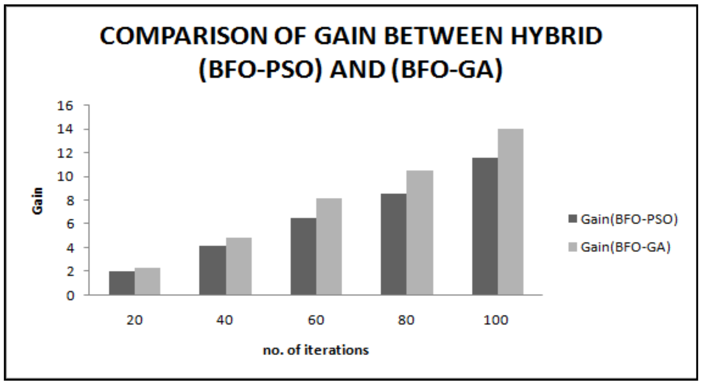

Fig.17 Comparison of Gain

The above table and bar graph shows the comparison of Gain parameter using hybrid approaches and shows that the hybrid approach using BFO-GA performs better than BFO-PSOHigher gain provides the more radiated power efficiency which decreases the chance of antenna failure by decreasing the unwanted signals that are the side lobe levels.

VI. CONCLUSION AND FUTURESCOPE

There are numerous benefits towards a phased array networks. It also consists of great reliability, high beam agility, stress-free maintainability, as well as multi-beam multi-target applications. The limitation consist of inflexibility in adding new frequencies, much higher price at the present-day, convolution of multi-frequency operations, and lower gain at lower elevations for a linear array antenna. The technology hazards and also the cost drivers embrace, primarily, the T/R modules after then the beam-forming network architecture and after this implementation. This paper proposes that, as a proof of concept demonstration, a small scalable flat panel array be built and tested, in order to prove the maturity of the concept and in the direction of working out the impending issues at the T/R module as well as the beam-forming stages, for achieving a GA-BFO-level performance. This paper evaluates parameters like Directivity, Gain, Efficiency showing GA- BFO will produce the best alternate path when one antenna fails to transmit the number of data packets.. At present, there are numerous methods for reflecting array elements to achieve the desired planar phase front. The first it uses identical micro strip patch with different length phase delay lines attached so that they know how to recompense for the imbalanced phase delays attributable to the divergent path lengths from the instructive feed.

In future invention algorithms which can be combined with GA, BFO and PSO to optimize the results like, NEURAL NETWORK, SUPPORT VECTOR MACHINE or FUZZY SVM/ Logics.

VII. REFERENCES

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