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A REVIEW ON ANTENNA ARRAY FAILURE CORRECTION USING OPTIMIZATION TECHNIQUES

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Abstract: The need of an array antenna is to maximize gain, deliver diversity reception and stop distortion or noise. Some of the uses of antenna arrays contain radar communications, satellite communications, wireless communications, vehicular, airborne communications, signal intelligence, surveillance and reconnaissance, radio and TV signal transmission with GPS and navigation, remote sensing, biomedical and in the astronomical study. This paper gives a basics of an antenna, review of various optimization techniques and its summary. Because of the more elements in an array antenna so there is a chance of damaging of one or more elements and it is used to finish a symmetry of array antenna, interfere with the pattern by increased side lobe level. So many optimization techniques or algorithms are used to solve these drawbacks by enhancing the pattern in elements which are failed. We observe that BSO which shows good results in case of symmetrical linear array antenna as compared to these previous techniques. It is also supportive to all of the researchers to gain knowledge about various optimization techniques and their implementations in different tools which are mentioned in this review.

Index Terms - BBO (Biogeography-based optimization), BSO (Brain storm optimization), MATLAB (Matrix Laboratory), Antenna array, DE (Differential Evolution)

I. INTRODUCTION

An Antenna is a transducer which translates electrical power to EM waves (transmitting antenna) and translates EM waves to electrical power of same frequency (Receiving antenna). In dual mode communication, the similar antenna can be for equally transmission and reception. In a communication scheme, the transmitting antenna translates an electrical signal to radio waves and direct it to the receiver and the receiving antenna accepts the radio waves and creates an equal electrical signal which is then delivered to the channel. The requirement for Antenna is that antennas are the basic building block of a wireless communication structure. So, an antenna permits the spread of EM waves from one end to other. Antennas, by creating electric and magnetic field from the applied signal and collective the two fields vertically with each other, form an **EM wave** i.**e. EH=0**. After the function of a transducer in an antenna there is a block of impedance matching device in which the antennas at the two ends are perfectly matched to sure that the transmitted signal can be totally received without much reflections then there is a block of radiator and sensor in which the transmitting and receiving antennas act as radiators and sensors of EM waves. The transmitting antenna radiates the EM wave in free space while the receiving antenna senses the existence of an EM wave in the space and gathers it then there is a block of Coupler in which it acts as a coupler between the device that creates the RF signal and free space or free space and transmission lines.

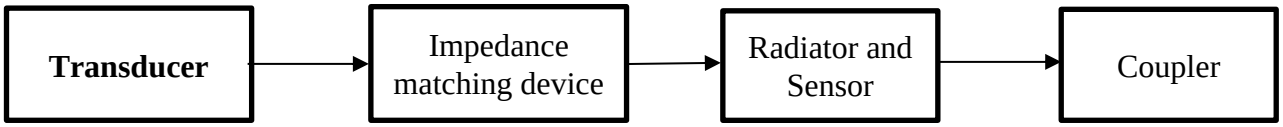

Fig.1.1 Functions of antennas

II. LITERATURE REVIEW

The radiations may be interrupted by the elements which are failed in an antenna array as when we are used to increase the number of an elements then some of the elements are failed and causes many problems for example SLL (Side Lobe Level), noise which reduces the efficiency of an antenna system. The Normalized excitation coefficient elements linear array design with the help of presented technique to gain those characteristics which are before the elements which are failed [1] [16]. A received array is in a digital form and is useful for different signal conditions but here the results are for one signal and its noise source conditions when the incoming signal positions are not accurately known and even when the signals are over a wide angular area [2]. The orthogonal technique is presented to recover the patterns of a symmetrical array with the failed elements by the Re-arrangement of amplitudes and phases of all elements but cannot completely made for the failed elements and therefore decrease the SLL [3]. A modified spider monkey optimization dual-search is a swarm intelligence to recover the efficiency of a practical optimization issue that is synthesis of linear antenna array for three different conditions. The observations tell that MSMO is better than PSO, cuckoo search, firefly algorithm, BBO, DE, tabu search and Taguchi method in case of decreased SLL and maximum convergence speed [4]. The customized antenna is gained by controlling the amplitudes of an elements and its efficiency have been shown by taking hard examples of array antenna which is combined with the outcomes of all other algorithms for e.g. BBO, PSO, GA, tabu search, cuckoo search and others which proves the improved and accurate presentation of the recommended technique [5]. A firefly algorithm is used to control the phase and amplitude of elements. A fitness value in term of template are expressed to gain the error between original SLL pattern and observed SLL pattern and error are reduced [7] [22] [24].Here the aim is to decrease maximum SLL along with the outcome of the antenna [8]. The tabu search is presented to find a best set of weights of an element that give a pattern by decreased maximum SLL with the beam width parameter [17]. A Symmetrical and circular arrays are optimized with PSO and the constraints of isotropic elements phase and amplitude and its positions, however for dipole array the enhanced constraints are elements phase and amplitude and its positions, and measurement. The PSO gives more improvements with the linear array than other methods [18]. The geometry creation is expressed as an optimization issue with the reduction of maximum SLL with nulls and is resolved through PSO by combining outcomes gained by the quadratic programming method [19]. This method permits standard nulls to take the outcomes of failed elements and to gain power patterns by computing the AF with the simulated annealing method [20]. BBO is presented to decrease the SLL and null control for isotropic array by enhancing various constraints (location, phase and amplitude) and for elliptical array, four methods (genetic algorithm, BBO, sequential quadratic programming and self-adaptive differential evolution) are presented to compute an optimal set of weights that give a pattern with decrease SLL using the parameters of beam width [23] [36]. Predator–prey BSO is suggested to resolve an issue for a DC brushless motor and is practical to resolve the optimization issues in an EM field. The combined outcomes prove that PPBSO and BSO can be successful in optimizing designs for a DC brushless motor to increase its effectiveness. An outcomes indicates PPBSO has superior capability to local optima than BSO [25]. The Nulling pattern is reached by controlling the amplitude of every element. The instances of Chebyshev pattern with the one, different and wide nulls at positions of noise are considered to indicate the correctness of the Bees Algorithm [27]. The more the SLL, the null level and the dynamic range ratio are taken into pattern. An outcomes of Chebyshev patterns with one, different and wide nulls are considered to indicate the efficiency of the MTACO [28]. To find the pattern with lowest SLL for particular HPBW (Half power Beam width) and FNBW (First Null Beam width) and the techniques are used to find the non-linear excitation to every element. The efficiency of the recommended optimization of antenna issues are used to find six sets of antenna types [29]. Some design conditions as the SLL, the null and the dynamic range are as a set of weighting factors in the cost function built for the tabu search [30]. A differential evolution method is there to resolve the issue and the cause of angle resolution has also been examined [31] The traditional gradient techniques in local minima and are not able of finding best answers so global optimization techniques are needed to thin huge array to gain less SLL. BBO is considered for thinning huge symmetrical and planar array antenna of linearly isotropic antennas. A goal is to create symmetrical arrays so as to take the extreme SLL equal to or below a customized level along the proportion of thinning equal to or above the customized level. An outcomes gained by BBO are combined with ACO, GA, Binary PSO and Immunity GA [32]. BBO presents a best set of amplitudes that give a pattern with decreased SLL and nulls in the particular positions. The outcomes indicates the efficiency of the BBO than earlier outcomes [33]. COA is presented for optimization of symmetrical and non- symmetrical circular array. It is presented to find a set of constraints of elements that give a needed pattern. The outcomes indicates good performance than other common techniques [34]. The goals are to decrease the SLL and null placement for isotropic array by controlling various constraints of the elements (location, phase and amplitude). The optimization is done by double methods: Taguchi's technique and the self-adaptive differential evolution method. The benefit is the capacity of

resolving issues by more complicated with minor number of trials in the Taguchi's technique is simple to perform and converges to the customized aim in combination with gradient techniques and PSO Evaluations by Taguchi's technique are in very better condition than the SADE technique[35]. An adaptive DE is presented to enhance space between the elements of array to gain a pattern with minimum SLL and null control. The adaptation methods are built on the objective values of the target vectors and donor vectors [37]. To indicate the efficiency of the HSA, The nulling technique on harmony search algorithm is able of steering the nulls exactly to un-customized noise positions. The outcomes of HSA are combined with the MODE, the non-dominated sorting genetic algorithm 2, the memetic algorithm, the tabu search algorithm, the genetic algorithm, the quadratic programming method, the particle swarm optimization, the clonal selection algorithm, the bacterial foraging algorithm, the bees algorithm, the plant growth simulation algorithm, modified touring ant colony optimization [38] BSA is a metaheuristic method created on an iterative procedure. Different instances of symmetrical patterns using the arranged one, different, and broad nulls are to explain an implementation and rigidity of BSA. An outcomes gained using BSA are combined with mean variance mapping optimization, seeker optimization algorithm, harmony search algorithm, comprehensive learning PSO, differential evolution, multi-objective differential evolution, non-dominated sorting GA-2, memetic algorithm, plant growth simulation algorithm, tabu search algorithm, clonal selection algorithm, bees algorithm, bacterial foraging algorithm, quadratic programming method, modified touring ant colony algorithm, genetic algorithm, particle swarm optimization and an outcomes indicates that the symmetrical array antenna with BSA gives less SLL and deep null levels [39]

III. COMPARISON OF AN OPTIMIZATION TECHNIQUES EMPLOYED FOR ANTENNA ARRAY FAILURE CORRECTION

Table 1 Summary of an Antenna Array Failure Correction with different optimization techniques.

Ref ID.	Method used	Features
[3], [11] ,[13] [18], [21], [28]	Orthogonal, BSO, PSO, MTACO	More efficient
[6]	GA	More efficiency and convergence speed
[12]	BSO	Better scalability and efficient.
[14]	Modified BSO	Decrease the complexity
[15]	BSO	Better Performance

Table 2 Summary of an Antenna Array Failure Correction with different optimization techniques with nulls.

Ref ID.	Method used	Features
[1], [5] , [7], [19] , [20], [27] , [28] , [30], [39]	BSO, FPA, FA, PSO, BA, MTACO, Modified Tabu Search, Backtracking Search.	Recover the issue of SLL, null control, more efficient, accurate, better performance.

Table 3 Summary of an Antenna Array Failure Correction with different optimization techniques in case of SLL.

Ref ID.	Method used	Features
[2], [7], [16], [20], [22], [24], [27]	Digitally Beam formed Array, FA, Improved bat algorithm, Simulated annealing, FA, BA	Recover the issue of SLL
[4]	MSMO	Recover the issue of SLL, max. convergence speed and efficiency
[8] ,[17]	Simulated Annealing, Tabu Search	Decreases SLL and efficient
[23], [29], [30], [31], [32], [33], [34], [35], [36], [37], [38]	BBO, FA,BA, Modified Tabu, DE, BBO, Cuckoo, Taguchi and Self-Adaptive DE, Harmony search	Recover the issue of SLL and More efficient
[39]	Backtracking Search	Recover the issue of SLL, More efficient, flexible and Accurate

IV. CONCLUSION

In the nut shell, it is concluded that this article gives description of basics or introduction of antenna, review of different Optimization techniques for Antenna array design and summary of in terms of comparison of an Optimization techniques employed for antenna array failure correction in which methods used and features are explained where Brain Storm Optimization Algorithm is advanced as compared to an Optimization techniques. It is also helpful to all of the research scholars to gain knowledge about different Optimization techniques and their implementations in different tools or software where mostly tools used are MATLAB

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